32nd Meeting of the Canadian Congress of Neurological Sciences

PRIZE PAPER PRESENTATIONS

Jasper Prize
K.G. McKenzie Prize in Clinical Neuroscience Research
K.G. McKenzie Prize in Basic Neuroscience Research
Presidents Prize

ORAL PRESENTATIONS

Thursday, June 26

A. Stroke .....A-01 to A-06
B. Peripheral Nerve.....B-01 to B-05
C. Epilepsy .....C-01 to C-06
D. Child Neurology .....D-01 to D-05
E. Surgical Oncology .....E-01 to E-11
F. Cerebrovascular Surgery .....F-01 to F-05

Friday, June 27

G. Movement Disorders .....G-01 to G-06
H. Neurophysiology .....H-01 to H-03
I. General Neurophysiology .....I -01 to I-06
J. Child Neurology .....J-01 to J-04
K. General Neurosurgery .....K-01 to K-11
L. Spinal Surgery .....L-01 to L-06

POSTER PRESENTATIONS

Thursday, June 26

- Epilepsy .....P-001 to P-012
- Pediatric Epilepsy .....P-013 to P-018
- Child Neurology .....P-019 to P-027
- General Neurology .....P-028 to P-037
- Cerebrovascular Surgery .....P-038 to P-046
- General Neurosurgery .....P-047 to P-056

Friday, June 27

- Stroke .....P-057 to P-074
- Movement Disorders .....P-075 to P-079
- Cognitive Neurology .....P-080 to P-084
- Neuromuscular Disease .....P-085 to P-090
- Spine .....P-091 to P-098
- Surgical Oncology.....P-099 to P-110

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1997 Prize Papers

Jasper Prize

Effects of Voluntary Activation on Spinal Cord Evoked Responses and Muscle Responses after TCMS in Awake Human Subjects

D.A. HOULDEN, M.L. SCHWARTZ, C.H. TATOR, P. ASHBY AND W.A. MACKAY (Toronto, Ontario)

Background: Facilitation of muscle responses after transcranial magnetic stimulation (TCMS) during a voluntary muscle contraction is thought to be due to increased motor cortical excitability and/or increased excitability at the spinal motoneuron pool but the precise mechanism is not known. To elucidate the mechanism responsible for facilitation, we recorded spinal cord evoked potential (SCEPs) and muscle responses after TCMS during rest and voluntary activation of left tibialis anterior (TA) in seven awake, neurologically intact subjects.

Methods: Corticospinal (CS) neuron excitability was determined by the amplitude, latency and rectified area of SCEPs recorded from an epidural dorsal column stimulating electrode at T8 after TCMS. Muscle recordings were concomitantly recorded from the left biceps, triceps, first dorsal interosseous, tibialis anterior (TA) and soleus. The magnetic stimulator coil was positioned for optimal activation of the left TA. SCEP and muscle responses were obtained as TCMS intensity increased from threshold ("T") for activation of a SCEP to T + 30% of the maximum output of the stimulator in 3 steps.

Results: The SCEP area was not significantly increased during voluntary activation of TA compared to rest across all TCMS intensities except at T ($p = 0.03$). Voluntary activation of TA significantly increased the amplitude of all muscle responses compared to rest across all stimulus intensities.

Conclusions: Increased excitability of CS neurons during voluntary activation of TA was not observed at TCMS intensities above T. It is proposed that TCMS intensities above T activated a greater percentage of a) corticospinal neurons not subserving TA and/or b) total cortical area available for increased excitability, thereby overshadowing the small, discrete changes in CS neuron excitability that were observed at T.

The K.G. McKenzie Prize in Basic Neuroscience Research

B7-2 and M-CSF Combination Immunogene Therapy for Human Glioblastoma Multiforme in an Allogeneic Human Lymphocyte – SCID Mouse Model

I.F. PARNEY, K.C. PETRUK, M.A. FARR-JONES, C.S. ZHANG AND L.-J. CHANG (Edmonton, Alberta)

Background: Gene therapy is a promising cancer treatment modality. We developed a human tumour/lymphocyte model to evaluated immunogene therapy for glioblastoma using B7-2 (a T cell costimulatory molecule) and granulocyte-macrophage colony-stimulating factor (GM-CSF).

Methods: The human glioblastoma cell line D54MG was transduced with B7-2 and/or GM-CSF via retroviral vectors. Severe Combined Immunodeficiency (SCID/bg) mice were reconstituted with allogeneic human lymphocytes. Subcutaneous D54MG/GM-CSF and D54MG/B7-2 tumour growth was measured after infection of 4×10^6 cells and compared to wild type and/or unreconstituted controls. Wild type tumour growth (1×10^6 cells) was measured after intraperitoneal vaccination with irradiated D54MG/B7-2/GM-CSF cells. Controls were vaccinated with wild type or control vector-transduced cells.

Results: D54MG/GM-CSF tumour growth was inhibited (day 53: mean volume 519 mm^3, $n = 8$; mean control volume 1176 mm^3, $n = 21$; $P < 0.001$) as was D54MG/B7-2 tumour growth (day 32: mean volume 73 mm^3, $n = 6$; mean control volume 1307 mm^3, $n = 13$; $P < 0.005$). Significantly, wild type tumour growth after D54MG/GM-CSF/B7-2 vaccination was markedly inhibited (day 55: mean volume 2 mm^3, $n = 6$; mean control volume 192 mm^3, $n = 15$, $P < 0.005$).

Conclusion: The human lymphocyte – SCID mouse model is a novel means to undertake *in vivo* preclinical studies of immunogene therapy for human glioblastoma. These allogeneic results indicate that expression of B7-2 and/or GM-CSF by glioblastoma cells inhibits tumour growth both locally and at distant sites. Work is ongoing to develop an autologous system.

The K.G. McKenzie Prize in Clinical Neuroscience Research

Cerebral Cavernous Malformations: Natural History and Outcome after Clinical Deterioration with or without Hemorrhage

PHILLIP J. PORTER (Toronto, Ontario)

Despite recent studies of the natural history of cavernous malformations, there remains significant uncertainty concerning hemorrhage rates and the importance of lesion location. Controversy arises over varying definitions of "hemorrhage". What is ultimately important to the patient is the occurrence of a neurologic event, which may not be associated with radiologically documented hemorrhage, as well as the chance of recovery after such an event. The purpose of this study was to determine the rates and sequelae of neurlogic events in patients referred to our vascular malformation clinic with cavernous malformations.

All patients ($n = 173$) were entered into a database. Mean age at presentation was 37.5 years. Lesion location was deep (brainstem, cerebellar nuclei, thalamus, or basal ganglia) in 64 (37%) and superficial in 109 (63%). The 110 patients eligible for follow-up were used to derive information on hemorrhage and neurologic event rates. An interval event (neurologic deterioration) required both symptoms and signs. The total mean follow-up was 46 months, the majority (65%) of which was prospective. There were 18 interval events in 427 patient-years of follow-up, for an overall annual event rate of 4.2%. Location was the most important factor for predicting interval event occurrence, with significantly higher rates for deep (10.6%) per year) compared

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to superficial lesions (0% per year) (p = 0.0001). Of patients suffering a neurlogic event, only 37% had complete resolution of their deficits.

This largely prospective study indicates that eep cavernous malformations carry a worse prognosis than superficial lesions with respect to annual rates of neurologic deterioration. The alarming rate of clinical events for deep lesions is punctuated by the fact that less than one-half of patients recover fully on long-term follow-up.

Presidents Prize

Mobius Myopathy, a Form of Sarcoglyopathy?

B.L. BANWELL, R. ZUKER, L. BECKER, J. VAJSAR, K. CAMPBELL* AND V. STRAUB* (Toronto, Ontario; Iowa City, Iowa, USA*)

Background: Mobius syndrome (M.S.) consists of bilateral facial diplegia, loss of ocular abduction, distal limb anomalies and, rarely, 8th nerve dysfunction. Skeletal muscle weakness has also been reported. Some authors believe brainstem nuclear dysgenesis to be causal, while others believe a mesodermal or muscle etiology. Genetic linkage to chromosome 13q13 has been reported in 2 pedigrees and a deletion in chromosome 13q12.2 has been reported in 1 child. Limb girdle muscular dystrophy, due to a defect in gamma sarcoglycan has also been mapped to chromosome 13q12.2.

Methods: We studied the skeletal muscle (gracilis) and facial muscle remnants and performed chromosomal analysis in 7 children with M.S. undergoing facial surgery (gracilis muscle flap transfer).

Results: All children had severe bilateral facial diplegia. Six children had bilateral abductor palsy and distal limb anomalies. Gracilis muscle in these 6 children was normal. One child presented with severe shoulder girdle weakness and sensorineural hearing loss in addition to her facial diplegia. Gracilis muscle showed an active myopathic process with dystrophic features. Immunohistochemical staining for dystrophin, merosin, adhalin and the sarcoglycan complex was normal in all 7 patients. In 3 patients, a small facial muscle remnant was found and showed small, structurally normal muscle fibres with no neurogenic pattern. In 4 patients, no recognizable facial musculature was evident. Chromosomal analysis was normal in all children.

Conclusions: We have studied 7 children with M.S. and found a myopathic etiology in 1 child, underscoring the need for close neuromuscular assessment in children prior to surgery. Details of the muscle biopsy findings in both the skeletal and facial muscles will be presented. Discussion of the possible etiologies of M.S. and of the muscle disease in the one child will be discussed.

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Oral Presentations

A. STROKE

A-01

Insulin Fails to Reduce Cerebral Infarction Due to Transient Focal Ischemia in the Rat

M.G. HAMILTON AND G. DIX (Calgary, Alberta)

Background: The deleterious effects of high blood glucose (BG) levels during global and focal cerebral ischemia are well accepted. More recently the benefits of lowering BG within the "normal" range (utilizing insulin) before transient focal ischemia were established (J Neurosurg 1995; 82: 262-268). These experiments tested the hypothesis that insulin would provide neuroprotection when administered after the initiation of transient focal ischemia.

Methods: A rat model of transient focal cerebral ischemia was utilized. Two experimental protocols (90 and 45 minutes of ischemia) were completed with three experimental groups: control, insulin at onset of ischemia and insulin 30 minutes after ischemia. Animals were sacrificed at 7 days post ischemia. Behavioural and histopathological evaluation was performed.

Results: Blood glucose decreased from 6.2-7.0 mM (control) to 3.4-4.3 mM in the treated animals. There was no obvious or statistically significant difference in the behaviour or in the amount of ischemic damage (approximately 32% hemispheric injury) between the three experimental groups at either 90 minutes or 45 minutes of ischemia. The protocol was repeated with 45 minutes of ischemia adding a fourth group of animals that received supplementary glucose, increasing their BG to 9.3 mM. There was no difference in the clinical or histophathological outcomes in this protocol.

Conclusion: Insulin producing reduction of blood glucose within the "normal" range (decreased from 9.3 mM to 3.4 mM), fails to reduce cerebral infarction when administered after the onset of focal cerebral ischemia.

A-02

Outcome Measures of Stroke Survivors – A Six Month Follow-up Study of Patients' Perception of Health Related Quality of Life and Barriers of Re-integration

E. HO, D.T. HARVEY, S.K. CARDWELL AND C. WRIGHT (Hamilton, Ontario)

Purpose: To identify the Health Related Quality of Life of a group of stroke survivors in response to an inpatient rehabilitation process and six months after they returned to their previous community.

Method: Thirty stroke survivors were recruited from the rehab unit at a university teaching hospital. The FIM, SF36 were administered on admission, discharge and 6 month follow-up. SAS was also performed at 6 month follow-up.

Result: The average age was 74.2. The average admission FIM was 78.7. There were 14 points improvement on discharge and the improvement was significant ($p < 0.05$). The average SF36 score was 41 on admission and 44 on discharge. There is no significance between admission and discharge SF36 scores. For the domains of SF36, significant improvement was noted in physical functioning and mental health during their stay on rehab. There was a week to moderate correlation between FIM and SF36 ($r = 0.02 - 0.4$). There was a further improvement of 8 points of FIM scores in the follow-up. The SF36 also showed significant improvement (SF36 score = 57.48) in the 6 months follow-up. The SAS showed barriers of this group of patients in their relationship with the extended family and the marital role.

Conclusion: Further improvement in FIM and SF36 was documented in stroke survivors after they returned to the community. Relationship with the extended family and the marital role as a spouse were the common barriers.

A-03

Cerebral Retroperfusion with Free Radical Scavengers in Experimental Middle Cerebral Artery Occlusion

R. LEBLANC, Y.L. YAMAMOTO AND N. INOUE (Montreal, Quebec)

Introduction: Despite recent advances in pharmacological cytoprotection the treatment of ischemic stroke remains unsatisfactory. We have tested the hypothesis that enhanced pharmacological cytoprotection can result from retrograde perfusion of the ischemic area, produced by experimental middle cerebral artery occlusion (MCA-O), through a cortical vein in subhuman primates.

Materials and Methods: Four Rhesus monkeys underwent unilateral MCA-O and cannulation of a prominent Sylvian vein through a craniotomy. Magnetic resonance imaging and co-registered oxygen-15 labeled water positron emission tomography (PET) scans measuring cerebral blood flow (CBF) were obtained 3 hours after MCA-O just before the continuous retroperfusion of the free radical scavenger LY 231617 in 3 monkeys, the other monkey received saline retroperfusion. PET scanning was repeated at 4 and 5 hours after MCA-O, one and 2 hours after initiation of treatment. The blood-brain transfer constant, a measure of permeability, was measured after the method of Blasbert et al. (J Cereb Blood Flow Metab 1983).

Results: Three hours of MCA-O diminished CBF in the ipsilateral cortex and basal ganglia (60% decrease versus the contralateral hemisphere). Blood flow improved to 80% normal, especially in the basal ganglia, after 2 hours of treatment. Retroperfusion through the cerebral vein did not enhance the blood-brain-barrier permeability.

Conclusions: The sub-human primate cerebral venous system is tolerant to retrograde trans-venous perfusion of pharmacological agents. Scavenging of free radicals in an ischemic area via retrograde, trans-venous perfusion attenuates the effects of MCA-O in monkeys probably through a mechanism of capillary vasodilatation and protection of blood-brain-barrier function.

A-04

Spontaneous Cerebellar Hemorrhage: a Local Perspective

M. WHEATLEY AND D. STEINKE (Edmonton, Alberta)

The management of spontaneous cerebellar hemorrhage remains controversial. We reviewed 34 cases. Patients ranged in

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age from 46 to 81 years, with a male preponderance. Charts and CT scans were reviewed noting the diameter of the hematoma, presence or absence of hydrocephalus, effacement of the basal cisterns and admission Glasgow Coma Score (GCS). The majority of hematomas were lateral ranging in size from 2.8 cm to 6 cm. Hydrocephlus was present in 50% and more commonly associated with midline hematomas. Effacement of basal cisterns was a common finding, present in more than 90%. Outcome was measured using the Glascow Outcome Scale (GOS). Overall mortality was 30%. A poor outcome was found in 50% of the patients. The mortality rate for hematomas larger than 3.5 cm was 50%. The mortality in patients with hematomas less than 3.5 cm was 10%. Admission GCS correlated with outcome. Patients with an admission GCS of 14 or 15 recovered regardless of hematoma size. Ninety per cent of patients with an admission GCS of less than 10 had poor outcomes. A minority of patients were treated surgically. This case series suggests hematoma size and admission GCS correlate with outcome. Indications for surgical management will be discussed.

A-05

Microsurgical Middle Cerebral Artery Embolectomy Revisited

J.M. FINDLAY (Edmonton, Alberta)

Background: Thrombolysis has renewed interest in reperfusion therapies for acute ischemic stroke, but lysis of emboli occluding the middle cerebral artery (MCA) trunk has proven difficult. We reviewed our experience of emergency MCA embolectomies in order to compare this procedure with intraarterial thrombolysis in particular.

Methods: In the last 7 years 6 patients (ages 32-76) have undergone MCA embolectomies, the embolic source cardiac in 2, carotid artery in 2 and idiopathic in 2. The estimated total occlusion time ranged from 5 to 12 hours (mean 7.3 hr), and the mean time from diagnosis to surgical reperfusion was 3 hours.

Results: MCA patency was confirmed in all 5 surviving patients. Three patients developed cortical infarcts and all developed deeper infarction which varied in size according to the number of lenticulostriates included in the blocked MCA segment. All patients presented with hemiplegia (and for the 4 with left MCA emboli, dysphasia) and outcome (Glasgow Outcome Scale, 1-7 years follow-up) was good in 2, moderate disability in 3, and 1 patient died.

Conclusion: The results from this small series, consistent with similar reports in the literature and compared to our local series of MCA emboli treated with intraarterial urokinase, suggest that MCA embolectomy rivals thrombolysis in terms of time from recognition to recanalization, and compares favourably in terms of patency.

A-06

Carotid Endarterectomy in the Elderly

J.H. WONG AND J.M. FINDLAY (Edmonton, Alberta)

Objective: Carotid endarterectomy (CEA) reduces future stroke risk in certain patients but age may limit candidacy for surgery. The goal of this study was to determine whether elderly patient age influences the results of CEA.

Methods: We performed a population-based retrospective cohort study of 291 consecutive patients undergoing CEA in our city. Patients were stratified dichotomously according to age and elderly patients were defined as those greater than 75 years at the time of surgery.

Results: Elderly patients, who compromised 21% of the study population, more frequently had a history of coronary heart disease, hyperlipidemia, and renal insufficiency than younger patients in this series (P 0.05). There was a nonsignificant trend towards a higher stroke and death rate among elderly patients (6.6% versus 4.8%, P = 0.53). Elderly age was an independent risk factor by multivariate analysis for postoperative cardiac complications, i.e. unstable angina pectoris, dysrhythmia, congestive heart failure, or myocardial infarction, (odds ratio 1.8, 95% confidence interval 1.1 to 2.9).

Conclusions: Carotid endarterectomy may be accomplished in selected elderly patients with an acceptable overall risk of stroke or death, however elderly patients are at higher risk of cardiac complications, possibly due to associated risk factors for atherosclerosis.

B. PERIPHERAL NERVE

B-01

Does Local Nitric Oxide Impede Nerve Regeneration?

M. MISRA, H. SUN AND D. ZOCHODNE (Calgary, Alberta)

Background: We tested the hypothesis that inhibition of nitric oxide synthetase (NOS) would adversely influence regeneration of myelinated fibres by blocking local NO-mediated vasodilation.

Methods: NOS was inhibited by L-NAME (10 mg/kg ip) given twice daily for the first 10 days following sciatic nerve transection in Swiss mice. Controls received the inactive enantiomer D-NAME. Serial recordings of the M potential from interosseous muscles of the foot innervated by sciatic-tibial motor fibres were used to follow regeneration. At 10 weeks after the transection, the nerve was removed and the morphometric analysis of myelinated fibres distal to the injury site was carried out.

Results: Contrary to expectation, M potentials reappeared earlier in the mice treated with L-NAME and were higher in amplitude (reflecting the number of reinnervating motor fibres) at 10 weeks after the injury. In the L-NAME treated mice, the mean axonal diameter of regenerating tibial myelinated fibres was larger, the fibre size histogram was shifted to larger fibres and there was a reduction in the number of degenerating myelinated fibre profiles.

Conclusions: Inhibition of NOS in a transected peripheral nerve is associated with enhanced regeneration of myelinated fibres. Local NO may be toxic to regenerating axons.

(Supported by AHFMR, MDAC and MRC)

B-02

A Prospective Study of Complications Following Whole Sural Nerve Biopsy in Diabetic and Non-Diabetic Patients

M. THERIAULT, J. DORT, AND D. ZOCHODNE (Calgary, Alberta)

Background: Sural nerve biopsy (SNBx) is commonly used in the diagnosis of peripheral neuropathies and in multicenter trials to judge the efficacy of new agents in diabetic or other neuropathies.

Methods: We identified the incidence, type, severity and duration of complications following whole SNBx in 27 diabetic patients participating in a multicenter clinical trial. The results were compared to those of non-diabetics who underwent SNBx for diagnostic purposes. The patients were assessed at 6 and 12 months for the presence of discomfort (0-10), slowed wound healing, neuroma, nerve stump tethering, electrical discharge, allodynia and quantitated sensory deficit (SD).

Results: There were no significant differences in complications between diabetics and non-diabetics. Resolution in SD occurred equally in both groups by 12 months. In diabetic patients, both the HbAlc and the prebiopsy sural potential amplitude influenced SD resolution. Longer nerve resections were associated with greater residual SD. None of the patients developed disabling causalgia but the majority noted mild and persistent local discomfort and sensory loss at 12 months following SNBx.

Conclusions: The majority of patients following SNBx experience persistent unpleasant sensory symptoms. Although these symptoms were mild, the routine use of sural nerve biopsies for large clinical trials should be reconsidered.

B-03

Epidemiology of Brachial Plexus Injury in a Multi-trauma Population

R. MIDHA (Toronto, Ontario)

Background: There is a paucity of data on the initial presentation of patients with brachial plexus injuries. The purpose was to identify prevalence, etiologic factors, injury types, associated injury patterns and overall trauma severity in multi-trauma patients who presented with brachial plexus injuries.

Methods: Retrospective review of a prospectively collected and computerized data base and chart review.

Results: During the period from January 1986 to December 1994, 4,538 patients were evaluated at Sunnybrook Health Sciences Centre, a regional Trauma facility. Of these, 54 patients (1.2%) sustained a brachial plexus injury. Young males predominated. Supraclavicular injuries were more common and more likely to be severe (Sunderland III-IV) grade ($p < 0.01$) versus infraclavicular injuries which were neuropraxic in 50% of cases ($p < 0.01$). The former therefore required surgical exploration and reconstruction more often (52 versus 17%; $p < 0.05$). Closed head injury, thoracic injuries and fractures and dislocations affecting the shoulder girdle and cervical spine were particularly common associated injuries. The injury severity score ranged from 5-59 with a mean of 24 and two patients died.

Conclusions: Brachial plexus injuries afflict slightly greater than 1% of multi-trauma victims. Motor cycle and snow mobile related crashes are especially high risk conditions, with incidence of injury approaching 5%.

B-04

Prognosis in Non-traumatic Posterior Interosseous Neuropathy

M. VEILLEUX, P. RICHARDSON AND J.D. STEWART (Montreal, Quebec)

Isolated posterior interosseous neuropathy (PIN) is a rare mononeuropathy that may result from traumatic (laceration, gunshot wounds, fracture of the radius/ulna, repeated supination-pronation) and non-traumatic conditions in clouding ganglion, tumours, aneurysm, entrapment at the arcade of Frohse. On clinical exam, there is a weakness of the finger extensors, and abductor muscles, and no sensory deficit. In the past 8 years, 5 cases of isolated non-traumatic PIN were seen. All had NCS and concentric NEE. The radial nerve was explored in all cases and no definite site of entrapment was found. The usual lesion was axonal interruption rather than conduction block. Two patients presenting with a subacute onset (< 6 months) of finger extensor weakness had a better recovery as compared to those with a more progressive onset over a period of more than 6 months who had no or little improvement despite surgery. The degree of axonal damage noted on pre-operative EMG did not seem to correlate with long-term recovery. In our series slowly progressive non-traumatic PIN neuropathies had a poor outcome and exploration of the radial nerve was not associated with a better prognosis for recovery. Neuropathies of sudden onset had a better prognosis.

B-05

The Abductor Pollicis Brevis R1 Response: Technique and Normative Data

C.A. DE MEULEMEESTER, P.R. BOURQUE AND R.C. GRONDIN (Ottawa, Ontario)

Background: H reflexes are not reliably recorded from resting human hand intrinsic muscles except in the setting of upper motor neuron lesions. During contraction, a short latency R1 response, thought to be similar to the H reflex, is readily obtained from upper extremity muscles.

Methods: The right and left median nerves of 20 normal subjects were repetitively stimulated at 3 Hz at stimulus intensities corresponding to threshold and 20%, 40% and 60% of maximal M-response, recording from the abductor pollicis brevis muscle. Studies were done during both minimal and moderate voluntary contraction. Fifty responses were averaged.

Results: The R1 response was present in all subjects at the 40% stimulation intensity level during moderate contraction. The mean latency was 27 ms (SD 1.77 ms) with a good correlation to arm length. The mean amplitude was 1.17 mV (SD 0.79 mV).

Conclusions: Abductor pollicis muscle R1 responses can be reliably measured, although latency shows much less intersubject and side to side variability than amplitude. This technique

may be useful for the assessment of demyelinative lesions of the inferior segments of the brachial plexus and C8-T1 roots.

C. EPILEPSY

C-01

Two Magnetic Foci Proved by Chronic Invasive Intracranial Monitoring in a Child with Right Fronto-Central Epilepsy

H. Otsubo, R. Sharma, S. Holoka, J.T. Rutka and O.C. Snead (Toronto, Ontario)

Background: A fifteen year old boy with a 9 year history of refractory simple partial seizure secondarily generalized was studied with magnetoencephalography (MEG) to define magnetic source spikes followed by subdural grid placement to delineated the epileptogenic zone for cortical excision and carry out extraoperative functional mapping. MEG is known to detect epileptic spikes using equipotential current dipole analysis, and magnetic source imaging (MSI) on which MEG spikes are overlaid onto magnetic resonance imaging (MRI). In this fashion this technique may delineate an irritative or epileptogenic zone. However, the physiological differences between electrographic (EEG) spikes and spikes estimated by magnetic field remains uncertain.

Methods: We present one patient with medically refractory left partial motor and sensory seizures with secondary generalization. MRI was normal. MEG demonstrated 2 spike foci over the right superior frontal and inferior rolandic area adjacent to the sensory area. A 96 electrode subdural grid was placed to cover the involved area.

Results: Chronic invasive monitoring of ictal events using this subdural array detected two epileptogenic zones identical in location to those delineated by MEG. Cortical excision and subpial transection were performed with intraoperative electrocorticography. The patient has been seizure free for 6 months with no neurological deficit.

Conclusions: Magnetic Source Imaging is valuable in the planning for subdural grid placement to cover the epileptogenic zone.

C-02

Post-encephalitic Epilepsy: Clinical Characteristics, MRI Features, and Surgical Outcome

F. Dubeau, C.F. Hui, A. Bastos, D. Reutens, A. Olivier and F. Andermann (Montreal, Québec)

Background: Patients with a history of a viral encephalitis are at greater risk than the general population of developing epilepsy. We analyze the clinical characteristics, MRI findings, and surgical results in patients with post-encephalitic epilepsy.

Methods: Between 1980 and 1996, we investigated 38 (26 males) consecutive patients with post-encephalitic epilepsy, the majority during presurgical evaluation for intractable partial seizures.

Results: Initial illness was severe in every patient. A specific virus, herpetic, measles, varicella, coxsackie B4, parainfluenza and mumps, was suspected in 42%. Mean age (years) at encephalitis was 15.2 (range, 1-39) and first unprovoked seizure 15.9 (1.5-39). Duration of latent period to onset of refractory seizures was 0.64 and duration of epilepsy 12.9 (2-34). Patients presented with limbic (61%), neocortical temporal (17%) and extratemporal (33%) clinical manifestations. Multifocality was confirmed in all 12 patients who underwent invasive intracranial recordings. Qualitative, volumetric and morphometric MRI studies also showed multifocal structural abnormalities. Nineteen patients were operated on: none became seizure free, and only two had > 90% reduction of their attacks.

Conclusions: Encephalitis often leads to severe intractable epilepsy. Clinical and imaging findings suggest a multifocal or diffuse process. Varied viral pathogens seem to have a peculiar tropism for limbic structures and for neocortical, particularly temporal, and central areas. The surgical outcome is usually poor.

C-03

Prolonged Cognitive Impairment (PCI), *or* Non Convulsive Status Epilepticus (NCSE)?

P. Diadori, H. Darwish and V. Lange (Calgary, Alberta)

Background: Clinical and EEG features of NCSE have been well described. We have encountered epileptic children who have PCI, but don't fit these features of NCSE.

Objective: To demonstrate similarities and differences between NCSE and epileptic children with PCI who respond to intervention.

Method: Comparison of clinical and EEG features of 5 children with PCI and 3 with NCSE.

Results: Partial 2° generalized epilepsy with transient myoclonic seizures occurred in 4/5 children with PCI, whereas NCSE occurred in a variety of epileptic syndromes.

The EEG in both was characterized by predominance of abnormalities over frontal regions. In PCI there were sustained changes with delta and intermixed or superimposed paroxysmal features. In NCSE there were 2 EEG and clinical concordant states with EEG morphology characterized by spikes and spikes and waves, during NCSE events.

The EEG response to medication in children with PCI was discrete and significant clinical improvement occurred, but over days to weeks.

Conclusion: PCI and NCSE have in common frontal predominance of intraictal EEG abnormality. Significant differences in EEG morphology, clinical features and time course may result in delay in diagnosis and deter some from appropriate aggressive therapy.

C-04

The Asymmetrical Epileptogenicity of Brain Lesions

P. Pathak and W.T. Blume (London, Ontario)

Background: Brain lesions, such as tumours, are often epileptogenic as a result of their effects on adjacent cortex. We propose that this peri-lesional epileptogenicity is asymmetrically distributed, as evidenced by electrographic ictal and interictal data.

Methods: One index case and 18 retrospective cases, who were investigated with chronic subdural grids, were identified. Inclusion criteria: the presence of a well-demarcated lesion by neuroimaging, adequate grid coverage of the lesion and its periphery, completion of satisfactory recordings. Clinical and neuropsychological data were also assessed.

Results: Four females and 7 males, aged 3-40 years, were selected. Lesions included tumours (n = 4), schizencephaly (3), vascular malformation (1), cortical dysplasia (1), post-traumatic encephalomalacia (1), and unknown pathology (1).

Interictal spikes were located asymmetrically around these various lesions as was the electrographic ictal origin, to a lesser extent.

Clinical semiology corresponded to the cerebral hemisphere and/or region that contained the lesion, in 10/11 cases.

Conclusion: There is asymmetry of the cortex-lesion interface which can be identified electrographically. This reflects the variable pathophysiological processes that surround a brain lesion.

C-05

Complications of Surgical Management of Hemimegalencephaly in Childhood

S.T. MYLES, H. DARWISH, M. HAMILTON AND V. LANGE (Calgary, Alberta)

Background: Hemimegalencephaly is a migration disorder usually associated with refractory and catastrophic seizures in infancy. Surgical management has varied from limited resections to anatomic hemispherectomies. Hemispherectomy series that include hemimegalencephaly but also diverse etiologies such as Rasmussen's encephalitis or Sturge Weber, quote hydrocephalus as a complication varying from 18-50%.

Objective: Review the features of hydrocephalus as a complication of surgical management of hemimegalencephaly.

Method: Clinical case review.

Results: Six children underwent 10 resections. 3 were lobectomies (L); 3 were anatomic (AH) and 4 were functional hemispherectomy (FH). One FH and 1 L were converted to AH. Three children had more than one procedure. Four developed hydrocephalus. Two were easily controlled with shunting. Two have posed major recurrent complications, with uncontrollable hydrocephalus and development of multiple intracranial compartments and pressure related shifts. One died as a result, and 1 had reversible central herniation.

The size of ventricles, presence of a neurocutaneous syndrome, first operation under 1 year, reoperation and type of procedure did not reliably predict subsequent complication.

The post-op development of a shift towards the unoperated side heralded intractable hydrocephalus.

Conclusion: Surgical management of epilepsy secondary to hemimegalencephaly, is associated with a high risk of difficult to treat hydrocephalus.

C-06

The Ketogenic Diet. First Report on the Bloorview Cohort

R.L. SMITH AND R.M. CURITS (Toronto, Ontario)

Background: The ketogenic diet has been used since 1921 in the management of epilepsy. There is a recent resurgence of interest, particularly in children with intractable epilepsy.

Methods: A case series over two years.

Results: A ketogenic diet programme for children with intractable epilepsy was established by the Bloorview Epilepsy Programme, Toronto in early 1995. Currently 34 children have been enrolled and 27 remain on the diet. 17 boys and 17 girls; mean age at entry 8.3 years (range 1.1-15.5); mean duration of epilepsy 6.3 years (range 0.5-11.0). Sixteen have Lennox-Gastaut syndrome; ten myoclonic epilepsy, five complex partial seizures and three primary generalized tonic clonic episodes/unclassified. Two children failed at onset; four after a short trial and one child withdrew for unrelated reasons. Of the remaining twenty-seven; nine are seizure free, ten have a reduction in seizure frequency of > 50%, sixteen are more alert. The remainder is either unchanged or awaiting follow-up. Two G-tube fed children had transient, symptomatic hypoproteinaemia. There were no serious side effects.

Conclusion: The ketogenic diet remains a safe and effective treatment of particularly Lennox-Gastaut syndrome and the myoclonic epilepsies.

D. CHILD NEUROLOGY

D-01

Long Term Psychosocial Outcome Following Surgical Intervention in the Treatment of Refractory Epilepsy in Childhood and Adolescence

D. KEENE AND E. VENTUREYRA (Ottawa, Ontario)

Background: Surgical treatment of refractory epilepsy in childhood and adolescence has been shown to be effective in reducing the seizure frequency. This paper examines the question: "Does this result in a better life in later years?"

Method: Patients who underwent a surgical procedure for the treatment of their medically refractory epilepsy at our hospital; had more than two years follow-up; and were greater than 18 years at time of survey were included. From a retrospective chart review, age of onset and surgery; duration of seizures prior to surgery, years of follow-up, type of surgery, neurological status was obtained. From a telephone survey, seizure frequency post surgery; degree of satisfaction with procedure; marital; financial and driving status; and level of education and employment were obtained. At the time of telephone survey a QOLIE – 31 was administered.

Results and Conclusion: 45 out of 64 patients in our epileptic surgical series meet entry criteria. Significantly high levels of education, employment status and independence and satisfaction were found in patients with class 1 Engel-outcome group, compared to other Engle outcomes. QOLIE score were significantly greater in Engel class one outcome group, compared to other Engel outcome groups.

D-02

Ondine's Curse: Fetal Infarcts of the Tractus Solitarius Abolish Central Respiratory Drive in Neonates

H.B. SARNAT (Seattle, Washington, USA)

Background: The aetiology of "Ondine's curse", poor central respiratory drive, rarely is disclosed by EEG, imaging or metabolic

studies in young infants. The tractus solitarius and its nuclei are key components of the pneumotaxic centre: afferent fibres of cranial nerves IX and X provide impulses from the lungs and carotid sinus; efferents of the tractus solitarius descend to the spinal cord to modulate motor neurons of the phrenic nerve and to intercostal muscles; collateral axons project to the reticular formation and nucleus ambiguus.

Method: Two neonates, one born at 34 wk gestation who lived 10 days and the other born at term and lived 9 weeks, had poor respiratory drive without airway obstruction or pulmonary disease. Infant 2 also had jaw immobility and micrognathia. Clinical investigations failed to reveal the causes.

Results: Neuropathological examination revealed old gliotic, calcified infarcts in the pontine and medullary tegmentum bilaterally, involving the tractus solitarius; the lesions were at least several weeks or months old. The motor trigeminal nucleus also was involved in infant 2.

Conclusion: Ondine's curse in young infants may be due to small fetal infarcts of the brainstem involving the tractus solitarius. Symmetrical tegmental microinfarcts are a well documented pattern of fetal ischemic damage and may be below the limits of resolution of CT and MRI. Tractus solitarius lesions abolish both chemoreceptor signals and respiratory responses.

D-03

Dandy Walker Syndrome: The Experience at the Montreal Children's Hospital

G.K.T. CHU, J.P. FARMER, A.M. O'GORMAN AND J.L. MONTES (Toronto, Ontario)

Background: The prognosis of intellectual outcome of patients with Dandy Walker Syndrome (DWS) has traditionally been said to be poor with only 30 to 40% having a reasonable intellectual outcome. It has only been recently that these findings have been reexamined and that intellectual outcome for these patients may not be as bad as originally thought. Neurosurgeons are often asked to predict the intellectual outcome of such children even before they are born. We therefore analyzed our experience at the Montreal Children's Hospital with DWS patients to attempt to find any predictive factors of intellectual outcome.

Methods: We examined the records retrospectively from 1973 to 1995 at the Montreal Children's Hospital, for a diagnosis of DWS. We subsequently attempted to correlate intellectual outcome with radiologic central nervous system (CNS) anomalies and non-CNS anomalies.

Results: Fifteen patients were found to have DWS. The intellectual outcome was analyzed and it was noted that eight (53%) were of normal intelligence and seven (47%) were delayed. Three patients were found with isolated radiologic CNS anomalies, two of which were of normal intelligence and one was delayed. There were seven patients with non-CNS anomalies, two (29%) had normal intelligence and five (71%) were delayed. The breakdown for the two patients with both CNS and non-CNS anomalies is one in each group. The three patients with no anomalies other than the Dandy Walker were all of normal intelligence.

Conclusion: The experience at this hospital has been that the intellectual outcome of these patients is higher than the traditional experience. However what is most interesting is that Dandy Walker patients with CNS anomalies do not necessarily have a poorer outcome as previously thought but a poor intellectual outcome seems to be more associated with the non-CNS anomalies, perhaps reflecting either the syndromic nature of these clinical manifestations or an earlier gestational age at the time of the insult.

D-04

Intrafamilial Variability in the Clinical Presentation of Dystrophin Disorders

V. VEDANARAYANAN AND S.H. SUBRAMONY (Jackson, MS, USA)

Background: Variations in the clinical phenotypes of dystrophin disorders are well documented. These are correlated to the qualitative and quantitative differences in the expression of dystrophin in the muscles. Intrafamilial differences in severity of the disease amongst affected male family members has not received much attention. We are reporting two families where two affected brothers in each family showed significant difference in motor function and disability.

Clinical Data: Family N: Two male siblings with dystrophinopathy beginning from childhood. Patient AN became wheelchair bound by 12 years of age and his older brother RN is 34 years old now and ambulatory. Both brothers, their mother and a sister had a duplication mutation in exon 3 of the dystrophin gene. Family E: Two male siblings diagnosed with muscle disease in childhood. Patient CWE began having difficulty walking at 13 years of age and at 19 years of age needs a quad cane to walk and cannot climb steps. His brother MPE is 17 years old, can run and climb steps and complaints of muscle cramps after exercise. He has practically no motor disability at this time. Muscle biopsy on CWE showed no detectable dystrophin (Athena Labs). DNA studies are in progress.

Conclusion: This report demonstrates that clinical phenotype of variable severity can result from same genotype amongst affected family members with dystrophin disorders. Factors other than the dystrophin gene may be responsible for this phenomena.

D-05

Merosin Expression in Classical Congenital Muscular Dystrophy

J. VAJSAR, V. JAY AND A. MOMEN (Toronto, Ontario)

Background: Merosin (α_2 chain of laminin 2) deficiency and white matter changes on brain imaging have been reported in 30 to 40% of patients with classical congenital muscular dystrophy (CMD). The merosin-deficient cases, most of them associated with mutations in the LAMA2 gene on chromosome 6q2, were suggested to form a subgroup of clinical homogeneous, more severe CMD patients.

Method: We examined the merosin expression in muscle biopsies from 21 children with classical form of congential muscular dystrophy followed in our institution. Immunocytochemistry was performed with antibody that recognizes the 80 kDa fragment (C-terminal domain) of merosin.

Results: Only 1 patient was merosin-deficient. At 5 years of age, she is unable to stand and has abnormal brain myelination on MRI. Out of the 20 merosin-positive cases, 4 are severely weak and unable to stand. The others have only mild or moderate weakness and can walk unsupported.

Conclusions: The classical form of CMD may be associated with either deficiency or a normal amount of merosin. The patients with total absence of merosin are rare in our population, but they have a severe phenotype. On the other hand, the weakness in the more common merosin-positive CMDs may vary from very mild to severe. The relationship between the disease severity and merosin expression is, therefore, not as straight forward as suggested in the recent reports and further immunohistochemical and molecular biology studies are required.

E. SURGICAL ONCOLOGY

E-01

Aspects of Human Glioblastoma Immunobiology: Predictors for Immunogene Therapy

I.F. PARNEY, M.A. FARR-JONES, L.J. CHANG AND K.C. PETRUK (Edmonton, Alberta)

Background: New immunotherapies such as immunogene therapy have renewed interest in glioblastoma immunology. To study this further, we screened established human glioblastoma cell lines and low (<10) passage explants for expression of a panel of 11 key immunoreactive molecules.

Methods: Class I and II major histocompatibility complexes (MHC), B7-2, and Fas were assessed by flow cytometry. Granulocyte-macrophage colony-stimulating factor (GM-CSF), transforming growth factor β2 (TGF-B2), prostaglandin E_2 (PGE2), interleukin-6 (IL-6), IL-10, and IL-12 were assayed by ELISA of culture/explant supernatant. Fas-ligand (FasL) was assessed indirectly by observing if culture supernatant induced apoptosis in a FasL-sensitive cell line.

Results: All samples (13/13) expressed Class I MHC and Fas (1-2 log increase in fluorescence) but none (0/13) expressed Class II MHC or B7-2. Several (10/18) expressed GM-CSF but levels of expression were low (mean 0.4 ng/10^6 cells/24h). A similar number (14/23) expressed TGF-B2, but levels of expression were high (mean 8.4 ng/10^6 cells/24h). All (23/23) expressed PGE2 highly (mean 15.9 ng/10^6 cells/24h). Most (20/23) expressed high levels of IL-6 (mean 40.0 ng/10^6 cells/24h). Few expressed IL-10 (4/23) or IL-12 (1/18) and levels of expression were low (mean 0.4 and 0.1 ng/10^6 cells/24h respectively). None (0/7) expressed biologically active FasL.

Conclusion: Class I MHC and Fas expression suggests that glioblastomas can be recognized and killed (respectively) by activated cytotoxic T cells but absence of Class II MHC and B7-2 suggests that they are poor antigen presenting cells. Expression of immunoinhibitory cytokines (TGF-B2, PGE2, IL-6) likely further hinders T cell activation. If T cell activation can be enhanced by immunogene therapy using genes such as Class II MHC, B7-2, GM-CSF, and IL-12, effective immune mediated tumour lysis may be possible.

E-02

Early Discharge Following Excision of Supratentorial Brain Tumours Under Regional Anaesthesia

H. HUGENHOLTZ, L. PRATT AND C. WHERRETT (Ottawa, Ontario)

Background: Current techniques for mapping eloquent brain have limitations when used in conjunction with craniotomy under general anaesthesia. In contrast, craniotomy under regional anaesthesia which has been successfully employed for decades provided opportunity for continuous monitoring of language, memory, motor and sensory function. Preliminary experience with this technique suggested that regional anaesthesia also expedites recovery.

Methods: All craniotomies conducted under regional anaesthesia for supratentorial intraparechymal masses during 1995 and 1996 were reviewed for demographics; location, size and pathology of the lesion; indications for and technique of regional anaesthesia; intraoperative events and modifications; complications; patient acceptance; day of discharge; and, status at one month.

Results: Twenty-nine patients had a single lesion and three had two. Thirty-one lesions were close to eloquent brain. Corticography was used as an intraoperative adjunct to 30 lesions and sterotaxy in 22. In 4 patients intraoperative functional monitoring resulted in a modified surgical approach. Twenty-one patients were discharged by the third postoperative day (Median day of discharge – 3 days). Eighty-five per cent of patients indicated a preference for another craniotomy under regional anaesthesia.

Conclusions: Craniotomy under regional anaesthesia with continuous intraoperative functional monitoring facilitates extirpation of tumours close to eloquent brain. Patients recover quickly from the systemic effects of surgery and are commonly discharged by the third post-op day. Patient acceptance is high, suggesting that a prospective comparison with craniotomy under general anaesthesia is feasible.

E-03

The C_6 Atrocytoma Spheroid Invasion Model: Evidence for the Presence of a Glial-repellent Factor(s)

R.F. DEL MAESTRO, M. TAMAKI, W. MCDONALD AND V.R. AMBERGER (London, Ontario)

Background: Central to any strategy aimed at the elimination of malignant gliomas must be an appreciation for the role played by the invasive subpopulation of cells distant from the major tumour mass. The C_6 astrocytoma spheroid invasion model has been developed to more carefully assess this difficulty to detect and study cohort of cells.

Methods: C_6 astrocytoma spheroids of varying sizes were imbedded into collagen type I gels and invasive activity monitored over a 5 day period. Total invasion distance and rates of invasion were assessed. In other experiments to model operative procedures the initial spheroid was either partially or totally removed from the gel leaving the invading cell population.

Results: Cells from large C_6 spheroids (> 700 μm diameter) invaded the gel at significantly faster rates when compared to

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small (< 500 μm diameter) and medium sized spheroids (500 – 700 μm diameters). Complete and incomplete removal of the initial spheroid resulted in decreased invasive distances which could be reversed by placing a new spheroid in the operative defect. Medium from spheroid spinner culture and from the surface of gels containing large spheroids inhibited gel invasion by cells from spheroids. This medium contains a factor which is about 50 kDa in size and inhibited invasion in this model. This factor does not appear to have the characteristics of previously described scatter or invasive inhibiting factors.

Conclusions: The data can best be explained by hypothesizing the production of a repellent factor(s) by stressed cells in the central microregions of spheroids. Cells invade in a radial unidirectional manner away from high concentrations of the repellent factor(s) but modulate their invasive activity in the absence of a gradient.

E-04

Spread of Recurrent Meningioma Via the Dural Venous Sinuses

J. Siddique, B. Wallace and O. Al-Mefty (Little Rock, AR, USA)

Background: Post-surgical recurrence of meningiomas is dependent on grade of tumour and extent of initial resection. We present our experience with recurrent meningiomas spreading within the dural venous sinuses. Mechanism for tumour spread in this manner is discussed, and specific technical strategies for surgical resection discussed.

Methods: The senior author's (OA) entire tumour database was reviewed for the period 1985-1997 for the session of interest. Data were collected on the extent of tumour recurrence, the exact dural sinus involved, the surgical approach utilized, and any adjuvant therapy given. Morbidity and mortality of chosen therapy was calculated.

Results: Recurrent menigiomas within the dural venous sinuses are not common; when they occur, these lesions tend to respect the integrity of the dural venous sinus walls, allowing the same integrity to be used to the advantage of the surgeon at the time of reoperation.

Conclusions: Surgery within the dural venous sinuses poses special hazards to adjacent brain and neurovascular structures. Nonetheless, this surgery can be done relatively safely.

E-05

Effect of Implant Dose and Surgery on Survival in a Rat Brain Tumour Brachytherapy Model

J. Bampoe, J. Glen and M. Bernstein (Toronto, Ontario)

Background: Focused radiation like brachytherapy may provide better control for consistently fatal brain tumours.

Methods: Fifty-four F-344 rats were given right frontal 9L gliomas by stereotactic inoculation of cultured cells. Rats were divided into 5 treatment groups in 2 experiments: surgery alone, brachytherapy (brachy) low dose and brachy high dose alone, surgery plus brachy high dose, and sham surgery plus dummy seed implant (i.e. controls). Brachy consisted of a radiation dose of 60 Gy (low dose) or 80 Gy (high dose) to a 5.5 mm radius volume from an iodine-125 seed. Surgery consisted of gross total tumour removal using standard microsurgical techniques. Treatment started on the 12 day post tumour inoculation.

Results: Surgery alone produced an increased life span (ILS) of 28.6% over controls which was statistically significant ($p = 0.0023$; log rank test). Brachy (60 Gy) alone produced an ILS of 121% ($p = 0.0001$) and brachy (80 Gy) alone produced the most significant ILS with the median survival not being attained ($p = 0.0001$). No statistically significant difference in survival was found between rats that were treated with brachy 80 Gy alone and rats receiving brachy 80 Gy after surgery ($p = 0.4896$).

Conclusions: In this rat model, brachytherapy conferred meaningful prolongation of survival which was not improved upon by removal of the tumour prior to implant. The main limitation of this model is that the median survival could not be reached with high dose brachy, which unfortunately does not obtain in human patients with glioblastoma.

E-06

Magnetic Resonance Spectroscopy Guided Brain Tumour Resection: Differentiation Between Recurrent Glioma and Radiation Necrosis

R. Leblanc and M.C. Preul (Montreal, Quebec)

Objectives and Importance: It is often difficult to differentiate a recurrent glioma from the effects of post-operative radiotherapy by currently available diagnostic means. High grade gliomas in contra-distinction, have recently been shown to have a characteristic spectrum on magnetic resonance spectroscopic imaging (MRSI). We have been successful in using MRSI to distinguish a recurrent glioma from an area of radiation necrosis in a patient in whom both were histologically proven to be present.

Clinical Presentation and Methods: A 39 year old man had the resection of a right frontal glioblastoma followed by radiotherapy 6 months before follow-up gadolium-enhanced MRI suggested the possibility of recurrence of tumour or radiation necrosis. The patient underwent functional positron emission tomography imaging (f-PET) that demonstrated that the gadolinium-enhancing area was partly in the motor strip. Magnetic resonance spectroscopy imaging demonstrated a spectral pattern for choline-containing phospholipids (Cho), creatinine and phosphocreatinine (Cr) and N-acetyle-containing compounds (NA) in the posterior aspect of the enhancing lesion within and just anterior to the motor strip suggesting the presence of radiation necrosis. More anteriorly the MRS-I spectra for metabolites (Cho, Cr, NA) revealed tumour recurrence. Cortical mapping under local anesthesia, biopsy in front of the motor strip and resection more anteriorly confirmed the findings of f-PET and MRSI.

Conclusions: Magnetic resonance imaging is useful in differentiating radiation necrosis from recurrence of a malignant glioma and can guide further resection when the two are present. It can be combined with functional imaging in appropriate cases to assure maximal resection without added neurological damage. All investigative modalities (MRI, f-PET, MRSI) can be co-registered as a single data set for use with the viewing wand.

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E-07

Anterior Fossa and Orbito-Frontal Resection and Reconstruction Techniques: Using Vascularized Rib Grafts

A.B. KASSAM, C.B. AGBI, M.B. JANMUSKE, A. LAMOTHE, S.M. GILBERG AND S.F. MORRIS* (Ottawa, Ontario; Halifax, Nova Scotia*)

Background: Anterior fossa floor and orbital lesions represent challenging and complex cases requiring multidisciplinary approaches. Skull base approaches in this region mandate radical craniofacial bone resection, thus relying on innovative techniques for reconstruction.

Methods: We report our experience over the past year with five unique craniofacial and orbital lesions. Included in this report is a rare case of a true orbital arteriovenous malformation requiring a panoramic orbitotomy and reconstruction. The reconstruction techniques in the report include the use of a vascularized rib graft based on a rectus muscle free flap. This provided viable bony coverage for the anterior fossa floor following radical resection of a chondrosarcoma. We also describe a laboratory technique involving angiosome studies to assess the viability of this unique bone flap.

Results: We were able to achieve a gross total removal of all five lesions. In our case series we did not experience any complications. The reconstruction techniques provided viable coverage in all cases with acceptable cosmetic results for all patients.

Conclusion: Based on our experience with this vitalized rib graft we believe it to be an excellent option for skull base reconstruction requiring large areas of bony coverage.

E-08

Mengiomas of the Jugular Foramen

J. SIDDIQI, S. JAIQUMAR, S. PRAVDENKOVA AND O. AL-MEFTY (Little Rock, AR, USA)

Background: Meningiomas of the jugular foramen can arise primarily from the arachnoid villi of the jugular bulb, or extend secondarily from adjacent areas. The surgical resection of these rare lesions especially challenging due to the location of the jugular foramen, and the presence of critical neurovascular structures within it.

Methods: The entire tumour data base of the senior author (OA) was screened for the lesion of interest, over the period 1985-97. Five jugular foramen meningiomas were found, three arising primarily. All cases were studied for age, sex, signs and symptoms, and management. Morbidity and mortality were calculated for the choses management.

Results: Jugular foramen meningiomas are slow-growing tumours of adults, occurring most commonly in the 6th decade. The M:F ratio is 3:2, and the average duration of symptoms at presentation is 4 years.

Conclusions: Meningiomas of the jugular foramen are rare, but occur in similar sex and age distributions as other intracranial meningiomas. The most significant risk associated with these lesions (by natural history or surgical therapy) involves injury to the lower cranial nerves.

E-09

A Three-dimensional Assay System to Study Cell Migration from Human Brain Tumour Explants

V.R. AMBERGER, M. TAMAKI AND R.F. DEL MAESTRO (London, Ontario)

Background: Malignant brain tumours differ from more benign tumours in their ability to infiltrate the surrounding tissue. To study the invasive paradigm we developed a three-dimensional assay system which allows us to monitor tumour cell-matrix interaction and cell migration out of human brain tumour explants.

Methods: Human brain tumour specimen obtained during operative procedures were implanted in collagen type I gels and tumour cell infiltration of the gel was monitored over 10 days. After fixation paraffin sections of the explants were stained with hematoxylin, and eosin, antibody against glial fibrillary acidic protein (GFAP) and Ki67-labelling indices were assessed. To study the influence of CNS myelin on tumour cell migration the gels were supplemented with human myelin prepared from fontal lobe.

Results: Tumour cells from human glioblastoma multiforme invaded the collagen gels with a velocity of 25 to 100 μm per day, whereas cells from anaplastic astrocytomas invaded only 0 to 30 μm per day. The addition of CNS myelin to the collagen gel increased glioblastoma cell invasion by 51% but reduced or even blocked cell invasion from explants of anaplastic astrocytomas. Cell invasion out of low grade astrocytomas (grade II) into collagen was very slow or absent. Glioblastoma cell invasion into both types of gels could be blocked by the addition of 0-phenanthroline, a metalloprotease blocker, whereas blockers for serine-aspartyl- and cysteine proteases only had a minimal effect.

Conclusion: These results demonstrate that glioblastoma cells showed high migratory activity in a three-dimensional assay system and the invasion rate was increased in the presence of CNS myelin. These results fit well with the observation that glioblastoma cells *in vivo* infiltrate along blood vessels and preferentially along white matter fibre tracts. The strong inhibitory effect of metalloprotease blockers on invasion rates suggests the crucial involvement of a metallodependent protease in migration through collagen and collagen/myelin gels.

E-10

Outcome in Surgical Management of Invasive Lateral Sphenoid Wing Meningiomas

F.A. DURITY, H. BADER, J. ROOTMAN AND W.B. WOODHURST (Vancouver, British Columbia)

Background: Uncertainty still exists as to the most appropriate management strategy in invasive lateral sphenoid wing meningiomas (LSWMs), a benign and uncommon but relentlessly progressive disease.

Methods: From 1984-1993, a policy of "early" aggressive surgery aimed at totally unlocking the "trapped" orbit was instituted. During this period, 15 consecutive LSWMs were treated; 12 presented with significant proptosis, and 3 with progressive

visual loss. By an extended pterional craniotomy, 14 tumours were aggressively resected. Limitations to complete removal included subarachnoid seeding (1), cavernous sinus involvement (6), and other associated risk factors (3) e.g. advanced age. All but 1 orbit was reconstructed.

Results: Proptosis was relieved in all, vision improved in 3. Complications included visual deterioration in 1, enophthalmos in 1, transitory CSF leak in 2, and transient mild diplopia in 8. All patients returned to their usual life style with average follow-up of 7 years. Cosmetic results were excellent.

Conclusions: An aggressive but limited surgical procedure that unlocks the trapped orbit in LSWMs is an effective low risk, long term management strategy in this progressively relentless entity.

E-11

Brachytherapy for Malignant Glioma: Results of a Prospective Randomized Study

M. Bernstein, N. Laperriere, J. Glen, P. Leung, S. McKenzie, A. Landon and M. Pintilie (Toronto, Ontario)

Background: Experimental treatments like brachytherapy must be assessed in properly designed clinical trials.

Methods: A randomized prospective study to examine the efficacy of a high-activity iodine-125 brachytherapy boost after conventional external radiation for patients with newly diagnosed anaplastic astrocytoma and glioblastoma accrued 140 patients from 1987-1996 aged 18-70 years, with KPS $\geqslant$ 70, with unifocal disease $\leqslant$ 5cm. The groups were well-matched with regard to age and other important prognostic factors.

Results: Kaplan-Meier survival analysis reveals that the median survival was greater by 3 months (15.7 vs. 13.0 months) for patients who actually received an implant (not statistically significant). One-year survival was modestly but significantly greater in the patients who received an implant (72% vs. 56%) as was the 2-year survival (23% vs. 14%; $p = 0.03$). In the implanted patients there was a small tail of long survivors including two patients alive at 6 years and 9 years after diagnosis. Complications of brachytherapy were substantial; 16% of patients experienced significant morbidity directly attributable to radiation necrosis and/or the implant procedure and 33% of patients required a second operation.

Conclusions: Brachytherapy provides modest prolongation of survival in highly selected patients with newly diagnosed malignant gliomas. This study was partly funded by the NCIC. The authors also acknowledge the collegial support of Toronto and Canadian neurosurgeons and oncologists.

F. CEREBROVASCULAR SURGERY

F-01

Les anévrismes cérébraux de l'enfance

G. Milot (Québec, Québec)

Documentation de base : Les anévirismes cérébraux de l'enfance sont rarissimes et leur présentation clinique diffère de l'adulte.

Méthode : Une étude rétrospective de dossiers fut entreprise dans notre milieu.

Résultats : Sur 20 patients étudiés, 19 se sont présentés avec une hémorragie sous-arachnoïdienne. L'âge de présentation variait de 22 mois à 19 ans et l'évolution fut satisfaisante chez 17 patients.

Conclusion : Il s'agit d'une lésion peu fréquente pour ce groupe d'âge rarement asymtomatique et qui nécessite un traitement individualisé.

F-02

Intracranial Hemorrhage in the Newborn Full Term Infant

B.S. Jhawar and R.F. Del Maestro (London, Ontario)

Background: Intracranial hemorrhage in the full term newborn infant still remains a major cause of mortality and long term morbidity despite advances in obstetrics and neonatology.

Methods: Retrospective series of 27 cases managed at our institution from 1990-1995 based on chart review.

Results: Infants initially presented with obvious signs of external hemorrhage (78%), non-specific signs which prompted further investigations (22%) or neurological manifestations (22%). Several infants had abnormal laboratory results (26%). Definitive diagnosis was revealed by U/S, CT, and MRI imaging. Hemorrhages occurred in all compartments of the intracranial space (31% Subarachnoid, 11% Subdural, 34% Intracerebral, 23% Intraventricular). Identifiable causes tended to be either traumatic delivery or impaired hemostasis. Management consisted of ventricular and subdural taps. No infants required craniotomy although several required VP shunting. Three children did not survive the immediate newborn period.

Conclusions: Intracranial hemorrhage can occur to varying extends in the newborn period and is associated with significant neurological injury. Today, diagnosis can be prompted by historical risk factors, physical examination and suspicious laboratory results. Imaging studies are usually definitive and help guide management. Treatment revolves around supportive care in the initial period with close observation and occasionally ventricular and subdural taps. Surgical evacuation is usually not required although a VP shunt may be needed in the long term.

F-03

Anomalous Cortical Organization With Cerebral AVMS: Fact or Fancy?

R. Leblanc, G. Leonard, R. Roth and Z. Caramanos (Montreal, Quebec)

Introduction: We have evaluated handedness and language lateralization in 34 patients with a cerebral AVM in the left hemisphere to determine if there was evidence of atypical cortical organization.

Materials and Methods: The AVM patients underwent a battery of neuropsychological tests to determine handedness and cognitive function. They were compared to 145 patients with left temporal lobe epilepsy and to 396 patients with and without early left hemisphere brain damage.

Results: Thirty-three patients in the AVM group were right-handed (97%), and 33 were left hemisphere dominant for language (97%). The left-handed AVM patient was not the same one who was right hemisphere dominant for language. Right-handedness was more common in the AVM group than in the group with left temporal lobe epilepsy (72%, $p < 0.05$). Left hemisphere language lateralization was more common in the AVM group than in the group with left hemisphere damage (45%, $p < 0.000$), but was not significantly different from the group without left hemisphere damage (84%, $p > 0.05$). When only right-handed patients are considered, 32 of 33 AVM patients were left hemisphere dominant for language, a proportion almost identical to the 134 of 140 right-handed patients without left hemisphere damage who were left hemisphere dominant for speech (97% vs. 96%). There were no left-handed individuals in the 7 patients whose AVM was within or in close proximity to the motor strip. Eight of the 9 AVM patients (89%), all right-handed, whose AVM was in or about cortex subserving language remained left hemisphere dominant for language, not significantly different from the 96% of right-handed patients without left hemisphere damage who were also left hemisphere dominant for language.

Conclusions: Cerebral AVMs are not associated with anomalous cortical organization with regard to handedness and language lateralization.

F-04

Preliminary Experience with Carotid Stent Angioplasty for Severe Symptomatic Carotid Artery Stenosis in Patients at High Risk for Surgery

S.P. LOWNIE AND D. ROSSO (London, Ontario)

Background: Carotid stent-assisted angioplasty has emerged as an alternative to carotid endarterectomy for patients considered to be at high risk for surgery.

Methods: Between July and November 1996, five patients with severe stenosis or near occlusion of the internal carotid artery and ipsilateral cerebral hemispheric (4) or ocular (1) ischemia underwent percutaneous balloon angioplasty and stent placement using balloon-expandable stents. All patients had severe cardiovascular or pulmonary disease, or both, and were considered to be at surgical high risk.

Results: Despite heavily calcified severe stenosis or near occlusion angiographically, internal carotid artery catheterization and angioplasty were successfully performed in all patients. Atherosclerotic plaque "recoil" after angioplasty led to the need for stent placement in every case. Excellent restoration of luminal calibre occurred in all cases. Two patients sustained transient cerebral ischemia (less than 2 hours) which resolved completely. One patient had a delayed posterior circulation territory minor stroke. All five had excellent or good outcomes. Follow-up ultrasound at 3 to 6 months showed no early re-stenosis.

Conclusion: Carotid stent-assisted angioplasty has been effective and durable in these patients.

F-05

Early Experience with CT Angiography for the Detection of Intracranial Aneurysms

G.B. ANDERSON, J.M. FINDLAY, D.E. STEINKE AND R. ASHFORTH (Edmonton, Alberta)

Purpose: To compare CT angiography (CTA) with selective digital subtraction angiography (DSA) in the detection and anatomical definition of intracranial aneurysms, particularly in the setting of acute subarachnoid hemorrhage (SAH).

Methods: In a blinded, prospective study, 40 patients with suspected intracranial saccular aneurysms underwent CTA and DSA. The CTAs were interpreted for aneurysm presence, location, size, number of lobes, neck size, and adjacent arterial branches. The results of the CTA study were then compared with DSA control images.

Results: DSA revealed 43 aneurysms in 30 patients, and ruled out aneurysms in 10. For aneurysm presence alone, the sensitivity and specificity for CTA was 86% and 90%, respectively. False negative CTAs resulted from technical problems with the study, small aneurysm domes (< 3 mm) and unusual aneurysm locations. CTA was, compared to DSA, very accurate in describing aneurysm anatomy, and it provided a three dimensional representation of the lesion, useful for surgical planning.

Conclusions: CTA allows rapid and relatively noninvasive detection of aneurysms in common locations, and the anatomical information provided in positive studies is at least equivalent to that provided by DSA. In cases of SAH where CTA results are clear, it is possible to forgo DSA prior to emergency surgery.

G. MOVEMENT DISORDERS

G-01

Long Term Efficacy of Botulinum Toxin in Various Movement Disorders Over Nine Year Period

S.K. DAS, O. SUCHOWERSKY AND R. RANAWAYA (Calgary, Alberta)

Botulinum toxin (BT) injections have become routine method for treatment of a variety of dystonic and related disorders over past 10 years. In order to determine the long term effectiveness and side effects of BT, we reviewed all the charts in the movement disorder clinic in Calgary.

Total 238 patients were reviewed: 99 cervical dystonia (CD) (age-range 26-85 years); 38 blepharospasm (BS) (a.r. 24-84 yrs); 6 occupational dystonia (OC) (a.r. 24-54 yrs); 22 other dystonia (OD) (a.r. 17-82 years); 52 hemifacial spasm (SH) (a.r. 23-87 years); 6 hereditary chin tremor (HCT) (a.r. 8-76 years); 7 spasticity (SP) (a.r. 38-77 yrs); 5 miscellaneous disorders (MISD) (a.r. 39-77 yrs). Follow-up of patients was up to 9 yrs.

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type of disease	av. dose of BT (in units)	excellent/ good results (%)	side effects (%)
1. CD	196	58	18
2. BS	57	61	65
3. OC	53	67	50
4. O.D	112	50	36
5. HS	20	90	38
6. HCT	8	100	0
7. SP	67 (upper) 160 (lower)	85	15
8. MISD	13	80	0

Most of the side effects were transient and did not prevent repeated injection. 38.5% of the patients were lost in follow-up for various reasons. Overall BT appears a safe and effective long term treatment in these disorders. Highest success rate with lowest side effect profile occurs in hemifacial spasm and hereditary chin quivering.

G-02

18 Month Prospective Study of Amantadine (Amd) for Dopa (LD) Induced Dyskinesias (DK) in Idiopathic Parkinson's Disease

A. Rajput, M. Wallukait and A.H. Rajput* (Iowa City, Iowa, USA; Saskatoon, Saskatchewan*)

LD induced DK are common and may prevent adequate dosing in some cases. Clinical trials on different drugs to control DK have, so far, reported only limited success. We report 18 month (July 95 – Dec. 96) study of Amd in LD induced DK at University of Saskatchewan.

Twenty-two PD patients who experienced LD induced DK were treated with Amd but 3 were excluded because of concurrent LD dose adjustment. Of the remaining 19 (F 6, M 13), 13 had peak-dose choreic DK, 4 (21%) also experienced pain – all with additional dystonic DK. In 14 of 19 (73.7%) DK improvement occurred within 2 weeks on Amd 200 mg/day – 7 marked, 5 moderate and 2 mild, and 2 did not tolerate the drug. Seven of 14 (50%) who improved also reported better control of PD. At last follow-up (2 wks. to 12 months) 11 of 14 (78.6%) had sustained benefit but 2 developed adverse effects requiring Amd discontinuation.

Those who improved had an earlier PD onset compared to those who did not (mean 49.8 vs. 63.4 years). The age of sustained improved group (11 cases) was younger at Amd initiation than those who had primary or secondary drug intolerance (62.5 vs. 73.5 years). Six of the 14 DK improved cases had previous trial on Amd for PD which did not predict DK benefit.

Our data show that Amd is effective in controlling LD induced DK in most cases. We recommend that all cases with disabling DK be tried on Amd.

G-03

Response to Levodopa Following Unilateral Medial Pallidotomy for Parkinson's Disease

R.J. Uitti, R.E. Wharen, M.F. Turk and J.A. Lucas (Jacksonville, Florida, USA)

Background: Parkinson's disease (PD) patients undergoing pallidotomy may benefit from reductions in levodopa-induced dyskinesias. This study evaluated whether changes in beneficial responses to levodopa also occur following pallidotomy.

Methods: Pre- and 3 mo post-operative assessments (UPDRS scoring, timed motor function tests, neuropsychological testing, and patient diaries) were performed in 32 PD patients undergoing unilateral medial pallidotomy (using MRI-stereotactic and microelectrode electrophysiological techniques).

Results: Average age at surgery was 67 yrs. There were no significant complications. UPDRS "off", best "on" motor scores ($p < 0.001$), total UPDRS (77.0 to 64.5, $p < 0.001$) and Purdue pegboard testing ($p = 0.01$) all improved. Dyskinesia severity reduced ($p = 0.02$) while neuropsychological testing showed no changes apart from mild reductions in verbal memory in left hemispheric operations. Diary "on" time improved (pre = 3.6 hrs/d, post = 7.4, $p < 0.01$). The magnitude of levodopa effect, reflected by the difference in "off" and "on" motor scores, was unchanged post-operatively (pre: 39%, post: 43%). The rapidity of levodopa effect (time to best "on") did not change (pre = 133", post = 133").

Conclusions: Unilateral medial pallidotomy reduces levodopa-induced dyskinesias while not interfering with beneficial effects of levodopa in PD.

G-04

A Large Saskatchewan Kindred with Lewy Body Parkinson Disease: Exclusion of 4q21-q23, Yp-pseudoautosomal Region and Dopamine β-Hydroxylase Locus

K, Isozumi, J. Kaplan, H.-X. Deng, W.-Y. Hung, T. Sasaki, T. Siddique, A.H. Rajput*, M.E. Fenton*, D. George*, B. Kanigan*, M.A. Pericak-Vance† and A. Rajput‡ (Chicago, Illinois, USA; Saskatoon, Saskatchewan*; Durham, North Carolina, USA†; Iowa City, Iowa, USA‡)

Background: The cause of Parkinson disease (PD) is unknown, and both genetic and environmental causes have been suggested. Recently, an autosomal dominant from of PD was linked to chromosome 4q21-q23, suggesting that a single gene may be sufficient to cause the PD phenotype. We report a large Saskatchewan PD kindred with 11 affected males with male-to-male transmission in three generations which is not linked to chromostome 4q21-q23.

Patients: Clinical appearance and response to levodopa were typical for PD, and autopsy of one patient who died 12 years after onset showed the pathological changes typical of PD with Lewy bodies. Only one instance of definite non-penetrance is known.

Methods and Results: Since all affected persons are males with male-to-male transmission, we investigated the possibility of pseudoautosomal inheritance in this pedigree. Haplotype analysis on four PCR-based polymorphisms excluded 80% of

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Yp-telomeric pseudoautosomal region. Then autosomal dominant inheritance was assumed for chromosome 4q21-q23. However, the linkage was excluded to this region using both an age dependent and a low penetrance model. Dopamine β-hydroxylase was also excluded as a candidate gene.

Conclusions: This report demonstrates genetic heterogeneity of familial PD. A genome scan is now in progress.

G-05

Paroxysmal Dystonia in Patients with HIV Infection

S.M. MIRSATTARI, A. NATH, C. POWER, M.E. BERRY* AND J.K. HOLDEN* (Winnipeg, Manitoba; Vancouver, British Columbia*)

Background: Primary Human Immunodeficiency Virus (HIV)-induced paroxysmal dystonia (PD) is a rare finding which has not been well characterized. In the present study, we describe the clinical, radiological, and pathological features of HIV-induced PD.

Methods: Six HIV-infected patients presenting with PD were identified through the Neuro-AIDS clinics in Vancouver and Winnipeg. We used Demirkiran and Jankovics' classification of PD but we did not exclude patients with decreased level of consciousness. All patients had metabolic screening tests, cerebrospinal fluid studies, electroencephalogram, and neuroimaging studies to exclude opportunistic infections and metabolic disorders causing dystonia.

Results: All patients had adult-onset PD with mean age at onset of 35 years. PDs were focal, multifocal, or hemidystonic in 4 patients and generalized in another 2 patients. PD progressed to persistent dystonia in one patient with HIV dementia (HIVD). Two out of 6 patients had paroxysmal kinesigenic dystonia and the remaining 4 had paroxysmal non-kinesigenic dystonia. Dystonia and HIVD were the presenting features of AIDS in 1 patient. Choreoathetosis (n = 3), myoclonus (n = 2), postural tremor (n = 5), and dysarthria (n = 3) were observed. Two patients had decreased level of consciousness associated with dystonia and were subsequently diagnosed with HIVD. Patients were followed up for a mean period of 12 months (range = 1-24). Clonazepam improved signs and symptoms in 2/4 patients. Autopsy of one patient revealed severe encephalitis with an unusual degree of deep gray matter involvement including the caudate nucleus, putamen, and thalamus.

Conclusions: HIV-infected patients may develop PD in the absence of other secondary causes of dystonia. The most likely pathogenesis of PD is the direct invasion of the basal ganglia by HIV. When given in right dose, clonazepam may improve PD.

G-06

Amantadine (Amd) Effectiveness in Treatment of Progressive Supranuclear Palsy (PSP) and Multiple System Atrophy (MSA)

M.E. FENTON, A.H. RAJPUT, R.J. UITTI*, D. GEORGE AND S. BIRDI (Saskatoon, Saskatchewan; Jacksonville, Fl, USA*)

Background: MSA and PSP, in general, respond poorly to most antiparkinsonian drugs. We report treatment of these disorders with Amd.

Methods: Patients were seen at the Movement Disorder Clinic Saskatoon between 1968-96. The usual dose of Amd was 100 mg x 2/day given alone or added to stable antiparkinsonian regimen. Symptomatic benefit was defined as clinical and functional improvement after Amd initiation, worsening on Amd withdrawal, or lack of clinical progression for one year or longer.

Results: 27 patients (13 MSA and 14 PSP) were included – 11 (5 PSP and 6 MSA) confirmed at autopsy. Of 13 MSA (6F, 7M) 8 (61.5%) had symptomatic benefit, 4 (31%) had no benefit, and one had insufficient documentation. Improvement was seen in bradykinesia, rigidity, ambulation, daily life functions, and reduced dykinesia, but not in dysautonomia, cerebellar dysfunction, or pyramidal tract deficit.

Of 14 PSP (3F, 11M) 6 (42.9%) improved, and 5 (36%) did not. Documentation of response was insufficient in 3. Improvement was seen in bradykinesia, rigidity, and daily life function, but not in extraocular movements, dementia, or postural reflexes.

Conclusions: Symptomatic benefit was independent of onset age, sex, age at Amd initiation, duration of illness and response to levodopa. Side effects (4 MSA, 4 PSP) included leg edema, hallucinations, "headache", postural hypotension, and "dizziness". Based on these observations we recommend a trial Amd in treatment of these disorders.

H. NEUROPHYSIOLOGY

H-01

Role of Voltage-gated Potassium Channels in Axonal Dysfunction After Spinal Cord Injury

M.G. FEHLINGS, R. NASHMI, L.E. BECKER, C.A. ACKERLEY, O.T. JONES AND K. SCALES (Toronto, Ontario)

Background: The axons in the subpial rim which survive spinal cord injury (SCI) display dysfunctional conduction properties. After chronic SCI, blockade of K^+ channels with 4-aminopyridine (4-AP) improves axonal conduction. However, there are a great variety of K^+ channels and the specific K^+ channels that mediate axonal dysfunction after SCI have not been established. In this study, we used electrophysiological and molecular techniques to more specifically characterize the K^+ channels that are involved in axonal dysfunction after SCI.

Methods: Compound action potentials (CAPs) and current clamp recordings were recorded from injured and uninjured dorsal column slices from adult rat spinal cord *in vitro*. Injury was performed either *in vitro* (to the dorsal column strip with a 2 g clip for 15 sec) or *in vivo* (23 g injury for 1 min at T7). Western blots and immunocytochemistry (IMC) were performed using antibodies directed against the Kv1.1, 1.2 and 1.4 K^+ channel proteins.

Results: Infusion of 4-AP (1 mM) resulted in a significantly greater increase in P2 amplitude of injured (132.9 ± 12.3%) as compared to noninjured axons for the microelectrode derived field potential recordings. Sucrose gap recordings showed an increase in CAP amplitude (104.4 ± 1.9%) of injured axons with 1 mM 4-AP at 22°C which was even more pronounced (124.6 ±

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6.3%) at higher temperatures (37°C). TEA (0.1 mM, 10 mM), when infused alone and with CsCl (10 mM), produced similar effects on injured and intact axons. Current clamp recordings showed that following injury to the axons there was an increase in early K^+ conductance which was blocked with 5 mM 4-AP. IMC revealed little immunopositive staining along noninjured axons for all three antibodies. Four weeks after SCI there was increased immunostaining for Kv 1.1, 1.2 and 1.4 proteins on injured axons.

Conclusion: Our results are consistent with the hypothesis that the 4-AP sensitive K^+ channels that have rapid gating kinetics and are encoded by the Kv 1.1, 1.2 and 1.4 genes have altered distribution patterns following SCI and therefore, may contribute to axonal dysfunction.

(Supported by the Easter Seal Research Institute and the Rick Hansen Man in Motion Foundation.)

H-02

Local Activity of Endothelial and Inducible Nitric Oxide Synthetase (NOS) in a Rat Model of Chronic Neuropathic Pain

D. Levy and D.W. Zochodne (Calgary, Alberta)

Background: Local nitric oxide (NO) may play a role in the chronic constriction injury (CCI), a model of neuropathic pain in rats produced by tying 4 x 4.0 chromic gut ligatures around the common sciatic nerve.

Methods: CCI was induced in male Sprague-Dawley rats. Following confirmation of thermal hyperalgesia and mechanical allodynia the rats were assessed for possible NO mediated changes in local nerve blood flow (NBF) at 48 hours, 7 and 14 days. Changes in epineurial or intrinsic NBF were studied following systemic or local administration of the nonspecific NOS (nitric oxide synthetase) inhibitor L-NAME, its non-active enantiomer D-NAME and the iNOS inhibitor aminoguanidine (AG). Immunohistochemical staining was made for all three NOS isoforms.

Results: CCI was associated with local nerve hyperemia proximal and distal to the constriction, reversible with systemic or topical L-NAME in a dose dependent fashion. AG reversed hyperemia at later time points. There was ecNOS immunostaining proximal to and at the constriction at 48 hours and iNOS immunostaining at and distal to the constriction at 14 days.

Conclusions: Following CCI an increase in local NOS-NO action occurs through activation of the ecNOS then iNOS. NOS may be expressed by Schwann cells and macrophages.

(Supported by MDAC)

H-03

Intrastriatal Grafting of Ventral Mesencephalic Tissue Hibernated in Glial-Derived Neurotrophic Growth Factor (GDNF) in the Parkinsonian Rodent Model: a Behavioural Analysis

V. Mehta, M. Hong and I. Mendez (Halifax, Nova Scotia)

Background: Dopaminergic tissue grafting in Parkinson's Disease (PD) is a process whereby fetal nigral cells are placed into the affected striatum. Both the number of cells required and the reason for low survival of transplanted neurons are key issues that need to be addressed. We investigated the number of transplanted cells required when either hibernated with or without GDNF for 6 days to improve both rotational bias and forelimb akinesia in the rodent model of PD.

Methods: Twenty-five female Wistar rats were trained for both the "staircase" and "stepping" tests to assess complex sensorimotor function prior to 6-hydroxydopamine lesioning of the right dopaminergic nigrostriatal pathway. Lesioned rats then received intrastriatal transplants of 400,000 or 800,000 cells hibernated in control media or media containing GDNF. All animals were assessed at 3 and 8 weeks post-transplant for rotational bias to amphetamine challenge and for forelimb activity in the "staircase" test. Initiation time, ramp time and adjusting steps were also assessed using the "stepping" test. Graft survival was quantified using tyrosine hydroxylase immunohistochemistry.

Results: Animals receiving grafts exposed to GDNF demonstrated a significant improvement in rotational bias at 3 weeks post-transplant while all other transplanted animals showed improvement at 8 weeks. Only the grafts hibernated with GDNF significantly improved the adjusting step in the left forelimb, however, there was no improvement in decreased left forelimb function in either the "staircase" test or initiation and ramp time aspects of the "stepping" test. Cell number in those grafts exposed to GDNF was significantly enhanced.

Conclusions: Transplantation of 400,000 cells hibernated with GDNF is all that is required to improve rotational behaviour at three weeks and contralateral forelimb akinesia as assessed by the adjusting step.

I. GENERAL NEUROPHYSIOLOGY

I-01

What is the Most Sensitive Clinical Test or Combination of Tests to Detect Subtle Central Motor Deficits?

J. Teitelbaum and M. Garner (Montreal, Quebec)

Background: Many textbooks describe clinical manoeuvres that help detect subtle motor lesions. The actual sensitivity and specificity of most of these manoeuvres have not been tested or compared to those of the segmental motor exam. We calculated the sensitivity and specificity of each test and the combination of tests sensitive enough to eliminate the need for the segmental exam.

Methods: Straight arm raising (Barre) pronator drift, Mingazzini's manoeuvre, finger tap, forearm roll and segmental strength was tested in 164 patients with (86) and without (78) a proven lesion in the motor area.

Results: Sensitivity for Barre and pronator were 85% and 92% respectively and ranged from 41% (motor exam) to 77% for other tests. Specificity ranged from 89% (Barre and pronator) to 97% (segmental exam). An abnormality of Barre, pronator or finger tap had a sensitivity of 97% and a specificity of 89%. When all three tests were abnormal with or without weakness, specificity was 97%.

Conclusion: A normal Barre, pronator and finger tap is sensitive enough to assure the absence of a motor lesion without requiring the addition of the segmental motor exam. Despite normal strength, abnormality of all three tests points a central motor lesion.

I-02

"Status Intrusus": a Useful Localizing Neurological Sign

A. OGUNYEMI (St. John's, Newfoundland)

Background: A substantial proportion of neurologists have encountered patients who respond to questions or instructions posed to other nearby patients. We use the term "status intrusus" to label this neurological finding.

The behaviour is often dismissed as resulting from mental confusion, hallucination or dementia. To our knowledge, this phenomenon has not been clinically distinguished nor is there a neurological explanation.

Methods: Three patients exhibiting the behaviour described above as "status intrusus" were referred to us as having acute confusion, delirium and Wernicke's aphasia. They underwent detailed neurological assessment including clinical examination, blood tests, CT scan and EEG.

Results: Two female patients were 40 and 79 years old and a male patient was aged 84 years. Careful neurological examination of the 3 patients revealed the following clinical findings: (i) responses to questions and instructions directed to nearby patients; (ii) transient rambling and irrelevant speech during interview; (iii) neglect of left visual space and (iv) disorientation to place with intact orientation to person and time.

EEG demonstrated epileptiform potentials localized to the right posterior head region. CT scan was normal in the women and showed right frontal infarction in the man.

The intrusive responses and rambling, irrelevant speech coincided with post-ictal EEG findings localized to the right parietal-posterior temporal occipital region. All the 3 patients recovered normal mental state following treatment.

Conclusion: "Status intrusus" manifesting as intrusive responses and rambling irrelevant speech is a sign of dysfunction in the non-dominant parietal-posterior temporal-occipital region.

I-03

Management of Chronic Cluster Headache by Nervus Intermedius Section

D.W. ROWED AND R.S. HUM (Toronto, Ontario)

Background: Chronic cluster headache, which has proved refractory to pharmacological treatment, is a therapeutic challenge. Surgical treatment strategies have included ablative trigeminal procedures and section of the nervus intermedius or greater superficial petrossal nerve. We have preferred nervus intermedius section because it tends to provide long-lasting relief and avoids facial and corneal anaesthesia.

Methods: Twelve patients suffering from refractory chronic cluster headache were managed by a nervus intermedius section between March, 1988 and October, 1996. Follow-up ranges from 3 to 105 months (mean 64 months).

Results: Cluster headache has been completely relieved or dramatically improved in 8 patients (67%). The remaining 4 patients continue to suffer chronic cluster headache at approximately preoperative intensity. Parasympathetically mediated features have returned in 2 of the patients with continuing cluster headache. Six patients (50%) have experienced transient postoperative vertigo and 2 (17%) sustained ipsilateral hearing loss.

Conclusion: Nervus intermedius section is a safe and effective procedure in refractory chronic cluster headache and avoids the side-effects of trigeminal ablative procedures. Details of surgical technique, operative findings, intraoperative monitoring, and possible reasons for failure will be presented.

I-04

Inpatient Treatment of Chronic Daily Headache Using Dihydroergotamine: A Long Term Follow-up Study

T. PRINGSHEIM AND D. HOWSE (Kingston, Ontario)

Background: The treatment of chronic daily headache (CDH) due to medication overuse remains a common and difficult problem. For selected patients refractory to outpatient management we have used a treatment protocol using dihydroergotamine (DHE) as introduced by Raskin, during a brief (typically 48 hours) inpatient stay. While many studies document the short term efficacy of the DHE protocol, there are limited data on its long term effects. The purpose of this study was to investigate the efficacy of the protocol on the headache frequency, severity, analgesic use, absences from work, and quality of life, at three months and the present time.

Methods: A retrospective chart review of all patients admitted for the DHE protocol from 1991 to 1996 revealed 174 cases. Of these, 132 patients were interviewed by phone.

Results: The DHE protocol was shown to decrease headache frequency, severity, analgesic use, and absences from work at both three months and the time of the interview.

Conclusion: This study has the largest patient base and the longest follow-up period for the use of DHE for CDH. The results confirm that the DHE protocol is helpful in breaking the cycle of CDH, however the long term outcomes of this study are more modest than other studies have reported.

I-05

Non-Motor Symptoms of Multiple Sclerosis: a Community Based Survey

A.D. RAE-GRANT, N.J. ECKERT, S.M. BARTZ AND J.F. REED (Allentown, Pennsylvania, USA)

Objective: To assess the frequency and severity of non-motor symptoms in a community based population of patients with Multiple Sclerosis.

Background: Multiple Sclerosis (MS) is usually quantitated by gait, motor, sensory, and visual function. Non-motor symptoms include transient episodes of neurological dysfunction, pain, headache, fatigue and respiratory dysfunction. These

symptoms may dominate the clinical picture but are not measured in standard MS scales.

Design/Methods: Community survey, quantified variables including age, sex, disability, duration of disease, classification and a variety of symptoms questions.

Results: Three hundred eighty-seven patients surveyed, 53% response. Ages 42.9 ± 9.19 years, 28.4/71.6% m/f. Duration 0-3 years 15%, 4-10 years 46%, < 11 years 40%. One-third were disabled. "Benign" disease in 15%, "relapsing with return to normal" in 30%, "relapsing with accrued deficit" in 25%, "secondary progressive" in 21%, and "primary progressive" in 7%. One-half described brief episodes of neurological dysfunction (Seconds to Hours). These included altered sensation (21%) movement (11%), difficulty speaking (6%), and visual symptoms (6%). Two-thirds of patients identified pain related to MS, one-third with constant pain. Sixty-five per cent describe headache, and 68% Lhermitte's phenomenon. One-fifth of patients identified respiratory problems. Fatigue limited activity in 79% of patients. In females, symptoms were worse with menses in 37%. No correlation between disability, duration of disease and these symptoms. The "worst" symptom of MS was pain in 12%, fatigue in 17%, urinary dysfunction in 6%, and "dizziness" in 5%.

Conclusions: Non-motor symptoms are a frequent component of MS and should be considered as secondary endpoints for clinical trials.

I-06

Acute Disseminated Encephalomyelitis: a Comprehensive Review of 13 Cases

P. PATHAK AND R.S. MCLACHLAN (London, Ontario)

Background: Acute disseminated encephalomyelitis (ADEM) is a rare autoimmune disease, usually triggered by infection.

Methods: We reviewed all cases diagnosed clinically as ADEM, acute hemorrhagic encephalomyelitis (AHEM) or post-infectious encephalomyelitis over 10 years at London Health Sciences Centre.

Results: Thirteen patients (M:F = 3:10), aged 18-55 years, were identified. Nine of 13 patients had a prodromal respiratory tract infection. Focal deficits occurred in all cases. Stupor or coma occurred in eight. Seven had evidence of myelopathy, two had optic neuritis. Seizures occurred in two patients, one of whom had epilepsy. Brain MRI revealed multifocal white matter lesions in cerebral hemispheres and brain stem in 11 patients and was normal in one. One patient had diffuse white matter swelling on CT scan. MRI of spine showed increased T2 signal or cord atrophy in five of six cases. CSF protein was 0.7 - 2.9 g/L while white cells were present in eight of 11 cases. Oligoclonal banding was absent. Two patients died (pathology was that of AHEM), nine were left with moderate to severe deficits and two returned to normal.

Conclusion: 1. ADEM responds poorly to treatment and has an unfavourable prognosis for full recovery. 2. MRI is of considerable diagnostic value in this condition.

J. CHILD NEUROLOGY

J-01

Analgesic Rebound Headaches in Children

V.V. VEDANARAYANAN (Jackson, MS, USA)

Background: Analgesic rebound headaches are headaches occurring daily from daily intake of symptomatic headache medication. The headaches are most likely caused by and sustained by the medication and usually resolve with abstinence. The prevalence and incidence rates of drug induced headaches in adults are not available, however most headache centers report among 5 to 10% of adults seen fulfill criteria for drug induced headaches. Analgesic rebound headache has rarely been reported in children. We are reporting 5 children whose headaches were sustained by daily frequent analgesic use and the headaches resolved after analgesic medications were discontinued.

Clinical Data: In the past 2 years we treated 5 children, 3 girls and 2 boys who presented with daily headaches for 5 to 8 weeks. They were taking analgesic medication daily; ibuprofen and paracetamol in all and paracetamol with codeine in two of them. All had been missing school and other activities as a result of headaches. All children had previously suffered attacks of vascular headaches and family history was positive for migraine headaches in all. Imaging studies of the brain, MRI scans in 3 and CT scan with contrast in two were normal. Neurological and general physical exams were normal in all. Analgesic medication was discontinued in all and were treated with amitryptaline and their daily headaches resolved in 4 to 7 days.

Conclusion: Analgesic rebound headaches occurs in children though much less frequent than in adults. Discontinuation of analgesics resulted in resolution of daily headaches in these children.

J-02

Changes in Uncoupling of Cerebral Blood Flow and Oxygen Utilization During Functional Brain Activation

W.J. LOGAN (Toronto, Ontario)

Background: Functional brain activation produced by sensorimotor or cognitive activity produces a T2*-weighted magnetic resonance signal change which appears to be due to blood oxygen level changes. (BOLD effect). It has been shown that at least for somatosensory stimulation there is uncoupling of cerebral blood flow and oxygen utilization such that there is a relative increase in the oxygenated haemoglobin in the region of increased signal or activation. It is possible that oxygen utilization does increase but is overshadowed by the marked increase in cerebral blood flow, that there is an oxygen debt that is accumulated and then restored gradually during or at the end of activation or that there is increased anaerobic metabolism. There is some evidence with prolonged activation which has been interpreted as a restoration or recovery of the oxygen debt.

Methods: To further evaluate this possibility functional MRI studies utilizing the BOLD phenomenon were undertaken in

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normal adults. Trains of visual stimuli were presented of varying duration from 20 seconds to over 5 minutes. The time course of the areas of activation were examined for changes which might indicate a decreased BOLD effect thereby indicating changes in the uncoupling during activation.

Results: The time course signal intensity showed no consistent decrease with either repetitive or prolonged trains of visual stimuli. This does not support the mechanism of compensatory increase in oxygen utilization after continuous or repetitive visual activation.

Conclusion: This study did not detect any changes in the uncoupling of cerebral blood flow and oxygen utilization over time during functional brain activation. Persistence of the BOLD effect indicates that the increase in blood flow remains considerably greater than the oxygen utilization or possibly anaerobic mechanisms may be operative.

J-03

Computerized Image Analysis of Cerebrocortical Neuronal Migration in Three-Dimensional Fetal Mouse Cerebral Explant Cultures

P. HUMPHREYS AND W. HENDLEMAN (Ottawa, Ontario)

Background: Neuronal migration disorders contribute to several neurological syndromes including epilepsy, mental subnormality and learning disabilities. Mechanisms involved in neuronal migration have been studied in explant cultures of rodent cerebrum; unfortunately neurons stop migrating *in vitro* after a few days, and distinct cortical layers do not develop. Since techniques employed to date cause explants to flatten to single-cell thickness, we hypothesized that preservation of three-dimensionality might permit more normal cell migration.

Methods: Timed pregnant mice received 100 mg/kg bromodeoxyuridine (BrdU) intraperitoneally at embryonic day 15 (E15); 24 hours later the fetuses were removed. 350u sections of cerebral mantle were encased in a thin collagen layer to discourage flattening and maintained on porous membranes apposed to culture medium. Explants were fixed and sectioned at either 7, 11 or 15 days *in vitro*; the distribution in cortex of BrdU-labeled neurons was mapped using computerized image-analysis (IMAGE). Results were compared with the cortex of mice also labeled at E15 and sacrificed at postnatal day 1 (P1), P9 of P22.

Results: Explants remained viable and maintained 50-60% of their original thickness after 14 days in culture; two distinct cellular layers developed in the cortical plate (inner layer, large cells; outer, small cells). By 11 days *in vitro*, BrdU-labeled cells were confined to the cortex, mapping primarily to the mid-zone (putative layers III and V). In comparison, *in-vivo*, labeled cells at P9 clustered in the outer half of the cortex (layers III > II).

Conclusions: While migration of cortical neurons in cerebral explant cultures is significantly improved by preservation of three-dimensionality, the lack of full development of all cortical layers suggests that other factors are contributing to impaired neuronal migration *in vitro*.

J-04

Ischemia-induced Oligodendroglial Damage in a Model of Periventricular Leukomalacia in the One-Week Immature Rat

S.E. JELINSKI, J. ASSELIN, B.H.J. JUURLINK AND J.Y. YAGER (Saskatoon, Saskatchewan)

Introduction: Periventricular leukomalacia (PVL) is the most common cerebrovascular lesion affecting premature infants of 26-34 weeks gestation. Recent evidence suggests that the vulnerability of the oligodendrocyte *per se* significantly contributes to its pathogenesis. To examine the effects of an hypoxic-ischemic (HI) lesion on oligodendroglia *in vivo*, we developed a model of PVL in the immature rat.

Methods: All studies were performed on 7-day postnatal rats. At this age the oligodendrocyte is beginning to lay down white matter, and zones of myelinogenesis are prominent within the periventricular region. Seven-day old rat pups underwent bilateral, transient, common carotid artery ligation and exposure to 8% hypoxia for 10 minutes. The animals then recovered for up to 72 hours with their dams. Neuropathological assessment was obtained utilizing hematoxylin and eosin; immunohistochemical staining with O4 antibodies (to delineate oligodendroglial lineage), and lipid peroxidation, as an indication of oxidative stress was measured utilizing the TBAR reaction, and HSP 32 (heme oxygenase).

Results: Damage occurred consistently within the myelinogenic foci of the periventricular white matter, sparing cortical and subcortical gray matter structures. At 6 hrs. of reperfusion, O4 positive cells showed were damaged as indicated by a shrunken appearance and less intense signal, as compared to controls. Lipid peroxidation demonstrated profound fluorescence localized to the corpus callosum with the TBAR reaction, and an upregulation in both the periventricular and adjacent corpus callosum structures at 6 and 24 hrs of reperfusion with HSP 32.

Conclusion: A model of PVL in the 7-day immature rat pup was developed in which: 1) there is selective necrosis of the periventricular myelinogenic regions, 2) selective oligodendroglial injury has been verified, and 3) cell death was associated with enhanced sensitivity of the oligodendroglial precursor to oxidative stress. The findings suggest that intrinsic vulnerability of the oligodendroglial precursor following an HI insult contributes to the pathogenesis of PVL. (Supported by the Heart & Stroke Foundation of Saskatchewan.)

K. GENERAL NEUROSURGERY

K-01

Discharge from Hospital Following Head Injury

R. MOULTON, K. FELDMAN, K. TOWNSEND AND I. SULLIVAN (Toronto, Ontario)

The continuing downsizing of in-patient neurosurgical resources across the country continues to place pressure on neurosurgeons to discharge patients home from hospital as quickly as possible. Head injury is an extremely common neurosurgical

condition and one in which appropriate discharge for patients is frequently problematic. In order to conduct optimal discharge planning it would be useful to identify patients early in their stay who are going to require transfer to other institutions so that discharge planning can begin as quickly as possible.

Factors influencing the ability of patients to be discharged home from hospital following acute head injury were examined in a cohort of 1817 survivors of head injury admitted to hospital over a 9 year period beginning in Jan. 1986. Epidemiological and injury severity data were collected prospectively in these patients and stored in a computer database.

The most significant factors were patient age and admission Glasgow Coma Score (GCS) ($p < .0001$ for both). Using logistic regression a predictive function was developed to enable estimation of the probability of discharging a patient home. The range of probability ranged from 21% of elderly patients with a low GCS to 92% of young patients with a GCS of 15. The ability of patients to be discharged home (with or without home care services) was adversely influenced by the presence of injuries to other body systems, operable cerebral mass lesions, etiology of injury, and pupillary inequality ($p < .001$ for each). Statistical independence of these latter variables could not be demonstrated. Discharge home was unaffected by patient sex, or alcohol intoxication at admission. Transfer to other institutions was employed more frequently for patients referred from outside Metro Toronto ($p < .001$).

K-02

Cytoskeletal Degradation Following Spinal Cord Injury: a Target for Early Neuroprotective Mechanisms

M.G. Fehlings and S. Casha (Toronto, Ontario)

Background: In spinal cord injury (SCI) tissue damage caused by the primary mechanical insult is exacerbated by delayed secondary mechanisms. Attenuation of secondary injury mechanisms in expected to improve axonal survival and neurological outcome. Calpains are endogenous proteases activated by intracellular Ca^{2+} which degrade cytoskeletal components. They appear to be a key secondary injury mechanism. We have previously documented calpain activation and cytoskeletal breakdown within 24 h of SCI. We have also shown the neuroprotective effects of low Na^+ and Ca^{2+}, Na^+ and Ca^{2+} channel blockade and non-NMDA glutamate receptor antagonism *in vitro.*

Methods: Adult Wistar rats (n = 5/ treatment) were subject to *in vivo* 35 g clip compression injury at T6, with and without Na^+ channel blockade (QX314: 4µl, 20 nmols), non-NMDA glutamate receptor blockade (NBQX: 4µl, 16 nmols) or both, introduced by microinjection at 15 min post injury. T5-T7 spinal cord was excised and homogenized at 0, 1, 2, 4, 8 hours post injury and western blot analysis was performed.

Results: Degradation of NF200, MAP2, Spectrin, and Myelin Basic Protein are documented within the first 8 hours after SCI. The western blot profiles suggest early calpain activation with maximal activity seen at 2-4 hours. Our initial results indicate that QX314 and NBQX microinjected after injury do not reduce calpain activation, suggesting that their neuroprotective effects occur by other mechanisms.

Conclusion: It is anticipated that inhibition of calpain and changes in the early temporal profile of these proteins correlate with neuroprotection and that this may serve as a screening assay for potential neuroprotective agents. The neuroprotective mechanisms of Na^+ channel inhibitors and AMPA/Kainate receptor antagonists most likely do not include changes in clapain activity.

K-03

AMPA/Kainate Receptor Antagonist NBQX Blocks Local Glutamate Excitatory Transmission, Dose Not Relieving Traumatic Ischemia Following Spinal Cord Injury in Rats

S. Li and C.H. Tator (Toronto, Ontario)

Background: AMPA/kainate receptors play an important role in traumatic necrosis of cord cells after spinal cord injury (SCI) and their antagonists may provide neuroprotection in the treatment of SCI. The purpose of the present study is to evaluate the effects of NBQX on glutamate excitatory transmission and post-traumatic ischemia at the injury site by measuring evoked potentials and spinal cord blood flow (SCBF) in acute compressive SCI in rats.

Methods: Twenty-five rats received a 21g clip compression injury of the cord at T1, and were then randomly and blindly allocated to either 15 nmol (9 rats), 5 nmol (8 rats) NBQX or control (8 rats) groups. Intramedullary infusion of 1.70 µl NBQX or vehicle was started at 15 minutes after SCI through a glass micropipette with a tip of 30 µm in diameter, a nanapump and a stereotaxic micromanipulator. Somatosensory evoked potentials (SSEPs), cerebellar evoked potentials (CEPs) and hydrogen clearance technique were used to measure electrophysiological function and SCBF, respectively, for 4 hours after SCI.

Results: In the 15 nmol NBQX group, the amplitude of both SSEP and CEP peaks was significantly lower than in the control group during the 4 hour period of observation. There was no SCBF improvement in any treatment groups.

Conclusion: Thus, intrameullary administration of NBQX after SCI attenuates the amplitude of SSEPs and CEPs. This inhibition of evoked potentials demonstrates that NBQX reduces AMPA/kainate receptor-mediated excitation and produces a local blockade of glutamate excitatory transmission at the injury site. These reduced evoked responses provide evidence that AMPA/kainate receptor antagonist attenuates glutamate neurotoxicity and may provide neuroprotection. Thus, AMPA/kainate ionotropic receptors may be important in the aetiology of secondary injury after SCI.

K-04

Surgical Excision of Extratemporal Malformations of Cortical Development for the Treatment of Epilepsy: Imaging, Histology and Outcome

R. Griebel*, G. Fabinyi, R. Kalnins, Y. Chinvarum, G. Fitt, A. Mitchell and S. Berkovic (Saskatoon, Saskatchewan*; Melbourne, Australia)

Background: Focal developmental malformations of the cerebral cortex are increasingly recognized as a cause of extratem-

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poral partial epilepsy. The aim of this study was to assess the imaging, histology and surgical outcome in a select group of these patients. We hypothesized that the histology of these lesions would correlate with the imaging data and that adequate surgical resection would alleviate seizures.

Methods: The clinical, histological and imaging profiles of 20 consecutive patients undergoing resection of dysplastic foci were reviewed. Correlations between the histological grade of the dysplasia and the MRI, SPECT and PET imaging were determined as well as the surgical outcome.

Results: The histology of resected tissue ranged from mild disturbances of laminar architecture to severe changes in both arrangement and morphology of neurons. Histological grade of dysplasia correlated with MRI findings but not with those of SPECT or PET. Outcome was not influenced by histological severity but did relate to patient IQ and completeness of resection.

Conclusion: Histological grade of focal dysplasia correlates with MRI findings but not with functional imaging. Resection of foci can result in meaningful seizure relief in selected cases.

K-05

The Cubital Tunnel Re-visited

W. FEINDEL AND J. STRATFORD (Montreal, Quebec)

Background: In 1956, we treated three patients with ulnar palsy by surgical decompression of the nerve at the elbow, in what we termed the cubital tunnel. We also described the cubital tunnel syndrome: constriction of the ulnar nerve in the tunnel, swelling proximal to it, frequent sparing of the branch to flexor carpi ulnaris, and ulnar palsy aggravated by elbow flexion.

Method: Our technique involved incision of the aponeurosis of flexor carpi ulnaris overlying the nerve; sometimes subperiosteal removal of a prominent medial epicondyle; distal incision, if indicated, of the aponeurosis and division of any fascial bands proximal to the cubital tunnel. This approach obviates division of muscle, nerve branches and arteries to the nerve incident to anterior transposition.

Results: Cubital tunnel decompression has been widely adopted as an effective treatment for non-traumatic progressive ulnar nerve palsy. Over 100 reports from other centres have confirmed our findings and defined variations in cubital tunnel anatomy, refined the criteria for operation and added details of surgical technique.

Conclusions: Characterization of the cubital tunnel syndrome has provided understanding of the mechanism of ulnar nerve compression at the elbow and has led to its relief by simple surgical decompression in selected cases.

K-06

Epidural Spinal Cord Stimulation for Treatment of Chronic Pain, Predictors of Success: a 15-year Experience

K. KUMAR, C. TOTH, R.K. NATH AND P. LAING (Regina, Saskatchewan)

Background: An analysis of our series of 235 patients with chronic, benign pain treated over the past 15 years has clarified the value of specific prognostic parameters in prediction of success in SCS.

Methods: Patients were followed up for periods ranging from 6 months to 15 years with a mean follow-up of 66 months. The mean age of the 150 men and 85 women within the study was 51.4 years. Indications for SCS included 114 failed back syndrome, 39 peripheral vascular disease, 30 peripheral neuropathy, 13 multiple sclerosis, 13 reflex sympathetic dystrophy and 26 cases of other etiologies of chronic, intractable pain.

Results: Pain due to failed back syndrome, reflex sympathetic dystrophy, peripheral vascular disease of lower limbs, multiple sclerosis, and peripheral neuropathy responded favorably to spinal cord stimulation. In contrast, paraplegic pain, stump pain, phantom limb pain, primary bone and joint disease pain, and axial midline back pain without radiculopathy did not respond as well. Cases of cauda equina injury had promising initial pain relief, but gradually declined after a few years. After long-term follow-up, 47 of the 111 successfully implanted patients were grainfully employed, compared to 22 patients prior to implantation. Complications included hardware malfunction, electrode displacement, infection, and tolerance.

Conclusion: Aside from etiologies of pain syndromes, other parameters influencing success included the number of surgical procedures and duration of pain prior to implantation ($p < 0.001$). Age, sex, and laterality of pain did not prove to be of significant influence.

K-07

Delayed Diagnosis of Neurological Conditions by Primary Contact Health Care Practitioners

L. CAPUTO, M. CUSIMANO, I. STEIMAN AND S. MIOR (Toronto, Ontario)

Background: Diagnostic accuracy is essential for determining appropriate patient treatment. This study was undertaken to: a) determine the frequency of delayed diagnosis of neurological conditions by primary practitioners, and b) attempt identification of common features in these cases.

Method: Retrospective cross-sectional descriptive study. 350 records were randomly selected from a neurosurgeon's office and abstracted using a standardized form. Cases were excluded if missing information regarding presenting complaint or diagnosis by any practitioner. Cases were classified delayed if tertiary and primary practitioner's diagnoses were different. Frequency counts, cross-tabulations and Chi-square were performed.

Results: Of 62 cases entered for analysis, 50% had delayed diagnoses. Classification (correct vs. incorrect) was significantly related to location of pathology (intradural vs. extradural) (Chi-square = 6.607, 1 df, $p = .01$). Further, location of pathology was significantly related to location of patient's complaint (cranial vs. non-cranial) (Chi-square = 9.439, 1 df, $p = .02$). Advanced imaging was used by primary practitioner in 56% of cases. This was not related to delayed diagnosis, but data were unavailable for 35% of cases. The neurosurgeon used advanced imaging in 89% of cases, wich a mean (SD) of 1.683 (.983) procedures/case. CT and MRI were used more frequently than other studies.

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Conclusions: A large percentage of cases where the primary practitioner's diagnosis was known were classified delayed; however generalisability to other tertiary practitioners is limited. Lack of relationship between delayed classification and use of advanced imaging by either practitioner suggests that other factors may contribute to diagnostic difficulty. More attention to intradural pathologies in undergraduate and postgraduate education may improve diagnostic accuracy.

K-08

Neurosurgery Office Consultations: How Well are Patients Informed about the Referral?

M. BERNSTEIN, B. SALHIA, J. MICALLEF AND J. BAMPOE (Toronto, Ontario)

Background: The process of medical referral is an important component of comprehensive health care delivery.

Methods: A consecutive series of 2017 patients seen as elective office consultations by one neurosurgeon during a 92 month period ending May, 1996 was examined prospectively to see if patients understood why they had been referred and to what type of specialist. Patients seen in the emergency room, on the hospital ward, or in the specialty clinic of the senior author (Neuro-Oncology) were excluded, as were patients who were not being seen for the first time and patients who for cognitive or language reasons could not adequately participate.

Results: 52% of patients were referred by family physicians (FP's) and 48% by specialists. 62% of patients were fully informed, 35% partially informed, and 3% completely uninformed. Patients referred by FP's were significantly less well informed than those referred by neurosurgeons and all other specialists ($p < 0.004$). Patients with intracranial diagnoses were significantly better informed than those with spine and peripheral nerve problems ($p < 0.0000000001$).

Conclusions: Patients are not very well informed about their referral to a neurosurgeon. Potential explanations for these findings will be presented as well as the potential value of this study and future similar studies.

K-09

The Quality of Neurosurgical Literature: A Comparative Analysis of Study-Design in Articles Published in 1985 and 1995 from two Major Journals

B.S. JHAWAR AND A. RANGER (London, Ontario)

Background: Evidence-based medicine demands high quality research based on sound methodological principles and strong study design. Neurosurgical literature over the past ten years has been largely composed of case reports and uncontrolled case series.

Methods: A retrospective review of two major journals (Neurosurgery and Journal of Neurosurgery) was carried out for the years 1985 and 1995. The *total* number of articles and the proportion of studies of all design types were tabulated and compared between these two years for each journal.

Results: The total number of papers published (629 in 1995, 575 in 1985); clinical articles (425 in 1995, 443 in 1985); case reports (247 in 1995, 200 in 1985) and prospective controlled trials (11 in 1995, 14 in 1985). Methodology types were as follows: therapeutic (174 in 1995; 136 in 1985), diagnostic (55 in 1995, 71 in 1985), observational (41 in 1995, 32 in 1985) and review articles (12 in 1995, 8 in 1985).

Conclusions: There has been no improvement in the number of high quality articles published over the period evaluated. Case reports were the most frequently encountered study design and few studies fell into the category of prospective controlled trials. Future advances in neurosurgery require the understanding and implementation of more sound research principles.

K-10

Intraoperative Cranial Nerve Identification, EMG BAER, and CMAP Monitoring During Surgery at the Skull Base

D.W. ROWED AND D.A. HOULDEN (Toronto, Ontario)

Background: Cranial nerve injury is a possible complication of surgery at the skull base. Cranial nerve identification and monitoring techniques were employed in 38 patients undergoing surgery for evacuation of skull base neoplasm (31), nervus intermedius section (5) and vestibular neurectomy (2).

Methods: Cranial nerves III, IV, VI, VII, X and XII were selectively stimulated intracranially, and compound muscle action potentials (CMAPs) were obtained from needle eletrodes positioned in muscles innervated by the cranial nerves. Continuous monitoring of spontaneous EMG activity was also performed in selected cases.

Brainstem auditory evoked responses (BAERs, recorded from Cz-mastoid) and VIIIth nerve action potentials (NAPs, recorded directly from VIIIth nerve) were obtained after rarefaction click stimulation. A significant NAP or BAER (wave V) change occurred when amplitude decreased more than 50%.

Results: Stimulation of cranial nerves evoked appropriate muscle responses in 12 of 18 patients (67%). There were no spontaneous EMG abnormalities in the six patients who were continuously monitored.

BAERs and/or VIIIth NAPs were obtained from 19 to 20 patients (96%). Three of those had significant BAER change: one related to decreasing temperature (gradual BAER change with no recovery; no new post-operative deficits) and the other two related to surgical manipulation (sudden BAER change without recovery; new post-operative hearing loss in both).

Conclusions: Intraoperative cranial nerve identification and monitoring was possible in the majority of patients undergoing skull base surgery. BAER monitoring was useful in alerting the surgeon to manipulations that put the VIIIth at risk.

K-11

How to Split the Sylvian Fissure

J. SIDDIQI, M.G. YASARGIL AND O. AL-MEFTY (Little Rock, AR, USA)

Background: Splitting the Sylvian fissure is one of the most crucial technical challenges all neurosurgery residents face in

their microsurgical training. Being an intitial and critical step in so many different neurosurgery procedures, mastery of effective Sylvian fissure splitting is an absolute indispensable skill for micro-neurosurgery as it permits, among other advantages, easier access and greater maneuverability in the circle of Willis and perisellar regions.

Methods: The thirty years' experience of the senior author (MGY), together with an extensive review of the literature, are reviewed to arrive at the rationale of Sylvian fissure splitting. Relevant anatomical and technical aspects are discussed.

Results/Conclusions: The chief indications for Sylvian fissure splitting have been reviewed. All fissures must not be treated alike – technical modifications are critical for dealing with anatomical and lesion variability.

L. SPINAL SURGERY

L-01

Hernie discale lombaire chez l'adolescent

G. MILOT AND J. FRANCOEUR (Québec, Québec)

Documentation de base : La hernie discale chez l'adolescent est rarement rencontrée dans cette population. Elle varie de 0,8 à 3,8 % des interventions.

Méthode : À l'aide d'une étude rétrospective de dossiers nous présentons notre expérience à l'Hôpital de l'Enfant-Jésus de Québec.

Résultats : Sur les 22 patients étudiés, 21 furent soumis à une intervention chirurgicale et tous ont été améliorés par la chirurgie.

Conclusion : Le profil de ces malades, le mode de présentation ainsi que le suivi correspondent à celui de la littérature.

L-02

Posterior Cervical Stabilization Using the Ti-Frame: a Preliminary Report and Technical Note

A.B. KASSAM AND C.B. AGBI (Ottawa, Ontario)

Background: Over the last ten years a myriad of posterior cervical fusion techniques have emerged. In this report we describe our preliminary experience with the Ti-frame instrumentation for posterior cervical stabilization. The unique feature of this frame is its preshaped construct. Various sizes and angles are available obviating the need for intraoperative manipulation or construction, thereby facilitating relatively easy and quick application.

Methods: We have accumulated thirteen cases over the past year. In this series the system was employed for traumatic metastatic, and degenerative cervical spinal instability. We have utilized this technique for cranio-cervical stabilization in three cases, which we understand to be unique to our case series.

Results: As far as we are aware we have gained the most experience with this technique in Canada since its approval. We report our experience with the efficacy of this technique in achieving adequate immediate stabilization and delayed fusion rates. Our immediate stabilization rates have been 100%. To date we have had only a single malunion. This occurred in a case of a previously failed C1-C2 fusion We did not experience any operative complications.

Conclusion: Based on this preliminary experience the Ti-frame provides a safe and effective alternative for posterior cervical stabilization. A larger randomized comparative study is warranted.

L-03

Somatosensory Evoked Potential Monitoring During Surgery at the High Cervical Spine or Skull Base

D.A. HOULDEN AND D.W. ROWED (Toronto, Ontario)

Background: Surgery at the high cervical spine or skull base is associated with a relatively high risk of intraoperative neurological deterioration. We performed SSEP monitoring in 54 patients undergoing surgery at the high cervical spine (above C5) or skull base.

Methods: Median and/or ulnar nerve SSEPs were recorded from Erb's point-Fpz, neck (Cv2-Fpz) and scalp (C3'-C4'-Fpz). Posterior tibial nerve (PTN) SSEPs were recorded from the popliteal fossa, L1 vertebrae, and scalp (C3'-C4' and Cz'-Fpz). Phrenic nerve SSEPs were recorded from Cv2-Fpz and C3' or C4'-Fpz. A significant SSEP change occurred when SSEP amplitude decreased more than 50%.

Results: Fifty-three of 54 patients had reliable SSEPs obtained from at least one nerve. Two of 46 patients undergoing spinal surgery had a sudden PTN SSEP change related to spinal distraction and disk removal respectively. The SSEP recovered during surgery in both patients and they had no new post-operative neurological deficits.

Two of 7 patients undergoing surgery at the skull base had median nerve SSEP change; on e related to decreasing temperature (gradual SSEP change with no recovery; no new post-operative deficits) and the other related to tumour removal (sudden SSEP change with no recovery; new post-operative hemiplegia and incontinence).

Patients without a significant SSEP change had no new post-operative neurological deficits.

Conclusions: Intraoperative SSEP monitoring was possible in the majority of patients and was useful for alerting the surgical team to manipulations that put the nervous system at risk.

L-04

Management of Acute Odontoid Fractures

W. ZIAI AND R.J. HURLBERT (Calgary, Alberta)

In a retrospective review of 269 cervical spine fractures during a five year period, we found 42 acute fractures of the ondontoid process. There were 30 type II (71%) and 12 type III (29%) odontoid fractures. Anterior subluxation was the most common displacement. The leading cause of injury was a fall. Four patients had an associated incomplete spinal cord injury. Associated head and other cervical spine injuries occurred in 10% and 19% of patients respectively. Of the patients with type II odontoid fractures, 19 were initially managed conservatively;

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halo vest: 6, hard collar: 6, somi brace: 4, Guilford brace: 2, and soft collar: 1. The other 11 patients were treated surgically; 8 patients underwent anterior screw fixation, 3 patients underwent posterior cervical fusion. Type III odontoid fractures were all managed with external bracing (halo vest: 5, somi brace: 3, hard collar: 2, Guilford brace: 1, soft collar: 1 patient).

One patient died from unrelated medical causes. Of the remaining 42 patients, 26 were located for a median follow-up of 4.5 months (range 6 weeks - 19 months). Satisfactory restoration of bone and ligamentous stability was obtained in 73% of patients. Non-union occurred in 32% of odontoid type II fractures; dens displacement did not exceed 5 mm. Treatment failure was managed with a longer duration of (or indefinite) external bracing in three of these patients due to old age and two patients underwent successful posterior cervical fusion. Failure of instrumentation occurred in one patient following anterior screw fixation when she tore out the screws with an episode of acute respiratory distress requiring intubation. Replacement of a single screw did not provide complete stability. Non-union occurred in one patient (14%) with a type III odontoid fracture which was initially displaced 8 mm anteriorly. This patient was placed in Guilford brace for one month with successful fracture union.

Our results indicate that conservative management of odontoid fractures with external bracing result in fracture healing in most cases. Surgery should be reserved for cases of non-union or loss of reduction in the halo vest.

L-05

Segmental Reconstruction of the Thoracic Spine with Pedicle Screws: Review of Results with Long Term Follow-up

M.G. FEHLINGS AND M. THOMPSON (Toronto, Ontario)

Background: Despite the current trend for broader acceptance of pedicle screw fixation, the use of thoracic pedicle screws is controversial due to concerns regarding technical complexity and neurological complications. We present our experience in managing thoracic spinal instability with pedicle screw reconstruction.

Methods and Results: This series includes 17 patients (mean age 45; 10M, 7F) treated with spinal instrumentation incorporating thoracic pedicle screws for trauma (n = 10), metastatatic tumour (n = 4), degenerative disease (n = 2) and ostemyelitis (n = 1). Average postoperative follow-up was 2 years (range 12-48 mo). Indications for thoracic pedicle screw fixation included: a) disease bridging the cervicothoracic or thoracolumbar junction b) three column instability of the thoracic spine c) combined anterior/posterior approaches for kyphotic angular deformity d) simultaneous posterior/posterolateral decompression and reconstruction. Patients were positioned on a radiolucent Jackson table and thoracic pedicles were cannulated with AP and lateral fluoroscopy. Reconstruction levels included cervicothoracic (n = 1); thoracic (n = 7); thoracolumbar (n = 8); thoracolumbosacral (n = 1). The longest segment fixed with pedicle screws was 8 levels (T10-L5) and the longest construct was 12 levels (C6-T10). In long term follow-up, we did not experience any cases of screw fracture or pull-out. There were no neurological complications. All patients achieved satisfactory construct stability.

Conclusions: We conclude that disorders involving or bridging the thoracic spine can be safely and effectively treated with pedicle screw fixation.

L-06

Post Traumatic Syringomyelia: the Changing Scene

D. FAIRHOLM (Vancouver, British Columbia)

Historical treatments of post traumatic syringomyelia have been based on an uncertain understanding of the pathophysiology of the condition. Current understanding suggests that post traumatic subarachnoidal scarring at the site of injury causes an obstruction of the subarachnoid fluid pathways which causes fluid to enter the substance of the cord eventually resulting in a syrinx cavity.

The management of post traumatic syringomyelia has evolved over the past 30 years through a variety of shunting procedures which have met with limited success. The present management is based on the current understanding of the pathophysiology and relates to release of arachnoidal scarring, restoration of subarachnoid space and elimination of obstruction to flow of cerebral spinal fluid.

The author reviews the experience at the University of British Columbia where a total of 38 cases of post traumatic syringomyelia have been managed in the past 12 years. Ten syringo-subarachnoid shunts were performed with an effectiveness and patency of 30%. A total of 35 primary or secondary syringo-peritoneal shunts have been performed with effectiveness and patency in approximately 70%. There was surgical worsening in 3 patients, a peculiar delayed neurological deficit in 4, and infection in 2. Recent experience of 10 patients with restoration of subarachnoid space has a follow-up of less than 2 years and no conclusions can yet be drawn.

The current management of this condition is excision of scar tissue and restoration of the subarachnoid space. Ongoing follow-up of these cases will determine its effectiveness.

Poster Presentations

EPILEPSY

P-001

Aberrant Responses to Anticonvulsants; the Carbamazepine Story

M. STEFANELLI, S. PENNEY AND A.N. PRASAD (St. John's, Newfoundland)

Background: Unexpected exacerbation of seizures as an aberrant reaction to initiation of Carbamazepine (Cbz) may be an important cause of treatment failure. We reviewed the occurrence of such reactions in our patient population.

Methods: A retrospective analysis of our clinic database identified 129/691 (16.6%) patients with epilepsy, in whom Cbz was chosen as monotherapy. 38/129 children switched to another drug for various reasons. In 11/38 (28.9%) clinical and or electrographic deterioration occurred. We report on the findings in these 11 cases.

Results: Two groups identified amongst the 11 patients. Group I- Normal neurological exam, normal EEG background, and primary generalized epilepsy (IGE) [4 cases]. In this group, 2/4 patients developed multiple prolonged absences and 2/4 developed absence status. Group II- Abnormal Neurological exam and abnormal EEG [7 cases]. EEG abnormalities included a diffusely abnormal background (7/7), GSSW (generalized slow spike wave) in (3/7) or multifocal epileptiform abnormalities (4/7). Seizure types at onset included; complex partial seizures with or without secondary generalization (4/7), atypical absences (2/7) and febrile seizures (1/7). Diverse etiologies identified in this subgroup. Seizure exacerbation resulted in emergence of new seizure types; "drop attacks" (2/7), myoclonic jerks (2/7) and nonconvulsive status (2/7). One case showed profound EEG deterioration without seizure exacerbation. Both groups showed dramatic improvement in seizure control on Cbz taper and substitution with another anticonvulsant.

Conclusion: Aberrant responses to Cbz are an important cause of treatment failure. It is recommended that patients on Cbz with worsening seizures be assessed for such reactions. Dramatic benefit can be achieved by substitution with an alternative anticonvulsant.

P-002

Myoclonic Stupor Associated With Triphasic Waves During Lithium Intoxication

A. OGUNYEMI, D. ADAMS† AND G. MARCHE† (St John's, Newfoundland; Corner Brook, Newfoundland†)

Background: Neurological complications predominate in patient with lithium intoxication. Unconsciousness, seizures, cerebellar signs and based ganglia disturbances have been described. We are unaware of previous reports describing the occurrence of triphasic waves in the EEG of patients with lithium intoxication.

Methods: This 50 year old man with a history of bipolar illness was found to be confused in his apartment and brought to the hospital. General medical examination, neurological examination and detailed haematological, biochemical and toxicological laboratory testing were performed. CT scan of the brain and serial EEG recordings were also obtained.

Results: The general medical examination revealed normal vital signs. On neurological examination, he was stuporous and showed generalized and multifocal myoclonic jerking. When aroused, there was no coherent speech but he grunted some sounds. Asterixis was demonstrated in his upper limbs.

The haematological and biochemical testing and blood gases were normal. Toxicological testing only demonstrated plasma lithium level of 5.5 mEq/L. He was treated with haemodialysis.

The first EEG recording obtained when the plasma lithium was 2.2 mEq/L revealed generalized, bisynchronous triphasic waves. Serial EEG recordings correlated much more closely with his clinical states than did serial plasma lithium levels. He recovered fully.

Conclusion: Our patient with severe lithium intoxication presented with myoclonic stupor. His EEG recordings demonstrated triphasic waves. Serial EEGs correlated much better with his clinical states compared to serial plasma lithium levels.

P-003

Late Onset Primary Generalized Seizure Disorder

A.M. WONG AND A.O. OGUNYEMI (St. John's, Newfoundland)

Background: Onset of primary generalized epilepsy is uncommonly reported in the adult population. Scant literature exists that describes the clinical presentation in this age group.

Methods: This report concerns 4 patients aged > 40 years who were referred to our institution between Dec. '95 and Nov. '96 presenting with recent onset of episodic confusion, unresponsiveness, and blackouts. Neurological examination, haematological and biochemical testing, CT scan of the brain and EEG recordings were performed.

Results: The four women were 42, 57, 75 and 79 years of age. Three had generalized tonic clonic seizures and one had generalized non-convulsive seizures. Interestingly, the two older women in this case series had a delay of 1 year to 1 month before presenting to neurology clinic while they were being investigated for other causes of their symptoms. None had history of infection, stroke, metabolic disturbance, head injury, or alcohol withdrawal. One subject had mild developmental delay with CT showing long-standing cerebellar atrophy. The other subjects had normal CT scans. All had EEGs consistent with primary generalized epilepsy showing photoparoxysmal responses in two and generalized bi-synchronous spike and slow wave discharges in the others. All subjects responded well to either Dilantin or valproic acid.

Conclusion: Although uncommon, primarily generalized seizures should be considered as a cause of unconsciousness even among middle-aged and elderly patients without prior history of seizures. EEG with photic stimulation may yield diagnostic results.

P-004

Lamotrigine Induced Insomnia and Stuttering

R.M. SADLER (Halifax, Nova Scotia)

Introduction: Relatively unique or unusual adverse effects caused by new antiepileptic drugs are encountered as clinicians gain experience with these medications. Although the Canadian

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product monograph for lamotrigine (ltg) lists "insomnia" and a "speech disorder" as adverse events (< 6% of patients) these effects have rarely been described in published overviews of ltg. Recent experience with ltg induced insomnia and speech deterioration prompted an evaluation of these symptoms.

Methods: Medical records of all patients attending an adult epilepsy outpatient clinic since 1994 were reviewed. Ltg exposed patients' charts were examined to determine the development of insomnia or a speech disturbance after commencing ltg therapy.

Results: Among 63 patients treated with ltg, 3 patients developed severe insomnia (all patients reported less than 3 hours sleep per night). In 2/3 the insomnia necessitated drug withdrawal; 1 patient's insomnia resolved without dose adjustment over 2-3 weeks. Two patients (both with preexisting speech disturbances) had a substantial worsening of language function manifest by increased stammering and stuttering speech after ltg introduction; one patient's speech became unintelligible but resolved when ltg was stopped.

Conclusion: Severe insomnia and speech disturbance are unusual but easily recognized complications of ltg therapy that may require drug discontinuation.

P-005

Periventricular Nodular Heterotopia and Intractable Temporal Lobe Epilepsy: Contribution of Heterotopic Gray Matter Nodules to Epileptogenesis

E. DUBEAU, L.M. LI, F. ANDERMANN[1], D.R. FISH[2], C. WATSON[3], G.D. CASCINO[4] AND S.F. BERKOVIC[5] (Montréal, Québec[1]; London, England[2]; Detroit, Michigan, USA[3]; Rochester, New York, USA[4]; Melbourne, Australia[5])

Background: Patients (pts) with periventricular nodular heterotopia (PNH) can present with seizures suggesting temporal lobe epilepsy (TLE) and often refractory to medication (Dubeau et al., Brain 1995; 118: 1273). Temporal lobe removal alone does not lead to long term favorable outcome in this group of pts (Li et al., Ann Neurol 1997: *in press*).

Methods: We reviewed surface and intracranial EEG data of 10 pts with PNH and intractable TLE. Nine underwent temporal lobe resection. Six had intracranial depth electrodes evaluation, including one with recordings obtained from an ectopic gray matter nodule. Another had peroperative ECoG recording of a nodule.

Results: On MR imaging, PNH were bilateral in 7/10 pts. Interictal scalp EEG showed temporal spiking in all, and additional abnormalities were seen overlying the nodules in 4/10. Ictal scalp onset was temporal in 6 pts (3 bilateral), unilateral temporo-occipital in two, bilateral fronto-temporal in one, and hemispheric in one. Intracranial recordings confirmed temporal lobe onset in five pts but no independent activity could be seen in the heterotopic gray matter.

Conclusions: It is not yet clear if PNH are epileptogenic on their own or if they represent a marker of a widespread epileptogenic condition. As in pts with hypothalamic hamartoma findings pointing to temporal lobe origin are misleading, and epileptogenic activity may originate in or near PNH.

P-006

Latitude-Dependent Amplitude Variations of the Alpha Rhythm Oscillation

M.A. CORTEZ AND X.A. CASTRO* (Toronto, Ontario; Quito, Ecuador*)

Background: Photoperiodic entrainment may be responsible for the gradual development of the alpha rhythm from infancy to adolescence. Photoperiod (PP) depends on latitude, however latitudinal differences in the oscillation morphology of the alpha rhythm has not been reported.

Methods: Pilot study of normal EEG occipital oscillations obtained in two groups of adolescents (N=20), age range from 12 to 15 years, from two latitudes with marked photoperiodic differences: 43° 40' North Latitude and 0° 0' Latitude (Equator), to determine the correlation between the alpha rhythm oscillation morphology and the photoperiodic oscillations derived for those latitudes.

Results: Environmental (PP) oscillations derived for two geographical locations (Toronto, Quito) were ascertained. The photoperiodic oscillation at 43° North Latitude presented amplitude variations. (PP) oscillation at the Equator showed no significant amplitude variation of the photoperiod. EEG oscillation morphology in the northern latitude group showed similar amplitude variations in 95% of the cases. EEG oscillation in the Equator group presented no amplitude variation in all cases.

Conclusion: Photoperiodic and occipital EEG oscillations showed latitude-dependent morphological differences. Amplitude variation of the alpha rhythm oscillation may be photoperiod dependent.

P-007

A Case of Familial Band Heterotopia

J. KOBAYASHI AND S. MURRAY (Toronto, Ontario)

We report the clinical and neuroimaging findings of a mother and daughter with a similar presentation. Both child and mother exhibited mild global developmental delay and cognitive functioning below average beginning in infancy. Mother subsequently went on to develop a seizure disorder in her teenage years. Her child has had no evidence of seizure activity as yet and is now 5 years of age. The maternal grandmother was unaffected but the maternal grandfather is cognitively slow and has a seizure disorder. He was unable to be consented for an MRI.

MRI on both mother and child revealed diffuse band heterotopias and ventricular enlargement. There were no other brain abnormalities. Neither mother or child had dysmorphic facies or any other features consistent with syndromal diagnosis. Cytogenetics and molecular studies were unremarkable.

Review of the literature led to the discovery of only one other case of familial band heterotopia. Of interest is that this case also involved a mother and daughter. Six other cases of band heterotopia have been reported, but none familial. As a result, this represents a rare case of familial band heterotopia.

P-008

Vagal Nerve Stimulation: the Relationship Between Current Intensity and Seizure Control After 5 Years of Stimulation

B.M. CLARKE, A.R.M. UPTON AND H. GRIFFIN (Hamilton, Ontario)

Background: Vagal nerve stimulation (VNS) has been shown to be an important adjunctive treatment in controlling seizures in epileptic subjects (S) with intractable complex partial seizures. High frequency stimulation at 30 Hz, 500 μsec has produced a greater effect than low frequency stimulation 1 Hz, 130 μsec. The relationship between current intensity and seizure control was assessed after 5 years of VNS.

Methods: Seizure records were recorded in diaries by 10 subjects implanted with a left vagal nerve stimulator (Cyberonics Inc. Texas, U.S.A. and Medtronics Canada) who received VNS for 6 years. There were 9 complete data sets because one subject died of unrelated causes. Seizure data were plotted against increases in stimulator current intensity.

Results: In 6/9 S, the total number of seizures/month decreased as the stimulation current intensity increased. In 2/9 S, total number of seizures decreased but current intensity remained constant. In 1 case, there was no change in total number of seizures with an increase in current. Pearson correlation coefficients between seizure frequency and current intensity were: –.85, –.59, –.47, –.46, –.39, –.33, –.24, .54 and 0 with statistical significance of the correlation coefficients @ $P < .001$ for 6/9 subjects.

Conclusion: There is an inverse relationship between total number of seizures and stimulator current intensity of vagal stimulation.

P-009

Continuous EEG Monitoring in the Intensive Care Unit: A Technology Assessment

G.B. YOUNG AND J.D. KAY (London, Ontario)

Objective: To describe the methodology of a cost-effectiveness technology assessment trial assessing whether Continuous EEG Monitoring (CEEG) of comatose patients alters the outcome of hospital stay.

Background: CEEG is a new technology for monitoring cerebral cortical activity in patients in the Intensive Care Unit (ICU). Previous studies have shown that CEEG can detect abnormalities in cerebral activity, and is particularly useful in detecting non-convulsive seizures. However, before the use of this technology becomes widespread, it should be studied rigorously to define its usefulness.

Methods: We are conducting a technology assessment clinical trial comparing CEEG monitoring to a standard care in ICU patients with depressed level of consciousness. Patients are included if they are intubated and do not obey commands. They are then stratified into two groups with Glasgow Coma Score less than or equal to 8 or greater than 8. Patients in whom coma is attributable primarily to sedative drugs, metabolic or septic encephalopathy are excluded. Eligible patients are randomized to either standard care in the ICU or standard care plus at least 48 hrs. of CEEG. CEEG is monitored at the bedside by the ICU nurse, and in the EEG lab by the electroencephalographer. Significant findings are reported immediately to the attending ICU physician. Outcome in the CEEG and control groups is compared with the following measures: Length of stay in the ICU and hospital, mortality rates, mailed quality of life questionnaire to the survivors, and cost of care.

Results: To date 77 patients have been entered of whom 37 have been randomized to receive CEEG. The etiology of coma was trauma (23), anoxia (19), intracranial hemorrhage (11), ischemic stroke (6), status epilepticus (4), and other (14). The trial is ongoing and an estimated 243 patients will be needed to provide adequate statistical power.

Conclusions: CEEG is a new technology for monitoring cerebral cortical activity in comatose patients. CEEG has been shown to alter decision making in the ICU. However, CEEG has not yet been shown to alter the outcome of such patients. We propose that new technologies be subjected to controlled clinical trials prior to widespread use in clinical practice. Such trials are feasible and will provide insight into the optimal use of new technologies.

P-010

Outcome of Focal Resections in Patients With Non-Lesional Intractable Seizures

G.R. GANAPATHY, W.T. BLUME AND D. MUNOZ (London, Ontario)

Resective surgery yields the best results in patients with refractory seizures due to focal cerebral lesions. The outcome of surgery in patients without specific lesions has not been adequately documented.

Seven hundred thirty-five patients underwent focal resections (temporal and extra-temporal) for intractable seizures at University Hospital, London, Ontario between 1974 and 1995. Histological examination failed to reveal a specific pathology in 120 of these. Eighty-three had standard anterior temporal lobectomy, 6 temporal neocortical resection, 26 frontal, 4 parietal and 8 occipital lobectomies. Seven of these had multilobar resections. Sixty-nine of these were males and 51 females. Their ages ranged from 6 to 56 years.

We present a retrospective analysis of seizure outcome in these 120 patients with non-specific histology.

P-011

Reading Epilepsy Due to Brain Injury

P. PATHAK, G.R. GANAPATHY AND S. WIEBE (London, Ontario)

Background: Reflex reading epilepsy is uncommon. We describe a unique case secondary to brain injury.

Methods: Continuous scalp EEG and clinical observation were obtained while patient was in repose, read English and a foreign language, aloud and silently, named objects, wrote English sentences, and performed written arithmetic. Brain MRI was performed.

Results: A 26 year old male suffered a head injury resulting in coma for six weeks. Eight weeks after trauma, he developed

left frontocentral simple partial sensorimotor seizures. These seizures occurred either spontaneously or were initiated by reading. There was no history of seizures prior to head injury.

On EEG, reading aloud or silently activated left frontocentral spikes (F3-C3) accompanied by right upper lip paresthesiae and twitching. Both ceased abruptly when patient stopped reading. The following did not evoke spikes or clinical seizures: confrontation naming, reading a foreign language, writing English or performing written arithmetic.

MRI of head revealed post-traumatic encephalomalacia over the left frontotemporal regions.

Conclusion: To our knowledge, this is the first reported case of reading epilepsy due to brain injury.

P-012

Seizure Induced Atrial Fibrillation

M. SUNDARAM (Jackson, Mississippi, USA)

Background: Seizures are known to induce tachycardia, bradycardia and ST changes. We now report, for the first time, atrial fibrillation precipitated by complex partial seizure.

Case History: This 33 year old patient with intractable epilepsy was undergoing scalp telemetry monitoring. He was in sinus rhythm on admission. A single complex partial seizure was recorded with clinical and EEG data suggesting a probable mesial frontal focus. Approximately 30 minutes after the seizure, he complained of chest discomfort and an ECG showed atrial fibrillation with a ventricular rate of 120 to 130. There was no laboratory evidence of hypoxia or myocardial infarction. He reverted to sinus rhythm in app. 24 hours with oral quinidine.

Conclusion: Symptomatic atrial fibrillation should be included among seizure induced arrythmias. Possible mechanisms will be discussed.

PEDIATRIC EPILEPSY

P-013

Recurrent Absence Status Associated with a Cerebellar Vermis Tumour in a Child

L. SADLEIR, K. FARRELL AND A. HILL (Vancouver, British Columbia)

Cerebellar tumours have been reported to be associated with generalized 3 Hz spike-wave (S-W) discharges. We describe a child with a cerebellar tumour who had recurrent episodes of nonconvulsive status epilepticus.

This eleven year old girl had three episodes of acute confusion, lasting between two and ten hours, which occurred over an eleven month period. She had a history of migraine headaches but was otherwise normal. There was a family history of migraine but not of epilepsy. MRI brain scans, performed following the first and third episodes, demonstrated an enlarging tumour in the superior cerebellar vermis. An EEG performed two hours after the third episode demonstrated 35 bursts of generalized 3-4 Hz S-W lasting 4 to 10 seconds. Eight were associated with clinical change. A diagnosis of absence status was made and the seizures have been controlled on valproic acid.

3-4 Hz S-W discharges have been reported previously in association with cerebellar tumours. In our patient, the tumour has increased in size. Furthermore, nonconvulsive status epilepticus is uncommon in children, even in those with idiopathic generalized epilepsy. Consideration of these factors increase the possibility of a causal relationship between the seizures and the cerebellar tumour.

P-014

The Value of Standard Electroencephalograms in Apnea in the Premature Neonate

G.B. YOUNG, O. DA SILVA AND G.M. COLLADO GUZMAN (London, Ontario)

Background: Advances in neonatal care have improved survival of low birth weight babies. Apnea, defined as absence of respiratory effort for > 20 seconds, is common in such infants. Concern that such apneic spells represent seizures leads to frequent requests for electroencephalograms (EEGs). We reviewed our cases to assess the value of EEGs in the evaluation of apnea in premature newborn infants.

Methods: This is a retrospective review of hospital charts and EEG recordings of patients studied in a major neonatal intensive care unit. We included only prematures with apneic spells and excluded those with overt, clinically recognized seizures.

Results: Of 94 infants studied, 24 were premature with recurrent apneas and bradycardia without clinically overt seizures. Of these, EEGs were normal in 15; 9 showed excessive or atypical interictal epileptiform discharges. None showed seizures. In no case did the results of the EEGs affect clinical management.

Conclusion: In our limited study, we have not found discontinuous, standard EEGs to be of value in the investigation and management of apnea in premature neonates.

P-015

Cryptogenic Infantile Spasms: Seizure Onset Susceptibility in Low Solar Radiation Months

M.A. CORTEZ (Toronto, Ontario)

Background: Timing of seizure onset in symptomatic infantile spasms is not random, annually.[1] Timing of seizure onset in cryptogenic infantile spasms (CIS) remains to be determined.

Methods: Retrospective review of 32 (CIS) cases diagnosed between 1985-1995 at the hospital for Sick Children. Seizure latency from birth and circannual (about a year) clustering pattern were determined on a global solar radiation (GSR) histogram derived for 43°40' North Latitude (Toronto).

Results: Of 17 females and 15 males, 32 (CIS) onsets between 2 to 12 months (mean ± SD = 5.4 ± 2.1). Seizure onsets under 6 months occurred in 24 (75%) and 8 over six months (25%): 20/24 onsets under 6 months (83%) occurred below 41.36% (GSR), and 4 onsets (17%) between 79-100% (GSR). 4/8 onsets over 6 months (50%) occurred below 43.36% (GSR). Out of 21 acrophase births there were 2 acrophase, 8 mesor and 11 nadir seizure onsets (mean ± SD = 7 ± 4.5), $x^2 = 6$, df = 2, ($p < 0.05$). Out of 6 mesor births there were 3 acrophase, 1 mesor and 2 nadir seizure onsets (mean ± SD = 2 ± 1), $x^2 = 1$, df = 2,

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(0.5). Out of 5 nadir births there were 2 acrophase and 3 mesor seizure onsets (mean ± SD = 2.5 ± 0.7), x^2 = 1.3, df = 2, (0.5). (Bi-monthly mean seizure onset = 5.3 ± 3), x^2 = 64, df = 5, ($p < 0.001$), (x^2 test).

Conclusion: Seizure susceptibility in (CIS) is 5-fold higher in low (GSR) months. A prospective study on the timing of seizure onset in infantile spasms is proposed.

[1]Cortez M.A., et al. Infantile Spasms and Natural Light. Epilepsia 1995; Vol. 36, Suppl. 4: 128.

P-016

Nocturnal Paroxysmal Dystonia (NPD) in Children: a Partial Epilepsy Syndrome with Frontal Lobe Seizures or Sleep Disorder

D.L. MacGregor and W.J. Logan (Toronto, Ontario)

Background: NPD is described as complex motor attacks occurring abruptly during sleep. There can be dystonic posturing, tonic limb and trunk movement, automatisms and vocalizations. Short duration and more prolonged events are described. EEG, has been reported in some patients to demonstrate epileptic activity from the mesial frontal regions. There is good response to Carbamazepine or Clonazepam.

Methods/Results: A 13 year old boy presented for review of his long standing epilepsy having had no seizures reported for 2 years maintained with good therapeutic levels on Carbamazepine and Primidone. Onset had been at 11 weeks of age with intractable seizures from 6 months of age and a significant episode of status epilepticus at 9 months. Neurological examination was normal except for cognitive delay. At 10 years of age, his parents began describing "night startles" – having fallen asleep, he would sit upright, appear panicked (later describing that he felt "scared"). EEG showed excessive slowing with bifrontal independent epileptiform discharges, more active on the right.

Overnight sleep study showed 2 arousals from slow wave sleep during which he displayed dystonic posturing, choreoathetoid movement of the right arm and head rotation lasting 1 minute with ending in confused wakefulness. EEG with expanded frontal temporal montage did not detect sleep related seizure activity. Addition of Clonazepam to his treatment regime resulted in a marked reduction in the frequency and intensity of these nocturnal events.

Conclusion: The occurrence of the nocturnal events described in this child indicate intractable epilepsy even with a non-epileptic EEG. NPD has been considered either a sleep disorder or nocturnal epileptic seizrues of frontal lobe origin. Recognition of these events as epileptic will allow appropriate diagnosis and therapy.

P-017

Predicting Outcome in Children and Adolescence Undergoing Surgical Treatment for Refractory Epilepsy

M. Gashlan, D. Keene and E. Ventureyra (Ottawa, Ontario)

Background: Surgery for management of childhood epilepsy has been shown to be successful in reducing seizure frequency. The question is which patient will benefit from surgery.

Methods: A retrospective analysis of charts of 64 patients with medically refractory epilepsy who underwent 64 procedures in an attempt to control their epilepsy. All patients had to have the initial surgery at the Children's Hospital of Eastern Ontario and have had at least two years follow-up data available. Different variables included: age of seizure onset, sex, age of surgery, family history, etiology, EEG, imaging studies, CNS examination, intellect, seizure description, site and side of surgery and duration of seizures prior to resection.

Results: In temporal lobe resection group the statistically significant variable for good outcome was tumour as an etiology. Diffusely abnormal CNS examination and intellect for poor outcome. The extratemporal resection group has diffusely abnormal CNS examination and mental retardation predictors for poor outcome.

Conclusion: The current predictors of outcome of epilepsy surgery are mainly used in adults and may not apply to children.

P-018

Recurrent Seizures in Metachromatic Leukodystrophy (MLD)

T. Balslev, M. Cortez, S. Blaser and R.H.A. Haslam (Toronto, Ontario)

The unusual presentation of juvenile onset MLD and frequent complex partial seizures in a patient prompted us to perform this retrospective study of 18 patients with MLD, to identify the prevalence and type of recurrent seizures during the first two years of the disease. Five of 17 patients (29%) had developed recurrent seizures within 12 months of the onset of symptoms, and one patient was lost to follow-up. By 24 months of onset of symptoms, 5 patients were lost to follow-up, and 6 of the remaining 13 patients (46%) had developed recurrent seizures. A total of 7 patients, 4 with late infantile onset and 3 with juvenile onset of disease, developed recurrent seizures. Four patients, including 3 with juvenile onset disease had complex partial seizures. We conclude that recurrent seizures are common in MLD and may occur at any stage of the disease, particularly in patients with juvenile onset. Generalized seizures are more commonly seen in patients with late infantile onset, whereas partial seizures are seen more frequently with juvenile onset of the disease.

CHILD NEUROLOGY

P-019

Allgrove Syndrome – A Rare Multisystem Neurodegenerative Disorder in Childhood

D. Hewes, R. Rothstein and E.H. Roland (Vancouver, British Columbia)

Background: Allgrove syndrome is comprised of alacrima, achalasia and sensorimotor polyneuropathy with insensitivity to ACTH. Neurological features include autonomic dysfunction,

pyramidal and extra pyramidal tract abnormalities, brainstem dysfunction and sensorimotor polyneuropathy all of which can be explained on the basis of progressive degeneration of cholinergic neurons. We report the clinical features, neuroimaging and electrodiagnostic studies of a girl with this rare multisystem neurodegenerative disorder.

Case Report: A Caucasian girl developed Addison's disease at 3 years of age. By 12 years she had alacrima, achalasia, educational difficulties, and autonomic dysfunction with syncope and postural hypotension. She developed visual loss, incoordination, tremor and had mild mental handicap. Neurological examination revealed optic atrophy, spasticity and incoordination, positional tremor, distal limb weakness and sensory abnormalities.

Investigations: Visual evoked responses had delayed latency bilaterally, auditory evoked responses suggested auditory nerve dysfunction. MRI scan of the head and spine, electroencephalogram, cerebrospinal fluid examination and biochemical investigations were normal. Nerve conduction studies confirmed a demyelinating sensorimotor neuropathy.

Conclusion: This child demonstrates the features of Allgrove syndrome which is a rare multisystem neurodegenerative disorder of childhood associated with endocrine dysfunction secondary to cholinergic dysfunction.

P-020

Breath-holding Spells: An Unusual Case Associated with Lead Toxicity

D. HEWES, G. LOCKITCH AND E.H. ROLAND (Vancouver, British Columbia)

Background: Breath-holding spells are common in early childhood and are usually benign. A ten week old infant presented with frequent, cyanotic breath-holding spells and toxic blood lead levels.

Case Report: The infant was the first child of unrelated Armenian parents. The birth history and neonatal period were unremarkable. At two weeks he developed classical cyanotic breath-holding spells which increased in frequency to 25 times per hour. Neurological examination and development were normal apart from irritability. Investigations were undertaken because of early onset and increasing frequency of the spells.

Investigations: Electroencephalogram, barium swallow, electrocardiogram and MRI of the head were normal. Hemoglobin was 95 g/l (slight anisocytosis, occasional hypersegmented polymorphonuclear leukocytes). Blood lead levels were elevated: 2.48 and 2.4 µmol/L (normal < 0.48 µmol/L). Zinc protoporphyrin > 600 µmol ZPP/mol (normal < 70). After intravenous Calcium Disodium EDTA for five days, the breath-holding spells resolved. Blood lead levels were elevated in all family members. The source was a traditional lead kettle used to boil water.

Conclusions: Lead toxicity is a known cause of neurological dysfunction in childhood. However, to our knowledge, it has not been reported in association with breath-holding spells. Possible mechanisms include direct cerebral toxicity or secondary to pain from abdominal discomfort.

P-021

Early Developmental Delay Due to Cobalamin (Vitamin B_{12}) Deficiency in an Exclusively Breast Fed Infant of a Vegan Mother

L. SADLEIR, M. DELEVIE AND M. CONNOLLY (Vancouver, British Columbia)

Background: Nutritional Vitamin B_{12} deficiency in infancy is rare outside India. Spinal cord involvement is rare in infants who usually present with developmental regression and megaloblastic anaemia. We report an infant with developmental delay from two months of age.

Case History: A 21 month male was referred with hypotonia and delayed development. His mother was a vegan who took no vitamin supplementation during pregnancy and lactation. The infant was breast fed exclusively. Subsequently, a vegan diet was introduced without vitamin supplements. Examination revealed truncal hypotonia, limb hypertonia, hyperreflexia and developmental function at the 10 month level.

Investigation revealed macrocytosis without anaemia, Vitamin B_{12} level of 62 pmol/L (110-500 pmol/L normal range), elevated plasma homocysteine, and methylmalonic aciduria. MR imaging of the brain showed delayed myelination. Maternal Vitamin B_{12} was 127 pmol/L. Treatment with Vitamin B_{12} improved development, but at 30 months of age, function was at the 18-24 month level.

Conclusion: Presentation is unusual in that symptoms began at 2 months of age. It is probable that there was inadequate Vitamin B_{12} availability in utero, and from breast milk. This preventable cause of injury to the nervous system should be considered in vegetarian/vegan mothers.

P-022

Anti-Purkinje Cell Antibodies in Childhood Post-Varicella Acute Cerebellar Ataxia

C. ADAMS, P. DIADORI AND M.J. FRITZLER (Calgary, Alberta)

Background: Anti-Purkinje cell antibodies have been reported in cerbellar ataxia following Epstein-Barr virus (EBV). We investigated Purkinje cell and other autoantibodies in post-varicella ataxia.

Methods: Purkinje cell antibodies from serum were tested by indirect immunofluorescence (IIF) on cryopreserved monkey cerebellum sections and other autoantibodies were measured by conventional IIF protocols using HEp-2 cells as a substrate. Antibodies to myelin associated glycoprotein (MAG) were measured by ELISA.

Results: Four of 7 children with acute post-varicella ataxia had high titer autoantibodies that reacted with cerebellar tissue but none had Purkinje cell specific antibodies. Purkinje cell antibodies were also negative in CSF from 2 children. All patients with strong reactivity with cerebellar tissue by IIF had elevated levels of anti-MAG. Purkinje cell antibodies were negative in a child with ataxia following EBV, in 2 with acute disseminated encephalomyelitis (ADEM) and in one with ataxia and ganglioblastoma. None had anti-Golgi or other organelle-specific autoantibodies on HEp-2 substrates.

Conclusion: Our study does not confirm that anti-Purkinje cell antibodies are a serological feature in children with post-infectious ataxia. Of interest, some children develop antibodies that have strong reactivity with cerebellar tissue and these tend to accompany antibodies directed against MAG.

P-023

Mitochondrial Respiratory Chain Defect as a Cause of Pervasive Developmental Disorder in a Sibling Pair

S.D. LEVIN, B.A. GORDON, J.B. KRONICK, C.A. RUPAR, A.M. FOX AND D.A. RAMSAY (London, Ontario)

The male proband was developmentally delayed from infancy, appeared "very shy" from early childhood and at 10 years was diagnosed with atypical pervasive developmental disorder. When assessed at 15 years there was little social interaction and no eye contact, cognition was at a 6 year level, there was marked generalized muscle wasting, especially of the hands, bradykinesia and mild hip girdle weakness. His sister, 2 years older, demonstrated similar but significantly milder findings. Family history was unremarkable and the past medical history for both patients non-contributory.

In the proband MRI and EMG were normal. EEGs on several occasions showed only occasional spikes posteriorly. CK 801 u/L, blood lactate 1.7 μmol/L, CSF lactate 1.95 μmol/L and pyruvate 0.082 μmol/L – all normal. Muscle biopsy findings in both patients were the same with subsarcolemmal, faintly basophilic granules which stained brightly magenta on modified Gomori trichrome stain. True "ragged red" fibres were not seen. EM demonstrated abnormally large mitochondria with haphazardly arranged cristae and the mitochondrial cytosol was unusually dense with dark intramitochondrial particles. Mitochondrial respiratory chain enzyme assay demonstrated normal activity of the mitochondrial marker enzyme citrate synthase and all complexes except complex IV with cytochrome oxidase activity 20% of the normal mean. In a second biopsy 2 years later activities of complexes I-III and II-III were at the lower limit of normal. Mutation analysis looking at $A_{3243} \rightarrow G$, the MELAS mutation was negative.

P-024

Congenital Malformations Related to Maternal Exposure to Chemotherapy During Early Intrauterine Development: a Case Report and Review of Literature

M. ABDULHAK, R.F. DEL MAESTRO AND D. MATSUI (London, Ontario)

Background: Females are at times inadvertently exposed to chemotherapy during pregnancy. We report a case of a 36 year old female diagnosed with non-Hodgkins lymphoma who received four courses of CHOP (cyclophosphamide, doxorubicin, vincristine, and prednisone) chemotherapy during her first trimester of pregnancy.

Methods: Intrauterine ultrasound identified the presence of progressive ventriculomegaly. The child was delivered by elective C-section at 38 weeks of gestational age.

Results: At the time of birth the child had a number of congenital malformations including: 1) microcephaly, 2) ventriculomegaly secondary to aqueduct stenosis, 3) dysmorphic features involving the feet (lack of one digit on each foot and syndactyli) and 4) an aborted dermal sinus in the sacral region. First trimester cyclophosphamide exposure has been associated with skeletal and palate defects, as well as malformations of the limbs and eyes (estimated risk 1 in 6). Doxorubicin has been reported to cause a missing digit on one foot (seen in an aborted fetus). Vincristine and prednisone exposure usually do not result in congenital malformations. Although a number of congenital abnormalities have been seen after intrauterine exposure to chemotherapeutic agents in the first trimester, this constellation of malformations has not been previously reported.

Conclusions: Females inadvertently exposed to chemotherapy during pregnancy should have genetic counselling and intrauterine ultrasounds may provide useful information related to the decision to terminate pregnancy. The delivered infants need careful genetic assessment and follow-up.

P-025

Segmental Neurofibromatosis in a 3 Year Old Boy

E.A. MACDONALD AND R.M.L. SMITH (Kingston, Ontario)

A 10 month old boy with delayed walking was found to have congenital pseudoarthrosis of the left tibia. In the next 5 months progressive deformity of the left foot with development of a "rocker bottom foot" was noted. At 16 months he was recognized to have hyperpigmentation in the dermatomes caudal to L1-2 bilaterally and was diagnosed with neurofibromatosis. Ultrasound examination and subsequent MRI scan of the abdomen revealed extensive involvement of the lumbar-sacral plexuses with massive neuromas, extending into the groin on the right. Repeat examination at age 2 showed an increase in the size of the masses, without features of malignancy.

Family members affected with neurofibromatosis (NF1) include father and two siblings. Father is caucasian, mother is black. No other family members have severe manifestations of neurofibromatosis.

Segmental neurofibromatosis has been described in neurofibromatosis, but rarely with such severe manifestations at such a young age.

P-026

Beckers Muscular Dystrophy Presenting as Cardiomyopathy with Subsequent Transplantation

R.L. SMITH, J. VAJSAR AND E.G. MURPHY (Toronto, Ontario)

Background: Cardiomyopathy in the dystrophinopathies usually presents after diagnosis of skeletal muscle disease. Rarely cardiac muscle disease is the presenting feature.

Methods: A case report of a 14 year old boy with undiagnosed Beckers Muscular Dystrophy (BMD) who presented with cardiomyopathy.

Results: A fourteen year old boy presented in acute cardiac failure with a dilated cardiomyopathy and a CPK of 10,416. Calf hypertrophy was noted and a diagnosis of BMD confirmed on muscle biopsy. he had a duplication at sites 3-6 on the dystrophin gene. He had decline in cardiac function with cardiac transplantation two months later. He is now two years post

transplant and well. It has been suggested that a deletion involving exon 49 is more frequently linked to cardiomyopathy. A 3-6 duplication has not been previously described in this setting.

Conclusion: Surveillance for cardiac involvement in people with BMD is recommended. There are several case reports in which the presenting feature was the cardiac disease itself. In severe BMD cardiomyopathy, transplant seems justified given the better long term prognosis compared with Duchenne Muscular Dystrophy. There is no consistent genotype-phenotype correlation.

P-027

Intramedullary Spinal Cysticercosis in a Child: Medical Treatment

B. MEANEY, J. KOBAYASHI AND J. KEYSTONE (Toronto, Ontario)

Intramedullary spinal cysticercosis (IMSC) is rare; only 32 cases have been published. A case of IMSC in a 5 year old boy is presented. The findings included flaccid weakness of his left arm, spastic weakness of both legs, urinary retention and low back pain. A right homonymous hemianopsia was also detected on examination.

Magnetic resonance (MR) imaging revealed a ring enhancing lesion at the C2 level accompanied by focal expansion of the cord. A second ring-enhancing lesion was also present in the parieto-occiptal white matter of the left hemisphere. Cysticercosis infection was confirmed by enzyme-linked immunoelectrotransfer blot assay.

A six week course of tapering corticosteroids was undertaken. By the end of the treatment period the patient's neurologic exam had normalized. A follow-up MR revealed complete resolution of the hemispheric cyst, but persistence of the cyst in the cervical spine. Because of the risk of spontaneous rupture of the spinal cyst, elective antihelminthic treatment was undertaken with albendazole and dexamethasone. There were no complications, and a follow-up MR is expected to show resolution of the spinal cyst.

Previous attempts at reversing this myelopathy have been entirely surgical. This is the first report of medical treatment of IMSC.

GENERAL NEUROLOGY

P-028

Neurological Manifestation of Adult Chediak-Higashi Syndrome

N. SHEHATA, C.M. YEGAPPAN AND K. GREWAL (St. John's, Newfoundland)

Background: The Chediak-Higashi Syndrome is a rare and autosomal recessive disorder that is characterized by partial oculocutaneous albinism, recurrent bacterial infections due to abnormal phagocytosis, mild bleeding diathesis and varied neurological manifestations including peripheral and cranial neuropathies, cerebellar signs and mental retardation. The underlying defect is in granule morphogenesis in multiple tissues and the syndrome can be diagnosed by pathognominic abnormal granules in peripheral smears. The average age of presentation is between 5-10 years and can be fatal in the first decade. Few patients have been reported to survive to ages greater than thirty years. The cause of death is usually infection or from an accelerated phase that is characterized by lymphadenopathy, hepatosplenomegaly, pancytopenia, caoagulopathy, peripheral neuropathy with widespread lymphohistiocytic organ infiltrates.

Cases: There were 11 siblings born to consanguinous parents. A diagnosis of Chediak-Higashi was made when one sibling died at the age of 21 from a bleeding diathesis after numerous hospitalizations for recurrent infection. The second patient aged 51 years presented (approximately 20 years later) with a 5 year history of progressive ataxia and a 1-2 year history of recurrent abscesses. Physical exam revealed nystagmus, dysarthia, ataxia, decreased vibration sense in the lower limbs and bilateral Babinski response. MRI of the head was unremarkable. Her brother aged 50 years also had recurrent infections since the age of 10 but recent onset of neurological symptoms.

Discussion: We believe that these patients are the oldest reported cases of the Chediak-Higashi Syndrome. This family demonstrates the variability of manifestation of this syndrome and the differences from childhood onset versus adult onset of the disease.

P-029

Disappearing Mystery Pachymeningeal Enhancement on MRI: A Case of Primary Neurosarcoidosis?

B. CHAUDHURI AND A. GORDON (Toronto, Ontario)

Background: The meninges are composed of three components, the pia mater, subarachnoid space and dura mater. The pia mater is known as the leptomeninges and the dura mater is known as the pachymeninges. Pachymeningeal thickening is usually seen in inflammatory processes such as in Carcinomatosis or in entities like sarcoidosis. Sarcoidois commonly presents as hilar lymphadenopathy; it is a granulomatous disease of unknown origin often seen in the black population. It usually presents as a pulmonary infiltrate.

Methods: A case report of a 34 year old woman presenting with diffuse band-like headache, accompanying right-sided hearing loss, as well as meningeal signs consistent with the diagnosis of viral meningitis.

Results: Two consecutive lumbar punctures showed only a dramatic increase in the total protein of her cerebrospinal fluid (CSF) but no other abnormalities. The total protein was 1300 mg with IgG present in the CSF at 46 mg/mL. Oligoclonal banding was present. The protein was negative for polymerase chain reaction of the herpes simplex virus and enterovirus. This headache lasted five weeks before an MRI scan was done with contrast. There was diffuse pachymeningeal enhancement and thickening manifesting on T2-weighted images. There was no leptomeninginegal enhancement and the brain parenchyma was normal. Biopsy was refused by the patient and a second MRI was performed one month later revealing no dural enhancement. both MRI's will be presented.

Conclusions: This enhancement is seen with carcinomatosis, usually of the breast, but no primary tumor was found. Since the

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patient has spontaneously resolved clinically and on MRI, the diagnosis is likely sarcoidosis. This poster will review the differential diagnosis, neurosarcoidosis and oligoclonal banding.

P-030

The Atlas, the Axis and Cervicogenic Headache

J.G. ASHBY (Toronto, Ontario)

Background: Few complaints are more common than headache and neckache and increasingly the cause of headache is found in the neck and thus treatment has been improved. The anatomy of the atlas, the axis and the neural connections with the descending tract of the trigeminal nerve and the vertebral arteries is important in understanding these improvements in treatment.

Methods: At the Rothbart Pain Management Clinic, head and neck pain is treated with a combination of cranial nerve blocks, cervical nerve blocks, behavioural modification and exercise to significantly decrease pain and reduce drug dependence.

Results: More than 80% of patients with chronic headache and neck pain are significantly improved with a combination of cranial nerve blocks, occipital nerve blocks and cervical paravertebral nerve blocks.

Conclusion: The changing patterns of headache and improved results with occipital, temporal, and supraorbital nerve blocks and paravertebral nerve blocks, indicate an improved outcome for patients with headache.

P-031

Frequency Dependent Firing Rate Sensitivity of Secondary Vestibular Neurons to Horizontal Sinusoidal Rotation

A.J. PRIESOL AND D.M. BROUSSARD (Toronto, Ontario)

Background: Vestibulo-ocular reflex (VOR) compensation after peripheral vestibular lesions is incomplete with asymmetric dynamic responses during rapid head accelerations.

Methods: Extracellular single unit recordings from 15 secondary vestibular neurons were performed on an alert cat during horizontal sinusoidal whole animal rotations at frequencies of 1, 2, 5, and 8 Hz with a peak velocity of 10 degrees/second. Each neuron had been identified as secondary by modulation of firing rate during sinusoidal rotation and by short latency of activation ($\leq$1.8 msec) following electrical stimulation of the ipsilateral semicircular canals. Each neuron was classified as type I if firing rate was increased by ipsiversive rotations and as type II if excited by contraversive rotations. Latency of activation following semicircular canal electrical stimulation was determined from frequency of firing histograms. For each class of neuron responses to the different frequencies of rotation were compared and statistical significance determined using the Friedman Fr-test for randomized block design.

Results: Sensitivity to horizontal sinusoidal rotation significantly decreased with higher frequency rotation for type II neurons ($\alpha = 0.010$) but not for type I neurons ($\alpha = 0.100$).

Conclusions: The frequency dependent sensitivity of type II neurons is consistent with the asymmetric dynamic VOR responses present during rapid head accelerations following compensation for peripheral vestibular lesions. Facilitation of contralateral vestibular input to type II neurons may result in low-pass filtering and explain why compensation is incomplete.

P-032

Neurosyphilis in the 1990s

D. DIOSY AND A. KERTESZ (London, Ontario)

Background: Fifty years ago, in the any young patient with stroke, or any patient with some unusual presentation of stroke, the diagnosis of neurosyphilis was routinely investigated. With the widespread use of antibiotics neurosyphilis in North America had nearly disappeared altogether. With the emergence of HIV disease we are now recognizing new cases, with very important diagnostic difficulties, however, the diagnosis must not be ignored in the non-HIV population.

Methods: Single case study.

Results: A 54 year old man, previously healthy, presented with right-sided weakness which came on over 1 day's time. Unusual CT findings prompted an MRI study which showed multifocal white matter changes. A lumbar puncture showed a marked lymphocytic pleocytosis. An angiogram showed findings consistent with vasculitis. At this time a serum VDRL was reported positive. A repeat lumbar puncture was performed and the CSF was shown to be VDRL positive. The patient had a Jarisch-Herxheimer reaction to penicillin, but never regained the use of his right arm.

Conclusion: Neurosyphilis exists today, particularly in immunocompromised patients, but must be considered in patients with unusual presentation of stroke.

P-033

Gradual Resolution of CSF Abnormalities in the Syndrome of Headache, Neurological Deficit, and CSF Lymphocytosis

B.J. STEWART, C.C. TOTH, AND A. KIRK (Saskatoon, Saskatchewan)

Background: The syndrome of headache, neurological deficit, and CSF lymphocytosis (HaNDL) has been reported in approximately 40 patients in the medical literature. Although the clinical findings and their CSF correlates are well described in the symptomatic period, there are no detailed reports of CSF results after resolution of neurological symptoms.

Methods: We performed serial lumbar punctures (LP) on a 17 year old male whose clinical and CSF findings were consistent with HaNDL syndrome.

Results: The patient experienced migraine-like headaches followed by transient neurological deficits in multiple neurovascular territories on five occasions over a period of eight days. CT, MRI, and SPECT scans of the brain were normal. Cerebral angiography was also normal. Initial LP performed within 24 hours of onset of symptoms demonstrated an opening pressure of 49.5 cm H_2O, protein of 1.25 grams per litre, and 200 ($x10^6$) WBC (91% lymphocytes). Two additional LPs performed during the symptomatic period continued to demonstrate similar findings. Further LPs done at 39, 70, and 196 days after resolution of symptoms showed a gradual return to normal CSF parameters.

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Conclusion: Of the approximately 40 patients with HaNDL syndrome in the literature, our patient had the longest period of clinical follow-up involving serial LPs. This demonstrated that: (1) CSF abnormalities may persist several months after resolution of clinical symptoms, and (2) HaNDL is a benign and self-limited syndrome.

P-034

Eliminate the Mystery: Developing Patient Education Material for Neuroscience Patients/Families (CANN)

DONNA LEE, KAREN CONNELL, GAIL GREEN, MARIAN ROACH, JENNIFER SAWYER AND YVONNE ZALESCHUK

P-035

The Prognosis of Multiple Sclerosis in Saskatoon, Saskatchewan – a Twenty Year Follow-up Study

W.J. HADER (Saskatoon, Saskatchewan)

A population-based cohort prevalent group January 1, 1977 of 150 clinical definite multiple sclerosis patients was followed over twenty years. The present clinical characteristics, familial history, disability and survival status was ascertained for 1 January 1997. In this group, 68 (45.3%) are living, 73 (48.7%) are deceased and 9 (6%) unable to trace. The mean age of onset for females was 28.5 ± 9.0 years and 31.9 ± 10.0 years for the males and the range of onset 8-59 years.

The mean age of the 50 living females is 61.0 ± 10.0 years and 64.3 ± 8.3 years for the 18 males. The mean duration of disease is 34.4 ± 9.0 years for females and 32.5 ± 7.8 years for the males. The mean age of death for the 46 females is 59.8 ± 13.0 years and 61.1 ± 14.9 years for the 27 males.

The familial history in close relatives increased from 15.3% to 28.0% in 1997 and from 23% to 36% including distant relatives. There was increase from 2.6% to 10% for a second relative and 4% had a third relative with M.S.

The outcome according to Kurtzke Disability Scale was compared for 1977 and 1997, and indicates the status 15 and 34 years after the onset of the disease. Minor disability DSS < 2.5 was 31.1% and 12.8%, mild DSS 3-5.5 was 17.3% and 2.8%, moderate DSS 6-7.5 was 25.3% and 8.5%, and severe DSS 8-9 was 22.6% and 24.1%.

The median survival time after onset is 36 years. The estimated 25 years survival is 78%, with no significant difference between the sexes. The actual observed survival time of this cohort confirms the estimates in reported studies. The disability status reflects the long term progressive course of multiple sclerosis.

P-036

Genetic Evaluation of Adult Onset Cerebellar Ataxia

S.K. DAS AND O. SUCHOWERSKY (Calgary, Alberta)

Adult onset cerebellar degeneration is a heterogenous disorder, with sporadic and genetic forms. Phenotypic variability within the same genotypic and vice-versa is described. To date 8 loci have been found to be associated with adult onset familial cerebellar ataxia. Recently DNA testing has become available for some spinocerebellar atrophies (SCA). The objective of this study was to analyze all the cases presenting with adult onset ataxia in regard to family history, pattern of inheritance and genetic studies with available DNA probes (SCA1, SCA3, dentato rubro pallido luysian atrophy).

All cases presenting with adult onset ataxia in Movement Disorder clinic over the past 12 years were reviewed. Appropriate investigations were done to rule out secondary causes. Total: 19 patients (Male 6, Female 13; age range 25-80 yrs) mean duration of symptoms 9.3 yrs. Presenting features were poor balance (14), dysarthria (8), dysphagia with dysarthria (1) and abnormal movements (2). MRI studies showed atrophy of the cerebellum and / or brainstem. Positive family history was found in nine patients in seven families. Four had a well defined autosomal dominant pattern (AD), one patient had either autosomal recessive, or maternal inheritance; two families had a positive family history with indeterminate pattern. DNA testing was positive in only two out of four AD families, one for SCA1 and one for SCA3. The other cases are presently being analyzed for the Freidreich's Ataxia gene. Only two out of four families tested positive; other familial cases may be the phenotypic expression of other genotype (SCA 2, 4, 5, 6, 7) hitherto reported. In sporadic cases, genetic testing does not appear to provide further information.

P-037

Inhibition of Glutamate Dehydrogenase Activities by Prolonged Intake of Monosodium Glutamate in Rat Brains

S.-W. CHO AND J. LEE (Seoul, Korea)

Background: Glutamate is known to be involved in the pathogenesis of human degenerative disorders. One enzyme central to the metabolism of glutamate is glutamate dehydrogenase (GDH). Since the pathology of the disorders associated with GDH defects is restricted to the brain, the enzyme may be of particular importance in the biology of the nervous system. What is the influence of glutamate on the GDH activities in brain?

Methods: Six monosodium glutamate (MSG)-treated rats in their drinking water and six control rats were fed for 6 months. After decapitation, the brains were weighed and homogenized. The 800 x g supernatants were assayed for glutamate, total protein, and the specific activities of glutamate dehydrogenase (GDH).

Results: The concentrations of the glutamate in the crude extracts of the MSG-treated rat brains were 3.2-fold higher than those of the control groups. Compared to the control groups, the treatment with MSG significantly decreased the specific activities and gene expression levels of GDH as determined by Western blot analysis.

Conclusion: These results suggest that the prolonged MSG feeding increases its concentration to inhibit the gene expression of GDH in rat brains. [Supported by KOSEF (95-0403-12-01-3).]

CEREBROVASCULAR SURGERY

P-038

Immediate and Longterm Pharmacological and Morphological Effects of *In Vivo* Balloon Angioplasty in a Canine Model of Vasospasm

J.F. MEGYESI, J.M. FINDLAY, B. VOLLRATH, D. COOK AND M.H. CHEN (Edmonton, Alberta)

Background: Using a canine high cervical internal carotid artery (ICA) model of vasospasm we have recently shown that *in vivo* transluminal balloon angioplasty (TBA) performed prior to the onset of vasospasm can prevent its development. TBA causes a significant impairment of contractile and vasodilatory responsiveness and some structural alterations of the vessel wall. This study was designed to determine the duration of these pharmacological and morphological changes.

Methods: Forty dogs underwent baseline angiography on Day 0, followed by bilateral ICA exposure. Dogs in Group A (n = 20) underwent simple exposure of one ICA and the placement of an empty silastic sheath around a segment of the opposite ICA. Dogs in Group B (n = 20) had blood clot filled silastic sheaths placed around both ICAs. On Day 7, in Group A, TBA was performed on the unsheathed ICA while in Group B, TBA was performed on one of the vasospastic ICAs. On Days 7, 14, 21, 28 and 56, four animals from both Groups A and B underwent repeat angiography and then were sacrificed for vessel pharmacological and morphological analyses.

Results: Arteries that were simply surrounded by a silastic sheath (Group A) resembled unsheathed arteries in all respects. Arteries that were encased in blood for seven days (without TBA; Group B) developed significant angiographic vasospasm and altered pharmacology and morphology that resolved by Day 21. Normal arteries that underwent TBA (Group A) and vasospastic arteries that underwent TBA (Group B) exhibited angiographic dilatation that resolved by Day 28. Pharmacological responsiveness of the vessels in both these Groups was impaired over the first 21-28 days. Some morphological alterations were also observed in both Groups.

Conclusions: These results indicate that the immediate alterations in angiographic appearance, pharmacological responsiveness, and morphology seen in angioplastied arteries, using this experimental model of vasospasm, are largely resolved 3 to 4 weeks after TBA.

P-039

Carotid Endarterectomy in the Presence of a Persistent Hypoglossal Artery

J.F. MEGYESI, J.M. FINDLAY AND R.A. SHERLOCK (Edmonton, Alberta)

Background: A persistent hypoglossal artery, one of the embryonic carotid-basilar anastamoses that can fail to regress in the embryo and be found past birth, is one of the only congenital anatomical variations of the internal carotid artery (ICA) that can complicate the performance of carotid endarterectomy. When associated with atherosclerotic carotid artery disease, the recognition and intraoperative management of a persistent hypoglossal artery is important.

Clinical Presentation: A 72 year old man presented with a symptom of transient right hemisphere ischemia, and while ultrasound indicated a right ICA stenosis (and no other abnormality), angiography also demonstrated that the atherosclerotic plaque extended into the origin of a large right persistent hypoglossal artery arising 1.5 cm from the origin of the ICA. In this patient the persistent hypoglossal artery was the only arterial supply to the basilar artery.

Intervention: The patient underwent a right ICA endarterectomy, and intraoperative angiography was necessary to ensure that the persistent hypoglossal artery was the vessel shunted during the arterial repair.

Conclusion: Recognition of the primitive carotid-basilar anastamoses is important to surgeons who perform carotid endarterectomy, and is not possible with ultrasonography alone. Intraoperative angiography enables the surgeon to accurately catheterize a persistent hypoglossal artery with a carotid shunt.

P-040

Transcranial Doppler Monitoring of Middle Cerebral Artery Blood Velocity During Carotid Endarterectomy

I.B. ROSS (Winnipeg, Manitoba)

Background: Other than for the assessment of vasospasm, transcranial doppler sonography (TCD) has been slow to be adapted in the North American neurological community. This paper describes a preliminary experience with TCD monitoring of cerebral perfusion during carotid endarterectomy (CEA).

Methods: Ten consecutive patients undergoing CEA between September and December 1996 by the author underwent ipsilateral middle cerebral artery (MCA) TCD insonation. Internal carotid artery (ICA) stump pressures were measured in all patients in whom TCD waveforms could not be obtained. Shunting was employed in all patients in whom TCD waveform reductions to ICA occlusion, or stump pressure measurements, suggested an increased risk of cerebral hypoperfusion during CEA.

Results: There were no intra or post-operative cerebral ischemic events in the study group. An adequate "cranial window" for insonation could not be obtained in three patients. All three, however, had stump pressures > 50mmHg and were not shunted. Of the remaining seven patients, two completely lost MCA TCD waveforms with trial ICA occlusion. These patients were shunted.

Conclusion: These findings suggest that TCD may be a useful adjunct for the monitoring of cerebral perfusion during CEA.

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P-041

Delayed Type of Hypersensitivity to Nickel and Cobalt Alloy Implants Following Cranial Surgery

I.B. Ross (Winnipeg, Manitoba)

Background: Because certain titanium (Ti) alloys are MRI-compatible and non-allergenic, they have been gradually replacing cobalt (Co) and nickel (Ni) stainless steel alloys for implants. Because of cost and availability, Ti aneurysm clips are still not widely used.

Methods: A 36 y.o. woman presented with an aneurysmal subarachnoid hemorrhage. Treatment included placement of a Co alloy aneurysm clip and wiring of the bone flap with Ni-containing stainless steel. Post-operatively, the patient was plagued by an intense, diffuse urticaria, unresponsive to medical remedies. Allergy testing eventually revealed severe reactions to Co and Ni. The patient was reoperated on, and all Co and Ni containing implants were replaced with inert material.

Results: At reoperation, CSF showed 50 cells/high power filed. Cytometry and immunophenotyping indicated that 70% of the cells were lymphoid (mostly T-lymphocytes with a normal CD4/CD8 ratio). Microscopic examination of gliotic brain near the aneurysm clip and scar around the skull wires demonstrated lymphocytic infiltration, though macrophages were only seen near the skull wires. Postoperatively, the urticaria cleared.

Conclusion: The routine use of Ti aneurysm clips and avoidance of stainless steel wires should be considered.

P-042

Comparison of the Utility of MRA and SIAA for Detecting Intracranial Aneurysms

S. Baeesa, H. Hugenholtz, M. Richard, C. Agbi, W. Morrish and S. Grahovac (Ottawa, Ontario)

Objectives: To compare the sensitivity and specificity of magnetic resonance angiography (MRA) versus selective intra-arterial angiography (SIAA) for detecting and defining morphologic characteristics of intracranial aneurysms.

Methods: During the period between July 1, 1994 and June 30, 1995, a retrospective analysis was conducted in 30 consecutive patients investigated specifically for the detection of suspected intracranial aneurysm with both MRA and SIAA at the Ottawa General Hospital. The reviewers (4 neurosurgeons and 2 neuroradiologists) were blinded to the clinical information of the patients. Seven parameters (location, size, shape, type and demarcation of neck, fundus orientation, neck location, and the presence or absence of vasospasm) were specifically studied. Diagnostic values of MRA vs. SIAA for the identification and description of the aneurysms and surgical planning was compared. A descriptive analysis of concurrence among the 6 examiners for the morphological characteristics of intracranial aneurysms and for the utility of MRA was conducted.

Results: Twenty-five aneurysms were detected among 20 patients, 14 of those patients had 17 aneurysms confirmed at surgery. Of the 17 operatively confirmed aneurysms, 16 were accurately identified on both MRA and SIAA (94% sensitivity for each). One proven aneurysm was detected only by SIAA and one other proven aneurysm only by MRA (93% specificity for each). Concordance among all 6 examiners by the parameters of 17 confirmed aneurysms was best for detection of aneurysm site, shape and presence or absence of vasospasm.

Conclusions: This analysis suggested that the sensitivity and specificity of these two diagnostic modalities were comparable and were in an acceptable range over 90%. The neurosurgeons considered the MRA as good as or better than SIAA for surgical planning (71%), while the neuroradiologists considered MRA as good as or better than SIAA for the identification and description of aneurysms (63%).

P-043

Fatal Traumatic Vertebral Artery Aneurysm Rupture by a Hockey Puck

M. Abdulhak, R. Sahjpaul, C. Drake and R. Hammond (London, Ontario)

Background: Vessels of the posterior circulation give rise to only 10 to 15% of all Circle of Willis aneurysms. The vertebral arteries give rise to less than 1% of these. Rupture of a saccular aneurysm in association with external head trauma is rare and has not previously been described with lesions in the posterior circulation.

Methods: A 32 year old male was struck beneath his helmet over the left mastoid region by a hockey puck traveling at high velocity. He was apneic within seconds of the injury and had no brainstem reflexes within minutes. CT head showed massive diffuse subarachnoid hemorrhage with associated intraventricular hemorrhage.

Results: The postmortem examination identified the remnants of a freshly ruptured berry aneurysm near the intradural origin of the left vertebral artery approximately 1 cm proximal to PICA.

Conclusions: This unique case documents the fatal traumatic rupture of a vertebral artery saccular aneurysm leading to massive subarachnoid hemorrhage and acute brainstem death. The temporal and physical correlation between the external head trauma and the location of the ruptured aneurysm was compelling evidence that the trauma directly precipitated hemorrhage from a preexisting aneurysm.

P-044

Study of Outcomes, Grading, and Complications of Patients with Aneurysmal Subarachnoid Hemorrhage Treated at the Kingston General Hospital

J. Kawakami, F.J. Espinosa and R. Smith (Kingston, Ontario)

Background: The following was investigated: (1) What are predictors of good outcome? Especially with respect to preventable entities such as complications. (2) Which grading scale has the highest correlation to clinical outcome?

Methods: A retrospective chart review on all documented subarachnoid hemorrhages at Kingston General Hospital from 1990-1995 was completed. Outcome was determined by the Glasgow Outcome Scores (GOS) at 6 months post-SAH. One

hundred and five charts, 83 computed tomograms and 91 cerebral angiograms were the data sources used.

Results: Of the 105 patients, 63% had good outcome (GOS of 4 or 5), 22% could not function independently (GOS of 2 or 3) and 14% of patients died. Vascospasm (30.5%) and hydrocephalus (25.7%) were the commonest complications. As the number of neurological complications increased in a patient, the outcomes worsened, and the length of stay increased. Patients with 2 or more complications had a 53% chance of staying in hospital longer than two weeks and with less than 2 complications, there was a 28% chance. the systemic complications had no significant effects on either. The Hunt and Hess scale, and the level of consciousness best correlated to outcome ($p < 0.05$).

Summary: These findings imply that aggressive monitoring, prevention and treatment of neurologic complications should reduce morbidity, mortality and the length of stay from subarachnoid hemorrhage. Additionally, on initial presentation, the Hunt and Hess scale of level of consciousness should be documented as they are more useful for predicting outcome than the Glagow Coma Scale.

P-045

Clinical and Surgical Decisions based on MR Angiography – A Two Year Experience

B. Addas, R. Holness and B. Baxter (Halifax, Nova Scotia)

Background: We examine the value of non-invasive MR angiography (MRA) in assessment of patients with cerebrovascular disease and in making decisions for carotid endarterectomy (CEA). There were two groups of patients.

Results: A) In 38 patients, 14 had ultrasound (US), MRA, and conventional angiography; 24 had clinical decisions based on US and MRA only. This included patients with carotid disease, vertebral basilar insufficiency (VBI) and 2 cases of intracranial occlusions. There was close correlation between MRA and angiography.

B) Surgical group

I. In 10 cases of CEA there was 100% correspondence between MRA angiography, and surgical findings. In one patient with severe stenosis the lesion was undercalled by US (40% vs. 66%).

II. Of 12 patients having CEA who had US and MRA *only* there was 100% correspondence between MRA and surgical findings.

III. Postoperative MRA – In 11 patients there was very clear imaging of the patent postoperative site which proved to be very useful in confirming patency.

Conclusions: MRA is a reliable adjunct in assessment of patients with cerebrovascular disease. In combination with US, many patients with symptomatic carotid stenosis can be offered surgery without the need for invasive angiography. This is important in those with contraindications for angiography or those who are on anticoagulants. Examples of cases will be shown and pitfalls of MRA will be discussed. Our ongoing experience will be further documented.

P-046

History of Intracranial Aneurysm Clips

T.G. Pait*, J. Siddiqi*, M.G. Yasargil*, J.Voelker† and J.L. Fox* (Little Rock, AR, USA*; Morgantown, WV, USA†)

Background: The contemporary aneurysm clip is arguably among the most critical developments in the history of intracranial vascular neurosurgery. Modifications of the aneurysm clip have surpassed its initial use as a substitute for the ligature. Presently, temporary and permanent aneurysm clips of various shapes and sizes are used to treat aneurysms, reconstruct vessels, preserve normal vasulature, and to gauge local hemodynamics. We trace the development and modifications of aneurysm clips historically.

Methods: Extensive review of the literature was complemented by personal conversations with some inventors to arrive at a chronology of aneurysm clip development and modification. With each modification, the design rationale and surgical significance were studied.

Results/Conclusions: The intracranial aneurysm clip is among the most crucial inventions in vascular neurosurgery. Numerous neurosurgeons have contributed to the development of the aneurysm clip, which continues to be modified to keep pace with the changing needs of contemporary vascular neurosurgery.

GENERAL NEUROSURGERY

P-047

The Saskatoon Automatic Brain Scanner: A Precursor to Positron Emission Tomography

W. Feindel (Montreal, Quebec)

Background: In 1955, an automatic contour brain scanner, utilizing gamma-emitting radio-isotopes, was designed in collaboration with Johns and Reid at the Saskatoon Cancer Clinic, to replace hand-held monitoring, and to eliminate the "blind regions" of the cerebrum incident to rectilinear scanning.

Method: Twin detectors perpendicular to the curved contour of the cranium coursed automatically from back to front in eight bilateral concentric arcs. Count rates printed on a half circle of paper by mechanical stampers indicated right and left sides of the head, as well as focal uptake of the radionuclide. "Crossfire" between the two detectors distinguished between superficial and deep lesions.

Results: From April 1956 to December 1958, the Saskatoon scanner gave good or excellent localization in 90% of 115 patients with verified diagnoses. Using an improved version of the scanner in over 6000 patients at the Montreal Neurological Institute from 1960 to 1972, we showed mercury and technetium compounds to be effective scanning agents and also established a team with experience in radio-isotopic technology and methodology that led to the development of positron emission tomography.

Conclusions: The Saskatoon automatic brain scanner, from 1956 to 1972, provided good correlation for detection and localization of intracranial lesions and served as an important precursor of positron emission tomography.

P-048

Is There a Role for Aggressive Internal Decompression in Patients with Malignant Intracranial Pressure Following Severe Cranio-cerebral Injury?

C.B. AGBI, A.B. KLASSAM AND L.A. PRATT (Ottawa, Ontario)

Background: Malignant intracranial pressure (ICP) following severe head injury remains a major cause of secondary morbidity in survivors of cranial injury. Attempts at answering this question have been numerous in the reported literature without resolution.

Methods: We report our experience with a modified technique of internal decompression over the past 18 months. The technique involves opening the dura over non-eloquent brain that may still be viable. This region is then incorporated into a radical decompression along with the traumatized tissue. The decompression is continued until the ICP has been normalized. This is followed by an augmentation duroplasty and not replacing the bone flap.

Results: Our experience with the three patients to have received this therapy over the past 18 months have been encouraging. All three patients had suffered severe head injury and all were considered to be moribund. All three patients at one year follow-up had returned to gainful employment with excellent neurologic recovery.

Conclusion: In selected patients, radical internal decompression incorporating non-eloquent non-traumatized brain may provide for good recovery from severe head injury by controlling the effects of malignant intracranial pressure. This technique requires a more systematic review.

P-049

Long Term Outcome of Shunting in Hydrocephalus

F. GENTILI AND V. SADANAND (Toronto, Ontario)

Background: CSF shunting is a well accepted surgical treatment of hydrocephalus. Shunt insertion and/or revisions has obvious morbidity and mortality implications. The purpose of this study was to determine the impact of patient and shunt specific factors on the probability of a shunt revision and on the neuropsychological development of patients.

Methods: In this 30 year retrospective study, records of 127 patients were statistically analyzed. The present age of the patients ranged from 18 to 40 years and the age of first shunting ranged from 2 days to 18 years. The types of shunts used in this study were lumboperitoneal (LP), ventriculoperitoneal (VP), ventriculoatrial (VA) and ventriculopleural (VPL). Of these patients, 114 have had revisions while 13 have had no revisions.

Results: Results show that 50% of the patients have gone on to finish at least high school, 30% have attended at least college and 10% have at least a university degree. Only LP and VP shunts have incidences of "no revisions". The fewest revisions as a percent of total installed was with LP shunts. The lowest percentage of revisions was associated with Spina Bifida while the highest percentage was with congenital hydrocephalus. The age of first shunting did not affect the number of revisions. However, patients with no revisions tended to have their first shunt placed at an older age. It was also found that the neuropsychological scores were inversely related to the number of revisions. The majority of patients were living independently with their families or group homes with less than 10% institutionalized.

Conclusions: The long term functional outcome of patients with congenital hydrocephalus is good with many patients being capable of leading normal, independent and productive lives. Our findings improve our understanding of the impact of etiologies, shunt type, number of revisions and age on the long term clinical outcome of patients treated with shunts.

P-050

Rancho Los Amigos Scale: A Tool for Assessing and Describing Patients Afflicted by Head Injury (CANN)

WENDY BLACKBURN, WILMA STERLING, JACKIE TURNER, MAUREEN HILDITCH, LEEANNE LEBLANC, ITA DUNNE AND DEB EDGECOMBE

P-051

Ventricular Localization of Mind and Brain

J. SIDDIQI*, L. D'ASCANIO, R. WALLACE* AND O. AL-MEFTY* (London, Ontario; Little Rock, AR, USA*)

Background: The contemporary concepts of cerebral cortical localization are relatively new. For an almost two thousand year period from the ancient Greek times up to the Middle Ages, the intracranial ventricles were viewed as an independent system, being variably ascribed a central role in cognition (imagination, reasoning, and judgment), as well as in motor and sensory brain functions; they were also viewed in metaphysical terms as the "seat of the soul". Interestingly, by the Middle Ages, these intriguing hypotheses regarding ventricular function were commonly held in both eastern and western civilizations.

Methods: From an extensive review of the literature, we trace the development of medieval concepts of the ventricular system. Reasons for the decline of these ideas with the advent of the Renaissance are scrutinized.

Results/Conclusions: In the two centuries preceding the Renaissance, intracranial ventricles were attributed a central role in cognitive, physical and metaphysical functions. Much of these attributed roles reflected the traditional doctrinal milieu generated by church and state. With better anatomical studies during the Renaissance, traditional notions were debunked.

P-052

Ulnar Neuropathy at the Elbow: a Review of 198 Cases Treated by Anterior Transposition or Simple Decompression

G. VARUGHESE, D. FOURNEY, L. ELIAS AND S. LAL (Saskatoon, Saskatchewan)

Background: Ulnar neuropathy is usually due to entrapment of the nerve within the cubical tunnel. In simple decompression, the roof of the cubical tunnel is split and any bands of constrict-

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ing tissue are lysed. Many authors also advocate transposing the nerve anterior to the epicondyle. Our objective was to assess the outcome of patients treated with either procedure.

Methods: We performed a retrospective review of 198 consecutive cases of ulnar neuropathy treated by either anterior subcutaneous transposition or simple decompression by one surgeon between 1967 and 1994.

Results: Decompression was performed in 131, transposition in 67. Men were affected twice as often as women. The average age at presentation was 52.1 years. Follow-up consisted of a clinical review at approximately 3 and 12 months. Post-operative EMG was performed in 73 patients. Both simple decompression and anterior transposition resulted in improvement in over 80% of cases. Outcome was not significantly affected by the type of procedure, age (> 50 yrs, < 50 yrs), sex or duration of pre-operative symptoms (> 1 yr, < 1 yr).

Conclusion: The high percentage of satisfactory results is comparable with other studies. The overall results for patients treated by either technique was similar. Theoretical advantages of simple decompression include less manipulation of the nerve and less threat to its vascular supply.

P-053

Memory and Language Functioning 25 Years Following Left Cerebral Hemispherectomy: a Case Study

M. CROSSLEY (Saskatoon, Saskatchewan)

Background: The patient is a 40 yr old female with right infantile hemiplegia and seizure onset at age 8 yrs. Academic, emotional, and social problems associated with intractable and escalating seizure disorder resulted in left-hemispherectomy at age 16 yrs. This patient lives independently, is fully employed, and enjoys excellent physical and emotional health. She no longer suffers from seizures nor takes anticonvulsant medication.

Methods: The patient agreed to participate in a detailed neuropsychological assessment, including clinical and family interviews, and standardized tests of language, memory, and other higher brain functions.

Results: Intellectual functioning was in the low-average range with specific deficits in list-learning and free recall, and in achieving the abstract functions essential for arithmetic, spelling, and grammatical writing and speech. These results are corroborated by the patient's repeated failure to achieve Grade XII equivalency, despite tutoring and strong motivation.

Conclusions: This case demonstrates the potential and limitations of the right hemisphere to carry out basic, but not complex, memory, language and other abstract functions in individuals with infantile-onset pathology in the left hemisphere and subsequent hemispherectomy.

P-054 Withdrawn

P-055

Down the Drain: Lumbar CSF Systems (CANN)

D. BRETT, L. FAIRBURN, E. GRAY AND C. HARTLEY

P-056

Radiologic Requirements Following Drainage of Chronic Subdural Hematomas

R. AKAGAMI AND M.C. BOYD (Vancouver, British Columbia)

Background: In the time of restraint and promotion of "cost effective" medicine, the requirements for certain "routine" tests need to be reevaluated. In neurosurgery readily available imaging has allowed rapid and early diagnosis and a modality for following lesions. A retrospective review of chronic subdural hemorrhage (CSDH) was undertaken, looking at the pattern of use of CT scanning and whether there are any grounds to being more thrifty or critical in their use in examined.

Methods: A retrospective review of a tertiary care hospital in Vancouver was undertaken. Patients were selected if their diagnosis was CSDH. The hospital and office records along with the radiological reports of CT scans of each patient were reviewed.

Results: There were 66 operations on 52 hemispheres. Thirteen patients had no post op CTs. Fourteen patients were followed until CT scans showed complete resolution of lesions. Thirteen hemispheres required reoperation. Time to recurrence requiring operations ranged from 1 day to 6 wks; 8/13 occurring in < 2 wks. Asymptomatic patients > 3 mos after burr hole drainage of CSDHs all showed complete resolution of lesions.

Conclusions: This review supports the idea that CT scans are not required to follow lesions until radiological obliteration of lesions. And that patients who are asymptomatic at 3 mos have a small likelihood of having residuals. The presence of radiological residuals at > 6 wks are unlikely to go on to require redrainage and most are asymptomatic.

STROKE

P-057

Community Health Promotion: Who Says Stroke Prevention Cannot be Taught by Acute Care Nurses (CANN)

PETRA MANDYSOVA AND TIFFANY DUCKWORTH

P-058

Emboli Detection in Acute Myocardial Infarction

S. ISTVANIC AND Z. CHOUDARY, J.W. Norris Stroke Research Unit (Toronto, Ontario)

Only about 5% of acute myocardial infarction (MI) patients have clinical systemic embolism in the post-event phase. In most coronary care units (CCU) anticoagulant therapy is given acutely, but 2-3% will undergo serious hemorrhagic complications.

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We monitored 22 patients with acute MI in a CCU, using TCD to detect high intensity transient signals (HITS). In 6, insonation was technically difficult, and 6 of the remaining 17 (30%) had HITS in the first 24 hours, 5 in anterior MI and 1 in inferior lesions. 2/6 (33%) of patients with HITS had echo detectable mural thrombus. We are refining our technique to perform serial daily studies to determine if there is a phase of high embolism frequency.

A combination of echo detectable ventricular thrombus plus HITS may allow selective anticoagulant therapy and so reduce the patients at risk of hemorrhagic complications.

P-059

Recurrent Intracranial Hemorrhage Secondary to Postpartum Cerebral Angiopathy

M. URSELL, C. MARRAS, R. FARB, S. BLACK AND J. PERRY (Toronto, Ontario)

Background: Vasculitis affecting the brain unassociated with other systemic disease is referred to as primary angiitis of the CNS (PACNS). There is growing evidence that clinical subsets of this disorder exist, including a rare postpartum cerebral angiopathy (PCA) developing shortly after a normal pregnancy. Intracranial hemorrhage due to PCA has been described in four isolated case reports. We present PCA as the cause of recurrent intracranial hemorrhage and review the appropriate investigation and management of this condition.

Case Study: A 39 year old normotensive, non-toxemic woman presented with a right frontal hemorrhage 9 days after a routine vaginal delivery and two years later with a small subarachnoid hemorrhage 9 days following elective cesarean section.

Results: This is the first example of recurrent intracranial hemorrhage due to isolated postpartum cerebral angiopathy. In addition to regions of hemorrhage, MRI showed small multifocal T2 signal abnormalities within the centrum semiovale bilaterally and arterial angiography on both occasions showed marked beading of large and small cerebral vessels. A brief course of high dose steroids successfully stabilized her disease and a repeat transcranial doppler one month later had normalized.

Conclusions: Although rare, this is a distinct clinicoradiologic entity that should be considered in the differential diagnosis of postpartum stroke. Prior case reports indicate this to be a self-limited cerebral vasculopathy often managed without the need for aggressive immunosuppression. The exact pathophysiology of PCA remains to be elucidated.

P-060

Hemodynamic Transient Ischemic Attacks with Limb-Shaking

K. BRYDON, G.B. YOUNG AND J.D. BROWN (London, Ontario)

Background: Epileptic seizures occur in about 5% of patients with acute focal brain ischemia. Hemodynamic seizure-like events are extremely rare and not well documented. We present the unique case of a man with cerebrovascular disease who developed episodes of limb-shaking and muteness during bouts of coughing.

Methods: Single case study.

Results: A 62 year old man with chronic bronchitis developed episodic, repetitive, involuntary jerking movements of the right upper and lower limbs, a right lower visual field loss and muteness. These events lasted about 5 seconds and occurred repeatedly only during bouts of vigorous coughing. Investigations included a normal CT head scan and nonspecific EEG changes but no epileptiform activity. Cerebral angiography revealed complete occlusion of the left and 75% stenosis of the right internal carotid arteries, both at their origins. No further episodes occurred in two years following a right carotid-endarterectomy.

Conclusion: We propose that the patient suffered Valsalva-related, hemodynamic, regional hypoperfusion of the left cerebral hemisphere to produce the limb-shaking and other phenomena. Arguments will be presented that the episodes were not epileptic in nature.

P-061

Saskatchewan Clinical Stroke Prevention Project: Interdisciplinary Behavioural Interventions in Primary Care (CANN)

V.R. RAMSDEN, et al.

P-062

Saskatchewan Clinical Stroke Prevention Project: The Design (CANN)

V.R. RAMSDEN, et al.

P-063

Development of a Stroke Education Package for Family and Caregivers (CANN)

A.L. VAN DUSEN, M.J. DEIGHTON, C.M. ALLEN, W. FRIESTADT AND J. MCKENZIE

P-064

Bilateral Medullary Pyramid Infarct with Spastic Onset

B.A. BEMACKI, M.M.C. YEUNG AND A.H. RAJPUT (Saskatoon, Saskatchewan)

Objective: A unique case of bilateral medullary pyramid infarcts with spastic onset.

Background: Experimental animal pyramidotomies have produced long term hypotonic paresis of the extremities. Case

reports in humans of isolated medullary pyramid infarcts are rare – only two patients have been described with isolated bilateral pyramid infarctions. Other series (total 24 patients) have described medial medullary syndromes with hemisensorimotor stroke and not pure motor quadriapresis. The 2 patients with pure motor quadriparesis had gradual onset of symptoms over 4 to 5 days, and spasticity was not evident until 5 and 15 days after onset; site lesions were not identified until autopsy (3 and 12 months after onset).

Design/Methods: A 73 year old man presented with a one day history of progressive weakness of left leg and, 24 hours later, left arm weakness. Tone was increased on the left side and there was hyperreflexia, clonus, and an extensor plantar response. Facial and bulbar muscles were spared, and sensory examination normal. On day 3 his right leg became weak with spasticity, hyperreflexia, clonus, and a Babinski's sign. Within hours his right arm became weak, spastic, and hyperreflexic, and he became dysarthric. Within five days of admission he was functionally quadriplegic with no movement in his upper or lower extremities, and had marked dysarthria. MRI done 2 and 12 days following admission revealed bilateral pyramidal infarcts at the level of the medulla. At discharge 13 weeks after admission he continued to have spastic quadriparesis with minimal movements of the right upper extremity.

Conclusion: This is the third case report of isolated bilateral medullary pyramid infarctions in the English literature. In contrast to previous descriptions, this patient showed a stepwise progression of weakness. In addition, he did not evolve from flaccid to spastic quadriparesis – spasticity occurred with onset of weakness. To our knowledge this is the first report of MRI visualization of isolated bilateral medullary pyramid infarction.

P-065

Effect of Lamotrigine on Extracellular Level of Glutamate and Analine in Reversible Focal Ischaemia Model of Rat

Y. YANG, A. SHUAIB, Q. LI, H. MIYASHITA AND W. HEWLETT (Saskatoon, Saskatchewan)

Background: Ischaemia-induced glutamate and analine are two excitatory amino acids which are believed to be involved in the development of infarction of cerebral tissue. Growing evidences indicated that lamotrigine, a novel anticonvulsant drug, has cerebroprotective effect. This study aimed to evaluate the effect of lamotrigine on extracellular concentration of glutamate and analine in a reversible focal ischaemia animal model.

Methods: Sixteen male Wistar rats were assigned to reversible focal cerebral ischaemia (untreated, n = 8, drug-treated, n = 8) by clamping the left middle cerebral artery (MCA) for 15 min and reperfusion afterwards. Lamotrigine (50 mg/kg) was orally administrated 2 hours before MCA clamping for the drug-treated group. *In vivo* microdialysis was performed to monitor extracellular concentrations of glutamate and analine in CA1 region of the hippocampus before, during, and after ischaemia/reperfusion.

Results: In the drug-untreated group, the level of glutamate rose more than 2-fold over the baseline ($p < 0.05$) 10 min following ischaemic insult and also demonstrated a secondary peak 50 min after onset of reperfusion. The level of analine also experienced a similar course but not significantly. In the drug-treated group, lamotrigine diminished the first elevation of glutamate ($p < 0.05$) but did not significantly affect the secondary peak. Unexpectedly, lamotrigine increased the level of analine throughout the course of monitoring.

Conclusion: Our data suggests that lamotrigine seems to have a broader spectrum of activity in this animal model and it's role in inhibition of elevated glutamate release may contribute to protection in cerebral ischaemia.

P-066

Lamotrigine Reduces the Level of Neuroactive Substances in Rat Middle Cerebral Artery Permanent Occlusion Model of Focal Ischaemia

Y. YANG, A. SHUAIB, H. MIYASHITA, Q. LI AND W. HEWLETT (Saskatoon, Saskatchewan)

Background: Lamotrigine is a novel anticonvulsant drug that blocks voltage-gated sodium channels and recently showed neuroprotective properties in global cerebral ischaemia. We investigated the potential effect of lamotrigine on ischaemia-induced release of glutamate and other neuroactive amino acids in focal ischaemia model.

Methods: A total of 24 Wistar rats (450-500 g, body wt.) in 3 groups (non-occlusion as controls, n = 8, drug untreated, n = 8, drug pre-treated, n = 8) were subjected to permanent left-MCA occlusion using electrocauterisation. Lamotrigine (50 mg/kg) was orally administrated 2 hours before MCA occlusion for drug pre-treated group. Concentrations of excitatory amino acids such as glutamate, serine, glutamine, taurine, and alanine and inhibitory neurotransmitters such as GABA and glycine in the extracellular space were monitored in CA1 region of hippocampus immediately after MCA occlusion for 120 min using *in vivo* microdialysis technique.

Results: MCA occlusion caused a 2 or 3-fold rise in the concentrations of all the neuroactive substances except glutamine, compared to the control group. Pre-ischaemia administration of lamotrigine not only reduced ischaemia-elevated excitatoxic glutamate, serine and taurine but also attenuated inhibitory glycine and GABA. The inhibition effect of lamotrigine on the five amino acids reached significance ($p < 0.05$, unpaired two-tailed *t* test) for a period of 20 or 30 min following the insult. However, lamotrigine did not affect the level of alanine.

Conclusion: Our results suggest that lamotrigine may have cerebroprotective effect in focal cerebral ischaemia by inhibiting multiple ischaemia-related excitatory amino acids.

P-067

In-vivo Microdialysis as a Biochemical Tool in the Assessment of Neuroprotective Drugs

R. KANTHAN, S. IJAZ, H. MIYASHITA, A. SHUAIB AND J. KALRA (Saskatoon, Saskatchewan)

Background: Histological, radiological and behavioral studies are common tools used to evaluate the degree of neu-

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roprotection as offered by varying interventional techniques during cerebral ischemia. In the present study, we evaluated the biochemical parameters by *in-vivo* microdialysis to test the efficacy of lamotrigine during transient cerebral ischemia in gerbils.

Methods: Sixteen animals were exposed to 5 minutes of cerebral ischemia. Eight of these animals had been treated with lamotrigine prior to the insult. The remaining eight were saline treated controls. Seven days later all animals received a second 5 minute ischemic insult and their cerebral glutamate levels were monitored by *in-vivo* microdialysis. The brains were removed and histologically evaluated for neuronal damage.

Results: Baseline levels of glutamate were not significantly different in the two groups of animals. However, a significant difference ($P < 0.05$) was observed with the second ischemic insult. The dialysate glutamate values in the lamotrigine treated animals increased from 83.35 (± 10.4) micromoles per litre to 194.89 (± 37.2) in comparison to 66.8 (± 7.07) to 114.3 (±16) in the saline treated animals. Histological evaluation of the brains in the two groups showed significantly less hippocampal damage in the lamotrigine treated group.

Conclusions: We evaluated the neuroprotective ability of lamotrigine using *in-vivo* microdialysis as a biochemical tool in monitoring the release of glutamate in neurons that had been previously exposed to transient global ischemia. Such measurements may provide additional modalities in the assessment of new neuroprotective compounds.

P-068

Ischemic Stroke in AIDS: Two Case Reports

B.M. KEEGAN, D.W. GROSS, J.R. DONAT AND K.E. WILLIAMS (Saskatoon, Saskatchewan)

Background: Stroke is an uncommon complication of the Acquired Immunodeficiency Syndrome (AIDS), with an incidence estimated to be around 0.75%.

Methods: Two AIDS patients were investigated for recent onset of focal neurologic deficits.

Results: A forty-six year old male with a history of left sided herpes zoster opthalmicus presented with progressive onset of right sided weakness, sensory loss and aphasia over several days. While hospitalized, he developed a right homonymous hemianopia and worsening obtundation leading to death. MRI at presentation demonstrated a nondiagnostic hyperintense lesion. CT scan at the time of deterioration was suggestive of a left MCA ischemic stroke which was confirmed at autopsy. Vasculitis was identified in small vessels.

A forty-five year old male presented with weakness and ataxia of the left upper and lower limbs and a left homonymous hemianopia. CT showed a hypodensity in the posterior cerebral artery (PCA) territory and magnetic resonance angiography revealed an occluded left PCA. No definitive cause for this occlusion could be identified.

Conclusions: The differential diagnosis of focal neurologic deficits in AIDS includes many diseases uncommon in the general population; however, as demonstrated by our patients, more commonly occurring diseases such as ischemic stroke should be considered.

P-069

The Performance of Carotid Endarterectomies at the Vancouver General Hospital Following NASCET

A. TRABOULSEE AND S.A. HASHIMOTO (Vancouver, British Columbia)

Background: Ischemic strokes are a leading cause of death and disability. Carotid stenosis and transient ischemic attacks are associated with a higher risk of future stroke. The North American Symptomatic Carotid Endarterectomy Trial (NASCET) demonstrated a risk reduction for patients with severe symptomatic stenosis in the surgical cohort (9% risk of stroke at 2 years) compared to the medically treated group (stroke risk 26% at 2 years).

Methods: Retrospective chart review of all carotid endarterectomies performed at a university hospital in 1992, to determine the percentage of procedures that fulfilled the NASCET criteria for carotid endarterectomy.

Results: Seventy-three endarterectomies were performed in 69 patients in 1992. Median age was 69 and 64% of the cohort were males. Eighty-seven per cent were symptomatic (TIA or minor stroke). Fifty-nine per cent had hypertension and 49% had coronary artery disease. Eighty-eight per cent were using antiplatelet medications. Seven per cent did not have cerebral angiography prior to surgery. Only 45% had a CT head scan. Seventy-five per cent met the NASCET criteria of severe symptomatic carotid stenosis greater than 70% on angiography. Fourteen per cent had severe asymptomatic stenosis. Eleven per cent were symptomatic with carotid stenosis less than 70%. Thirty-four per cent had severe stenosis or occlusion of the contralateral carotid artery. Perioperative morbidity and mortality was 5.5% compared to 5.8% for NASCET.

Conclusion: Carotid endarterectomy is indicated for patients with severe symptomatic stenosis. A significant proportion of patients in 1992 had this procedure for asymptomatic severe stenosis and symptomatic moderate stenosis.

P-070

Magnetic Resonance Imaging in the Newborn: Demonstration of Hippocampal and Parasagittal Brain Injury

D. HEWES, E.H. ROLAND, K. POSKITT AND A. HILL (Vancouver, British Columbia)

Background: Improvements in neuroimaging techniques, particularly MRI, have permitted visualization of specific patterns of neonatal brain injury recognized previously only by neuropathological studies. We report MRI findings in two newborns which correlate with classical neuropathological patterns of injury.

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Case reports: (1) A term newborn had severe meconium aspiration syndrome and required paralysis/ventilation/sedation for 10 days. Subsequently, there were neurological abnormalities including hypertonia, dystonic posturing and adducted thumbs. Cranial ultrasound scans were normal. CT scan demonstrated nonspecific low attenuation in cerebral white matter. However, MRI performed at 13 days of age demonstrated increased signal in hippocampal regions bilaterally, suggestive of hypoxic-ischemic injury with reperfusion hemorrhage.

(2) This term newborn was jittery, lethargic and had feeding difficulties. Delivery was unremarkable. Cranial ultrasound (day 1) demonstrated symmetrical echogenic areas in parasagittal regions bilaterally. CT scan (day 3) demonstrated bilateral low attenuation consistent with parasagittal watershed ischemic injury. MRI (day 9) demonstrated bilateral multifocal hemorrhage in the same distribution.

Conclusion: In each case MRI permitted diagnosis of a specific pattern of injury which is rarely possible in the live newborn. The topography of cerebral injury corresponds to recognized areas of vulnerability e.g., hippocampal regions (case 1) and parasagittal watershed zones (case 2).

P-071

The Effect of Post-ischemic Hypothermia in the Immature Rat

J.Y. YAGER AND E.A. ARMSTRONG (Saskatoon, Saskatchewan)

Background: Intra-ischemic hypothermia is neuroprotective in both the immature and adult animal. In the immature rat pup, 3 hrs. of hypothermia immediately following an hypoxic-ischemic (HI) event (180 min.) which consistently produces severe cerebral infarction is ineffective in attenuating brain damage (Yager et al., 1993). In the present study we determined whether post-HI hypothermia may be beneficial following less severe HI insults.

Methods: Seven-day rat pups underwent unilateral common carotid artery ligation and exposure to 8% oxygen for 90 or 180 min. at 37°C. Following HI, separate groups of rat pups were maintained in environments (water bath) thermocontrolled to 31, 34 or 37°C for 3 hours, after which they were returned to their dams. Cerebral damage was then assessed at either 7 or 23 days of recovery.

Results: Hypothermia made no difference to the extent of brain injury following 180 min. of HI, at either 7 or 23 days of recovery. Following a less severe insult of 90 min. rat pups assessed 7 days post HI displayed a significant reduction in brain damage ($p < 0.05$) following post-ischemic hypothermia. Mean rank scores for neuropathologic injury were 7.10 (31°C), 12.86 (34°C) and 13.73 (37°C). This beneficial effect of hypothermia was lost, however, when animals exposed to 90 min. of HI were evaluated for brain damage at 23 days of recovery.

Conclusions: In the immature rat pup: 1) Brief post-ischemic hypothermia is ineffective, even transiently, in attenuating the brain damage following severe hypoxia-ischemia. 2) Post-ischemic hypothermia attenuates the brain damage seen following less severe HI insults. 3) The latter effect is transient, but clearly establishes and prolongs the "therapeutic window" following cerebral HI. (This research was supported by the Heart & Stroke Foundation of Saskatchewan.)

P-072

Stroke in Childhood with Raised Anticardiolipin Antibody Titres and Possible Early Moyamoya Disease

F. BOOTH, R. YANOFSKY, K. OEN AND I. ROSS (Winnipeg, Manitoba)

Background: Stroke has been reported as one of the (clinical) manifestations of the anticardiolipin antibody syndrome. Raised anticardiolipin antibody (aCL) titres have been noted in a few cases of moyamoya disease.

Case Report: A right-handed 7½ year old girl of mixed ancestry (mother caucasian, father oriental) had a 2 year history of intermittent headaches associated with photophobia and phonophobia and presented following the sudden onset of a severe occipital headache, incoordination and vomiting. Within 3 hours she developed a right hemiparesis and dysphasia.

Investigations: A CT scan was consistent with a non-hemorrhagic infarct of the left basal ganglia and internal capsule. Her aCL IgG titres were 32 and 36 GPL ($N < 23$) and her aCL IgM titres, 9 and 12 MPL ($N < 11$). Her MRA suggested decreased flow in the supraclinoid segments of both internal carotid arteries and the left middle and anterior cerebral arteries but conventional angiography showed an isolated stenosis of the supraclinoid portion of the left internal carotid artery with collaterals, the findings of both studies felt to be consistent with moyamoya disease.

Management: The patient was considered to have antiphosopholipid antibody syndrome and was placed on anticoagulation. The need for revascularization for early moyamoya disease was debated.

Conclusion: The pathogenesis of stroke in childhood and optimal management remain uncertain.

P-073

Spontaneous Regression of an Arteriovenous Malformation causing Neonatal Intraventricular Haemorrhage

S.D. LEVIN, C.G. DRAKE AND D. LEE (London, Ontario)

This male infant was a normal vaginal delivery at term weighing 3.7 kg. Several left sided focal seizures occurred on day 2 and mild fever developed. An atraumatic LP revealed uniformly blood-stained CSF and an MRI demonstrated a right intraventricular haemorrhage with an arteriovenous malformation adjacent to the right trigone. Subsequent development and neurological examination was normal. A repeat MRI at 2 years of age revealed mild enlargement of the right lateral ventricle and low signal areas in the posterior limb of the internal capsule and an MRA showed abnormal signal in the right choroid plexus.

At 3 years he was assessed for treatment by focused radiotherapy but stereotactic angiography revealed no evidence of arteriovenous malformation and MRI and MRA at 4 years confirmed this.

Asymmetic intraventricular haemorrhage in term infants with no demonstrated aetiology is a not uncommon presentation. It is speculated that these are caused by cryptogenic vascular malformations destroyed in the bleed. This unusual case demonstrates spontaneous disappearance of an AVM having caused IVH in the neonatal period. The cause for spontaneous regression is not known. Spontaneous venous thrombosis has been suggested as a mechanism for regression.

P-074

Limb Infarction in Neonates Associated with Prenatal Cerebral Infarction

S.K. Weiss, J. Vajsar, H.M. Clarke and C. Newman (Toronto, Ontario)

Objective: The association of prenatal cerebral infarction and upper limb ischemia in neonates is rare. The limb abnormality may present as a brachial plexopathy or isolated limb ischemia. It is important for the clinician to recognize the possibility of coexistent cerebral infarction. This case series is presented to review this important association.

Background: There are few case reports previously published of neonates with this association. Neuroimaging in these neonates demonstrates evidence of peripheral and central infarction. Possible etiologies are discussed.

Design/Methods: a case series is presented including five neonates previously reported. Clinical and electrophysiologic data, radiographs, and photographs of the two new cases are provided.

Results: The neonates reviewed are similar in gestational age and size, and lack of obstetrical complications. The presenting symptom in the two new cases is skin changes in the affected limb. Evidence of cerebral infarction is not present at birth but once identified directs appropriate investigation and treatment.

Conclusions: All neonates with evidence of external vascular obstruction in a limb which may mimic an obstetrical brachial plexus injury or ischemic limb must be investigated for possible cerebral infarction. Further research is needed to determine the most appropriate treatment for neonates with this rare association.

MOVEMENT DISORDERS

P-075

Treatment of Hereditary Geniospasm with Botulinum Toxin

D.E. Riley (Cleveland, Ohio, USA)

Background: Hereditary geniospasm (HG) is a rare disorder with only 13 families reported in the English literature. The chin movement is refractory to medication but has responded to botulinum toxin in 2 previous cases.

Methods: A 38-year-old woman had trembling of her chin since birth. Her mother, maternal grandmother and 17-year-old son were affected. Botulinum toxin was injected into the mentalis muscle bilaterally on 2 occasions a year apart.

Results: Initially 10 units of toxin were injected into each mentalis muscle, abolishing the quivering within 24 hours. After 3 days she felt her speech and facial expression were abnormal, although no objective abnormality was seen. This lasted 2 months. There was no recurrence of twitching until after 11 months. The second injections (5 units on each side) abolished her chin movement by the next morning. There was no ensuing abnormality of speech or facial expression, and the benefit has persisted for one year.

Conclusions: Although HG is not disabling like other movement disorders, many patients seek treatment for social reasons. A low dose of botulinum toxin can be an effective remedy.

P-076

Parkinsonism with HIV Infection

S.M. Mirsattari, C. Power and A. Nath (Winnipeg, Manitoba)

Background: The clinical association between Human Immunodeficiency Virus (HIV) infection and parkinsonism has been suspected but not established. In this study, we describe the clinical parameters, possible etiological factors and response to treatment of parkinsonism in patients with HIV infection.

Methods: This is a retrospective chart review of 115 consecutive HIV-1 infected patients seen in the Neuro-AIDS clinic in Winnipeg, Manitoba between 1990 and 1996. We adopted the United Kingdom Parkinson's Disease Brain Bank criteria for the diagnosis of parkinsonism. Patients who did not meet all the criteria for parkinsonism were considered to have parkinsonian features. Patients with opportunistic infections or malignancies were excluded.

Results: We identified 6 patients with parkinsonism and another 10 patients with parkinsonian features. All patients except for 2 had a CD4 cell count < 40 cells/mm^3. Parkinsonism and parkinsonian features were *de novo* in 1/6 (17%) and 6/10 (60%) patients with no obvious cause other than HIV infection. Parkinsonism and parkinsonian features were associated with exposure to neuroleptics in 5/6 (83%) and 4/10 (40%) patients, respectively. Only one patient, with a CD4 cell count > 500 cells/mm^3 exposure to neuroleptics did not develop extra pyramidal side effects. Discontinuation of the neuroleptics did not develop extrapyramidal side effects. Discontinuation of the neuroleptics produced complete recovery in one patient and partial or no response in others. One patient treated with high dose Zidovudine and benztropine had no response. The patient with *de novo* parkinsonism had a progressive course in the absence of specific treatment.

Conclusion: Parkinsonism may be another primary HIV-induced syndrome. Neuroleptics may precipitate parkinsonism in patients with HIV infection and hence must be used cautiously. Treatment is challenging due to the frequent association of psychosis and lack of response to antiviral drugs.

P-077

Levodopa (LD) Response Profile in Idiopathic Parkinson's Disease (PD): A Clinical-pathological Study

S. BIRDI, A.H. RAJPUT, M.E. FENTON, D. GEORGE AND R. MACAULAY (Saskatoon, Saskatchewan).

Background: Factors related to long term response failure on LD and development of motor fluctuations remain controversial. We report LD response in 40 pathologically verified Lewy body (LB) PD cases seen over 27 years with mean follow-up of 8.92 years.

Methods: Mean onset age was 59.75 years, age at death 75.45 years, mean disease duration at death 15.79 years. First use of LD after disease onset was mean 5.94 years and mean duration LD use 9.28 years. Mean dose of LD (equivalent to plain) was 2.45 g/day.

Results: 29 patients (75%) had motor fluctuations – dyskinesia (DK), wearing off (WO), or on-off (OO). There was no significant difference between fluctuators and non-fluctuators for onset age and illness duration until death. Fluctuators started LD at a significantly younger age ($p = 0.0052$), had a longer duration of LD use ($p = 0.0001$), higher mean daily dose of LD ($p = 0.0045$), and greater lifetime cummulative LD dose ($p = 0.0001$). 25 (62.5%) had DK, 14 patients (35%) WO, and seven patients (17.5%) OO, alone or in combination.

Conclusions: Our study represents long term clinical follow-up with pathological verification of PD and provides insight into clinical correlates of motor fluctuations.

P-078

Botulinum Therapy in a Case of Scalp With Auricular Dyskinesia

S.K. DAS AND R.N. RANAWAYA (Calgary, Alberta)

A 30-year-old R-handed man presented with headaches associated with involuntary movement of the scalp and both his ears for the previous 8 years. he denied any past history of tics or other involuntary movements and no exposure to neuroleptic drug. There was no family history of tics or dystonia. Examination revealed involuntary, semirhythmic, back and forth movement of the scalp as well as both the ears. No other involuntary movement was noted in the face, palate or rest of the body. Botulinum toxin (BOTX) injections of the affected muscles of the scalp and the ears brought significant relief of his headaches and marked reduction of abnormal movements. Scalp and ear dyskinesias are rare with only 17 cases having been reported in English literature. Review of this case and 17 previous cases along with discussion of etiology and the treatment of this abnormal movement will be presented.

P-079

Huntingtin Expression in Mice Heterozygous for a Targeted Disruption of the Huntington Gene

S. SPACEY, Y. WANG, J. O'KUSKY, J. NASSIR, M. HAYDEN AND M. CYNADER (Vancouver, British Columbia)

Background: Huntington disease is an autosomal dominant neurodegenerative disease. The Huntington gene codes for "huntingtin" a protein whose precise function is unknown. Mice heterozygous for a targeted disruption of exon 5 of the Huntington gene (Hdh^{ex5}) manifest significant neuronal loss in the basal ganglia. The effect of Hdh^{ex5} heterozygosity on huntingtin expression is unknown. This study aimed to localize huntingtin in normal mice brain and compare its distribution to that found in Hdh^{ex5} heterozygous mice.

Methods: Normal mouse brain and brain from Hdh^{ex5} heterozygous mice were stained immunohistochemically with antibodies directed against the amino terminal of huntingtin. Stain distribution was assessed by two trained observers.

Results: In normal mice there was staining for huntingtin in the hypothalamic and thalamic nuclei, the periaqueductal grey matter and raphe nuclei, with evidence of light staining in layer V of the cerebral cortex. There was notable absence of staining in the striatum. In Hdh^{ex5} heterozygous mice there was significantly reduced immunoreactivity in these areas.

Conclusion: The reduced immunoreactivity seen in the brains of Hdh^{ex5} heterozygous mice suggests the consequence of the disruption is reduced expression of the huntingtin protein.

COGNITIVE NEUROLOGY

P-080

Diagnostic Utility of Neuronal Thread Protein Assay in Alzheimer's Disease – A Review

V. SALY, D. WEAVER AND J. HOSTETLER (Kingston, Ontario)

Background: Large scale trials of promising therapeutic agents for Alzheimer's Disease (AD) are underway or planned. A diagnostic test that could detect patients with early AD, who are the most likely to benefit from therapy but also the most difficult to diagnose clinically, would be extremely helpful for these trials. Neuronal Thread Protein (NTP) assays have been suggested as such a test.

Methods: The Medline database was reviewed from 1966 to the present for articles with text phrases "Neuronal Thread Protein" or "Neural Thread Protein". All abstracts relevant to AD were reviewed. Five included studies of the diagnostic utility of NTP.

Results: There was an overlap of up to 50% in NTP quantity, between patients with clinical AD and control groups, using *in vivo* CSF assays. Post-mortem assays showed less overlap.

Results: NTP assay in the CSF is not a useful diagnostic test for AD, with current knowledge and techniques.

P-081

The Prevalence of Cobalamin Deficiency in Acutely Ill Psychiatric Patients

P. ROSEBUSH, M. MAZUREK, A. LEVINSON AND S.GARSIDE (Hamilton, Ontario)

Background: Cobalamin (Vitamin B_{12}) deficiency is known to be associated with a wide range of neuropsychiatric distur-

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bances including cognitive impairment, psychosis and mood disorders. The prevalence of undiagnosed B_{12} deficiency is estimated to be higher than previously thought, with 30% having normal hematological indices.

Methods: We measured morning serum B_{12} levels in 117 consecutive patients admitted to our acute care psychiatry unit.

Results: The sample comprised 44 males and 73 females with a mean age (SD) of 43.26 (18.02). Eighteen of the 117 patients including 4 males and 14 females with a mean age of 52.83, were found to have abnormally low B_{12} levels with $\bar{x}$(SD) of 102.7 (17.63) compared with a $\bar{x}$(SD) value of 287.52 (161.64) for those within the normal range of 133-500 SI. Only 3 patients (16%) with low B_{12} levels had abnormal hematological indices.

Conclusion: The prevalence of vitamin B_{12} deficiency in a general acutely ill psychiatric population is high and may be relevant to the onset and nature of the presenting disorder.

P-082

Normal Striatal Glucose Metabolism by PET in Patients with Confirmed Huntington's Disease

M. MAZUREK, C. NAHMIAS, G. COATES AND P. ROSEBUSH (Hamilton, Ontario)

Objective: To determine whether striatal hypometabolism invariably accompanies the symptomatic phase of Huntington's disease (HD).

Background: Previous studies have reported reduced glucose uptake in the striatum in virtually all patients with symptomatic HD. This has suggested that the symptoms of HD might result from a failure of striatal energy metabolism.

Methods: We used positron emission tomography (PET) to study 18-fluorodeoxyglucose (18-FDG) uptake in symptomatic patients with genetically-confirmed HD.

Results: Three individuals (including two brothers) with symptomatic HD had normal 18-FDG uptake in the striatum on PET. All three had a marked choreoathetotic movement disorder (dating back 2-15 years) and neuropsychiatric changes (dating back 10+ years) at the time of the PET scans. Genetic testing showed an expanded IT-15 allele (> 37 CAG repeats) in each case. One of the patients had a sister with HD whose PET study showed the more typical pattern of marked reduction of striatal 18-FDG uptake.

Conclusions: Moderately severe symptomatic HD can be associated with normal glucose uptake in the striatum. The clinical manifestations of HD do not invariably reflect a failure of striatal energy metabolism.

P-083

Functional Magnetic Resonance Imaging (*f*MRI) in Cognitively-Impaired Patients with Sporadic Amyotrophic Lateral Sclerosis (ALS)

M.J. STRONG, G.M. GRACE, R.S. MENON, J.B. ORANGE AND A. LEEPER (London, Ontario)

Background: Recently described cognitive impairments reflecting frontal lobe dysfunction may be frequent and underreported occurrences in patients with ALS (Strong et al., 1996). To characterize this process, we are prospectively studying cognitively-impaired individuals with ALS using detailed neuropsychological, speech, language and functional neuroimaging evaluations.

Methods: Two male patients, aged 54 and 59, with disease durations of 8 and 16 months, underwent neuropsychological studies and within 10 days, *f*MRI on a 4 T imaging system. During the *f*MRI, a covert word fluency task was administered in which patients were asked to generate words silently beginning with different letters and indicate generation of each word.

Results: Both patients displayed impairments on tasks of executive functioning (e.g., word fluency, poor organization of drawings, and concrete positioning of hands on clock drawing), in the learning and recall of unrelated verbal information; and in visual-constructional and visual-perceptual skills. The second patient also showed impairments in delayed recall and recognition of verbal and visual material, working memory, visual processing skills, confrontation naming and praxis. During *f*MRI, this latter patient failed to activate frontal regions, consistent with the neuropsychological analysis suggesting more frontal based cognition impairments.

Conclusion: Cognitive impairment in these patients is characterized by features of frontotemporal dysfunction and disrupted frontal lobe activation on *f*MRI. Additional patients are being studied to validate and extend our present findings.

P-084

The Syndrome of Inappropriate Secretion of Antidiuretic Hormone in Neuropsychiatric Systemic Lupus Erythematosus

S.M. MIRSATTARI, C. POWER, A. FINE AND J.M.G. CANVIN (Winnipeg, Manitoba)

Background: The syndrome of inappropriate secretion of antidiuretic hormone (SIADH) occurs in a variety of diseases of the central nervous system but rarely in patients with Neuropsychiatric lupus (NP-SLE). The clinical features, pathogenesis, and natural history of the NP-SLE associated SIADH are poorly understood.

Methods: Case report in which SIADH was associated with the onset of NP-SLE and its course followed that of the SLE. We also reviewed the literature on SLE associated SIADH.

Results: SIADH was associated with the onset of systemic lupus erythematosus (SLE) in an 88 year-old female. The serological markers of SLE disease activity, serum antidiuretic hormone (ADH) level, extensive neurological investigations provided some insight into the pathophysiology of NP-SLE. The unique features of the case include the late onset of SLE presenting with neuropsychiatric manifestations, a positive antiribosomal P antibody, and a chronic, persistent SIADH. The SIADH onset and severity correlated with the SLE disease activity and response to therapy.

Conclusion: SIADH may be a presenting feature of NP-SLE. It is a chronic condition, whose severity fluctuates with the SLE disease activity. Despite clinical improvement of the SIADH, the serum ADH level remains chronically elevated. We hypothesize that an autoantibody mediated mechanism underlies the

SIADH in SLE and it may be the predominant cause of NP-SLE. Antiribosomal P antibody is a putative antibody that was present in our patient and could have resulted in focal lesions in the paraventricular and supraoptic neuronal populations of the hypothalamus. We suggest that NP-SLE should be considered in the differential diagnosis of SIADH and serum electrolytes of patients with SLE should be closely monitored.

NEUROMUSCULAR DISEASE

P-085

Myasthenia Gravis and Chronic Hepatitis C

M.L. D'AMOUR AND D. MARLEAU (Montreal, Quebec)

Recently Piccolo[1] and Mase[2] described a case of myasthenia gravis in a patient with chronic hepatitis C during treatment with Interferon-a. We describe the case of a patient with chronic hepatitis C reactivated after liver transplantation who was not receiving Interferon-a at that time. She had been on Interferon-a 2 years before, but not since.

This 57 year-old woman received a liver transplantation in February 1993 for cirrhosis secondary to chronic hepatitis C. In May 1993, the hepatitis C was reactivated as shown by increasing liver enzymes, a liver biopsy and a positive HCV RNA test on PCR. She was already being treated with Cyclosporine and Prednisone. In the following months, she began to complain of weakness, mainly when climbing stairs. In April 1994, Imuran was added to her medication regimen; Prednisone was slowly decreased and discontinued in September 1994.

However, her weakness continued to increase and she was referred for a neurologic consultation in October 1994. On examination, proximal muscle strength of the upper, lower limbs and neck was graded 4/5. The rest of the neurological examination was normal. An electromyogram was done and showed findings compatible with myasthenia gravis on repetitive stimulation and single fibre EMG. Acetylcholine receptor antibodies were negative. A computerized scan of the thorax was normal.

Treatment was started with Mestinon mg tid. In the following weeks, the patient's strength improved. As the hepatic enzymes remained elevated, however Interferon-a was added in December 1994. Strength continued to improve and returned to normal. Mestinon was slowly reduced and discontinued. An HCV RNA repeated in April 1995 was negative.

In this case, myasthenia developed during reactivation of hepatitis C following liver transplantation. It improved with the immunological treatment of the hepatitis, even when the patient was given Interferon-a. It is therefore possible that the myasthenia was related to the hepatitis C itself, since several auto antibodies have been described in this condition.

[1]J Neurol Neurosurg Psychiatry 1996; 60: 348
[2]J Neurol Neurosurg Psychiatry 1996; 60: 348-349

P-086

Reversible Respiratory Failure in Rigid Spine Syndrome

C. WHITE, C. GEORGE, C. BOLTON, S. WARREN* AND A. HAHN (London, Ontario; Atlanta, GA, USA*)

Background: The rigid spine syndrome is characterized by dysmorphic features, limitation of neck and trunk flexion, joint contractures, and a mild non-progressive myopathy with childhood onset. The phenotype is very similar to Emery-Dreifuss muscular dystrophy. Respiratory failure secondary to diaphragmatic dysfunction has been reported occasionally. It is essential to recognize and treat this reversible cause of respiratory failure.

Case: This 26 year old chemical engineer had severe respiratory failure and secondary right heart failure when referred for neurological assessment. He had long-standing difficulty turning his neck in either direction or extending his right elbow. Examination revealed rigid thoracic spine, restriction of neck flexion and rotation, flexion contractures of the right elbow and ankles, and short stature. There was only mild weakness at the shoulders and hips. Polysomnography revealed recurrent apneas with profound hypoxemia during REM sleep. Needle EMG of the diaphragm showed now motor units.

With institution of nocturnal continuous positive airway pressure ventilation with oxygen, his hypoxia and right heart failure have resolved.

Genetic testing ruled out Emery-Dreifus muscular dystrophy.

Conclusions: This case demonstrates the association of rigid spine syndrome with severe nocturnal respiratory failure secondary to selective involvement of the diaphragm, and emphasizes the reversible quality of the respiratory and cardiac failure with appropriate management.

P-087

Motor and Sensory Specificity of Host Nerve Axons Influence Nerve Allograft Rejection Response

R. MIDHA, C. MUNRO, L. ANG AND S.E. MACKINNON* (Toronto, Ontario; St. Louis, Missouri, USA*)

Background: Previous studies have shown both survival and loss of regenerated host axons within nerve allograft segments after withdrawal of Cyclosporin A (CsA) immunosuppression. We hypothesized that the nature of end-organ reinnervation may influence the response of the axon, with survival of axons for correct innervation versus degeneration for incorrect innervation.

Methods: The rat femoral nerve model was chosen, as it has approximately equal sensory (S) and motor (M) divisions. Four ACI rat peroneal nerve allografts (2 cm length) were sutured in correct (right leg; MM and SS) or incorrect (left leg; MS and SM) orientation in each Lewis rat recipients. Rats received 5 mg/kg s.c. CsA daily for 8 weeks to allow end-organ reinnervation after which CsA was discontinued. Rats were killed at 8 (n = 5), 10 (n = 5), 12 (n = 20), 14 (n = 10) and 20 (n = 5) weeks and underwent histologic and morphometric analysis of the graft segment axons.

Results: Under CsA immunosuppression, the axon population in the allograft reflected the nerve of origin: more, smaller

fibres when the proximal nerve was sensory and less, larger fibres when the proximal nerve was motor. After CsA withdrawal, there was approximately 40-50% decrease of host axons as part of the ensuing rejection response. The overall proportional decrease of axons were similar across all nerve orientation groups and therefore did not appear to be influenced by the nerve of origin nor by the end-organ. However, the sensory proximal group contained more mature, non-injured fibres while the motor proximal group contained significantly more degeneration and newly regenerating axons.

Conclusions: The nature of the host axon, rather than the end-organ, influences whether the axon survives or undergoes degeneration after immunosuppression cessation. More specifically, sensory axons may be more hardy while motor axons selectively vulnerable to this second injury.

P-088

Nitric Oxide and Nitric Oxide Synthetase in Injured Peripheral Nerve Trunks

D.W. Zochodne, D. Levy, H. Sun C. Cheng, M. Lauritzen* and I. Rubin* (Calgary, Alberta; Copenhagen, Denmark*)

Background: Nitric oxide (NO) may be liberated as an inflammatory mediator within injured peripheral nerve trunks.

Methods: We evaluated the proximal stumps of transected rat sciatic nerve, structures that later form neuromas or regenerative nerve sprouts, for evidence of local NO elaboration and activity.

Results: There was striking evidence of NO activity in 48 hour and 14 day old proximal nerve stumps as indicated by local hyperemia of vasa nervorum that was reversible, in a dose dependent fashion by systemic or topical use of the nonspecific NOS (nitric oxide synthetase) inhibitor, L-NAME, but not its inactive enantiomer. NO-mediated hyperemia was only detected at the distal end of the proximal nerve stump. At the same site, NOS-like immunoreactivity was detected for ecNOS (endothelial constitutive) in 48 hour preparations and for iNOS (inducible or macrophage) in 14 day proximal nerve stumps. NOS enzymatic activity, measured by L-[3H]-arginine to L-[3H]-citrulline conversion was increased in 14 day proximal nerve stumps compared to sham-exposed nerves.

Conclusions: Injured peripheral nerves have evidence of enhanced NO action, NOS expression, and NOS activity in proximal nerve stumps that provide the cellular outgrowth for regeneration or neuroma formation.

(Supported by AHFMR and MDAC)

P-089

Response of Facial Motoneurons to Axotomy within the Central Nervous System

B. Chaudhuri (Toronto, Ontario), N.R. Kobayashi, K.M. Giehl and W. Tetzlaff (Vancouver, B.C.).

Background: Lower motoneurons (LMN) regenerate new axons, increase expression of regeneration associate genes (RAG) and survive axonal injury. In contrast, upper motoneurons (UMN), i.e. corticospinal and rubrospinal neurons, fail to regenerate, show only transient RAG expression and undergo atrophy and cell death after axonal injury close to their cell bodies. In the present study we tested the hypothesis that the site of axotomy survival influences RAG.

Methods: We established a model to axotomize LMN within the CNS by stereotaxically cutting the axons of rat facial motoneurons at the inner genu of the facial nerve. *In situ* hybridization was used to quantitate cell numbers and cell death.

Results: Most facial motoneurons survived for 2 weeks with no significant cell losses until 3 weeks. After an initial increase, the expression of RAG declined in week 3 concomitant with cell atrophy and death. This contrasts with the rapid death of corticospinal neurons, within 3-5 days after axotomy in the internal capsule (Giehl & Tetzlaff, 1996, Europ. J. Neurosci. 8:1167-1175), the failure of corticospinal neurons to increase RAG and the transient increase of RAG in rubrospinal neurons last only one week.

Conclusions: We suggest that these differences may be due to different access to trophic support. We previously found that facial motoneurons, but not UMN, show increased, but transient, expression of Brain Derived Neurotrophic Factor (Kobayashi et al., 1996, Europ. J. of Neurosci. 8:1018-1029) and Fibroblast Growth Factor 2. Both UMN and LMN express receptors for these factors indicating a possibility of transient autocrine/paracrine support for axotomized LMN. Our preliminary data suggest that UMN fail to express similar trophic support after axotomy leading to early atrophy death and the failure to express or maintain RAG.

P-090

Giant Intraspinal Pseudomeningoceles Cause Delayed Progressive Neurological Dysfunction Following Brachial Plexus Injury

W.J. Hader and D. Fairholm (Vancouver, British Columbia)

Delayed progressive neurological dysfunction following brachial plexus injury is uncommon. Three patients with a history of significant brachial plexus trauma and subsequent delayed neurological deterioration secondary to giant intraspinal extradural cysts will be presented.

Three male patients, each with a history of brachial plexus trauma > 10 years prior, presented with slowly progressive upper limb weakness. Examination revealed significant bilateral lower motor neuron deficits in their upper limbs in all and evidence of spastic paraparesis in one. MRIs and CTs demonstrated a large anterior extradural cystic collection extending from upper cervical down to lower thoracic and upper lumbar levels in each. Myelograms demonstrated a connection with the subarachnoid space in two.

Direct obliteration of the connection between the cyst and subarachnoid space was accomplished in two while a cystoperitoneal shunt was placed in the third. Post operative MRIs demonstrated complete resolution of the extradural collections. Arrest of progression of upper limb deterioration was seen in all patients while dramatic improvement of long tract symptoms occurred in one patient.

Post traumatic pseudomeningoceles at the site of nerve root avulsion are common, but they rarely extend intraspinally and become symptomatic. The pathophysiology is not clearly known, however, several speculative mechanisms will be reviewed.

SPINE

P-091

Conus Medullaris Avulsion and Lumbar Pseudomyelomeningocele Formation Following Soft Tissue Flexion Distraction Type Injury to Lumbar Spine: Case Report

R. AKAGAMI (Vancouver, British Columbia)

The use of lap belts have been associated with severe abdominal and lumbar spine injuries. An interesting case of complete avulsion of the conus medullaris and subcutaneous lumbar pseudomyelomeningocele associated with a soft tissue flexion distraction injury to the lumbar spine and massive abdominal injuries is presented. A careful review of relevant literature failed to reveal reports of this constellation of injuries. Pseudomeningoceles associated with nerve root avulsion have been well described, but avulsion of the spinal cord with a subcutaneous pseudomyelomeningocele have not. Possible mechanisms of injury are discussed.

P-092

A Novel Method of Occipitocervical Instrumentation and Fusion

T. KAIBARA AND R.J. HURLBERT (Calgary, Alberta)

Instability of the occipitocervical (OC) junction arises from a variety of etiologies including trauma, rheumatoid disease, congenital malformations and malignancy. Such instability is commonly treated by fusing the occiput to the cervical spine. Simple onlay grafts or bone strut grafts using rib or iliac crest and more recently metallic instrumentation (i.e., rods, threaded pins and plates) wired to the occiput and cervical vertebrae are techniques designed to provide rigid fixation while bony fusion occurs. However, these techniques have had variable success and require either postoperative halo immobilization or instrumentation with sublaminar wiring of subaxial motion segments to ensure stability.

We present a novel method of OC fusion in a patient with Type II odontoid and C1 burst fractures. OC stabilization was achieved using a horseshoe plate fixed with occipital screws, bilateral C2 pars interacticularis screws, and bone grafting. Recognizing that screw fixation provides superior immobilization to wiring techniques, this method avoids the risks of sublaminar wiring in a degenerative spine as well as the incorporation of unnecessary motion segments. Six month follow-up demonstrates solid union from the occiput to C2.

P-093

Understanding Spinal Cord Injury (SCI): A Patient/Family Education Booklet (CANN)

S. GIBNEY-LONG, J. MCKENZIE, K. BUCHANAN AND D. MACKENZIE

P-094

Intra-operative Motor Evoked Potentials in Children Determining the Anaesthetic Regimen and Technical Methods for Monitoring Ventral Tract Function in Surgery

M. MONCADA, S. PARKER, J. WONG, B. BISSONNETTE AND M. LEVINE (Toronto, Ontario)

Sensory evoked potentials (SEPs) monitoring is a standard technique for assessing dorsal column function during spinal surgery in many centres. However, damage incurred to anterior spinal structures during surgery may not be detected by SEP monitoring. Post-operative motor deficits have been reported despite intact intraoperative SEPs. Therefore, it has become necessary to incorporate a technique for assessing ventral, as well as dorsal column function into the standard intra-operative spinal cord monitoring regimen. Transcranial electrical stimulation of the motor cortex elicits an efferent response which can be recorded from the spinal cord with an epidural lead or from distal muscle groups. In surgery, these motor evoked potentials (MEPs) may be altered by certain anaesthetic agents. Therefore, this study endevours to establish the ideal anaesthetic regimen and technical methods for eliciting and maintaining MEPs throughout spinal cord surgery.

Twenty-six patients, ranging from the ages of 4-17 years of age undergoing elective spinal surgery are included in this study. These patients are neurologically intact as determined by a normal clinical exam, as well as normal pre-operative SEPs. The study was divided into two phases. In phase 1 MEPs were recorded in patients who were randomized to receive either total intravenous anaesthetic (TIVA) – propofol – or inhalational anaesthesia – isoflurane. No N_2O was used. Succinylcholine was used to facilitate endotracheal intubation. No other neuromuscular blocking agents were used. Recordings were made from various upper and lower limb muscles, as well as from a lead placed over the spinal cord in the epidural space. In phase 2, MEPs were recorded during isoflurane anaesthesia with and without N_2O. Only epidural MEPs were recorded here.

Epidural recordings were successful in all patients. These recordings were of equal quality with either anaesthetic. The waveforms demonstrated three distinct peaks, one of early latency – 7.67 ± 3.6 ms – and two much later – 16.84 ± 3.2 ms and 25.68 ± 3.6 ms. Upper limb muscle recordings were successful in 6 of 18 patients. Lower limb muscle recordings were not successful in any patient. When nitrous oxide was introduced to an isoflurane anaesthetic, the amplitude of the MEP waveform was attenuated to less than 50% of the original baseline.

Finally, MEPs were attempted in three patients with neurological deficits undergoing spinal cord surgery. Two had motor deficits but almost intact dorsal column function clinically and had recordable SEPs intraoperatively. No epidural MEPs were obtainable in these two patients. The third patient was ambulatory, but showed severely compromised dorsal column function clinically and had absent intra-operative SEPs. This patient had clear, albeit attenuated, MEPs intra-operatively.

MEPs elicited by trans-cranial electrical stimulation can be recorded from a lead placed in the epidural space during TIVA or inhalational anaesthetic for paediatric spinal surgery. MEPs measure pathways which are distinct from those being assessed

with a technique for assessing spinal cord integrity in paediatric patients previously excluded from monitoring due to absent SEPs.

P-095

Cost Effectiveness of DCSI: a Prospective Trial

M. CHOW AND I. MENDEZ (Halifax, Nova Scotia)

Background: For over 2 decades, spinal cord stimulators have been used for pain control in patients with failed back syndrome (FBS). Although most studies agree on the efficacy of this modality, few have addressed the issue of cost-effectiveness. It is the purpose of this study to prospectively examine the cost-effectiveness of dorsal column stimulator implantation (DCSI) in the treatment of FBS.

Methods: Nine patients with FBS were entered into the trial and information was gathered pre-operatively by means of a modified McGill Pain questionnaire which included questions on the patient's age, gender, history, diagnosis, medications, previous treatments, and employment status. Implantation data and subsequent follow-up information was also collected. Outcome measures included changes in the patient's medication usage, employment status, pain scores, and overall satisfaction with DCSI.

Results: Mean follow-up was 6 months. Results revealed an improvement in 8 of 9 (89%) patient's verbal pain scores. Medication usage decreased in 8 of 9 (89%) patients and in 3 of these patients, pain medications were stopped entirely. One of the 9 (11%) patients improved enough to return to work. One patient required a lead revision but there were no other complications. The total cost of this modality was approximately $19,100 and the majority of this was due to the hospital stay during trial stimulation.

Conclusions: An alternative to DCSI would have to have greater than 90% efficacy or cost significantly less than $20,000 to achieve similar cost-effectiveness.

P-096

Cervical Myelopathy Associated with Hypoplasia of the Posterior Arch of the Atlas: Two Case Reports

N. PHAN, C. MARRAS, R. MDHA AND D. ROWED (Toronto, Ontario)

Background: Congenital abnormalities of the posterior arch of the atlas (C1) are uncommon. They range from partial clefts to total agenesis of the posterior arch. Occasional reports of myelopathy associated with dysplastic posterior C1 arches have occurred following minor or severe head or neck trauma. There has been no previous report of myelopathy secondary to a hypoplastic but complete C1 arch.

Methods: Case report of two patients.

Results: Two elderly Chinese males developed cervical myelopathy gradually over months to years, without preceding trauma. Imaging revealed a hypoplastic but complete posterior C1 arch associated with changes of spondylosis in both patients, producing severe spinal stenosis and spinal cord compression. Posterior decompression was achieved in both by the removal of the posterior arch of C1 with its surrounding thickened posterior ligaments. Symptoms stabilized in one patient and improved in the second patient on follow-up.

Conclusion: The anomaly presented in our two cases does not fit in the established classification of congenital abnormalities of the atlas, suggesting a different embryological defect. The hypoplastic posterior C1 arch created a congenitally narrowed spinal canal in our patients rendering the spinal cord more susceptible to compression by degenerative changes of the spine such as hypertrophied posterior ligaments.

P-097

Meralgia Paresthetica Following Iliac Crest Bone Graft for Anterior Cervical Discectomy: a Case Report and Review of the Literature

L. JACQUES, J.K. RATLIFF AND R. TIEL (Metairie, Louisiana)

Objective and Importance: A ten percent rate of major complications such as superior gluteal artery or sciatic nerve injury, deep wound infection, donor site herniation, pelvic instability, fracture or meralgia paresthetica (MP) has been described following iliac crest bone graft harvesting. We describe such a case of MP, including the clinical features and surgical result.

Clinical Presentation: A 52 year old male underwent a C6-7 anterior disectomy followed by a bone graft harvest from the right anterior iliac crest. Five weeks after surgery, he became more aware of numbness, pain and paresthesia in the right thigh in the distribution of the lateral femoral cutaneous nerve.

Intervention: The patient had 3 Marcaine injection and thereafter tried Elavil but declined further use due to side effects. He underwent surgical exploration. We found a partially transected nerve in the area of the previous scar. We sectioned the nerve well proximal to the anterosuperior spine of the ileum so that the end would retract into the abdominal wall.

Conclusion: MP is a distressing complication. Optimal surgical treatment after conservative therapy has failed remains controversial. Resection of the nerve is a viable therapeutic option.

P-098

Chondrosarcoma Arising in the C-5 Foramina: a Case Report and Review of the Literature

L. JACQUES, J.K. RATLIFF, D.G. KLINE AND R. TIEL (Metairie, Louisiana)

Objective and Importance: Vertebral chondrosarcoma is a rare tumour. We present the clinical and therapeutic features of a case which presented as a C5 nerve sheath tumour.

Clinical Presentation: A 44 year old male presented with a two year history of pain in the left arm and shoulder, 6 months with pain, numbness and tingling without weakness and 3 months numbness in the 3rd and 4th digits. He had undergone resection of a melanoma in the left shoulder area 15 years ago. His physical exam was unremarkable. An EMG showed mild

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chronic denervation of the left C5 nerve root distribution. MRI studies revealed a 2 cm unenhancing mass involving the C5 nerve root as it exits the left neural foramina.

Intervention: The patient underwent a left brachial plexus supraclavicular approach.

Conclusion: Microscopic examination of the tumour revealed a low grade, well differentiated chondrosarcoma. Because of the difficulty of diagnosis we emphasize the importance of early exploration and complete resection. Adjuvant therapy should be considered for aggressively behaving tumours.

SURGICAL ONCOLOGY

P-099

Cerebral Metastatic Disease from Unknown Primary Sources: Management and Outcome Results

B.D. TOYOTA AND W. HADER (Vancouver, British Columbia)

Background: Two prospective randomized clinical trials have clearly shown that surgery plus radiotherapy is the optimal treatment for patients with a diagnosed systemic cancer complicated by a single cerebral metastases. Excluded from these studies however are patients who present with a cerebral metastatic lesion from an *unknown* primary. Empirically one might assume that this population of patients may have a worse prognosis given a presumably uncontrolled and untreated primary cancer. It is the purpose of this report to describe the experience at the University of British Columbia (UBC) with this subset of patients.

Methods: Patients presenting between 1990 and 1996 with a cerebral metastatic lesion without an initial, identifiable primary were selected for review. Data was gathered regarding general demographics, treatment, complications and length of survival.

Results: Twenty-two patients were identified. Nine patients had single metastases and the remainder suffered with multiple lesions. Twelve of the patients had gross total surgical removal of the cancers and the rest underwent stereotaxic biopsy. Patients with gross total removal followed by radiotherapy had a median survival of 11 months.

Conclusions: The experience at UBC, through retrospective review, reveals that these patients, when treated with surgery and radiotherapy, have as good or better median survival than those patients with a known and rated primary cancer. Indeed there were five long-term survivors in this group, the longest being 69 months. We feel these results serve as an important descriptor of a group of patients not included in the two major prospective studies and whose prognosis seems equally improved by surgery.

P-100

Congenital Immature Teratoma: Clinical, Radiographic and Pathological Correlations

G. DIX, N. REWCASTLE AND M.G. HAMILTON (Calgary, Alberta)

Background: Congenial teratoma is a rare brain tumour. We present a report of a patient that provides a unique correlation between clinical, radiographic and neuropathological investigations.

Case Report: A baby was delivered at 32 weeks gestation because of rapid growth of an intra cranial tumour (as identified on serial ultrasounds). Hydrocephalus was also present. The baby was neurologically devastated with absent brain stem function. The baby died after failing to establish ventilatory ability. Radiographic investigations included CT scan and MRI. An autopsy determined that the tumour (12 cm x 6 cm) was an immature teratoma.

Conclusion: This case report, utilizing correlations between radiographic investigations and neuropathology provides a unique look at the growth and effects of congenital immature teratoma, a rare brain tumour.

P-101

Establishing a Human Glioblastoma Tissue Culture Bank Using an Improved Processing Technique

I.F. PARNEY, M.A. FARR-JONES AND K.C. PETRUK (Edmonton, Alberta)

Background: Laboratory studies of human glioblastoma multiforme have ben hindered by difficulty growing human glioblastoma primary explants. We report establishment of a human glioblastoma tissue culture bank using an improved tissue processing technique.

Methods: Sixty-five consecutive malignant glioma specimens (60 glioblastomas and 5 high grade astrocytomas) were obtained from June 1988 to December 1996. The first 23 were processed by dissection, partial enzyme digestion (DNase, collagenase, and pronase), and filtration through a tissue culture sieve. The remainder were processed similarly but tumour cells were separated from other contanimating cells on a density gradient prior to plating. Cells were cultured in complete Dulbecco's Modified Eagle's F12 Media at 37°C, 5% CO_2 in polystyrene flasks. All established explants underwent immunohistochemical staining for glial fibrillary acidic protein (GFAP) and vimentin. Growth curves were obtained for representative explant cultures and compared to established human glioblastoma cell lines.

Results: Success was defined as cultures surviving more than three passages and growing to sufficient numbers ($>10^6$ cells) to allow freezing. Using the first method, 30% (10 of 23) were successfully cultured. Failure was often due to outgrowth of contaminating fibroblasts. Addition of density gradient separation increased the success rate of 82% (49 of 60). All successful cultures stained positively for vimentin while 31% (20 of 65) were positive for GFAP. All explant cultures tested grew at slower rates and showed higher degrees of contact inhibition than established human glioblastoma cell lines.

Conclusion: Interpretation of laboratory glioblastoma studies has been hampered in the past by widespread reliance on animal glioma models. This simple, reproducible method for establishing cultures of human glioblastoma cells should aid in developing human glioblastoma models.

P-102

Focal Plaques of Demyelination Mimicking Cerebral Tumour. Reports of Two Cases with a Review of the Literature

C. TOCH, K. KUMAR AND V. JAY (Regina, Saskatchewan)

Background: Focal, demyelinating lesions of the cerebrum mimicking brain tumours, though reported previ-

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ously, are a rare phenomenon, and even rarer in a pediatric population.

Methods: Patient 1 was a 42 year old female who presented with confusion, personality changes, and memory loss. Computerized tomography (CT) and magnetic resonance imaging (MRI) suggested a diagnosis of a low grade glioma. Patient 2 was a 14 year old female who presented with seizures and received a radiological diagnosis of right frontal lobe cystic astrocytoma. Stereotactic biopsy in Patient 1 and excisional biopsy in Patient 2 revealed demyelinating lesions.

Results: At 20 months follow-up, both of these cases are clinically and radiologically stable without further evidence of demyelination in other areas of the brain. Patient 1 demonstrated marked improvement in both clinical and radiological follow-ups after prednisone pulse therapy. Patient 2 is asymptomatic with no new evidence of demyelination or new lesions detected on follow-up MRI scans.

Conclusion: Clinical and radiological presentation of both cases was extremely difficult to differentiate from a neoplasm. This suggests a cautious note for the treating physicians that a demyelinating lesion must be considered in the differential diagnosis of a mass lesion, even in pediatric populations, unless proven by histology. Radiation therapy is contraindicated in such patients.

P-103

Stereotaxic Partial Excision and Aspiration of Colloid Cysts of the Third Ventricle

M. KELLY, K. KUMAR AND C. TOTH (Regina Saskatchewan)

Background: Current strategies of surgical therapy for colloid cysts have been associated with low rates of initial success, high rates of morbidity and mortality, and high rates of recurrence of cysts. High rates of recurrence following stereotactic aspiration has been hypothesized to be due to regrowth of the epithelium composing the cyst wall. Various procedures involving craniotomy are associate with a higher rate of morbidity and mortality. Endoscopic procedures have a greater operator dependence and higher morbidity rates. It has been proposed that removal of a portion of the wall approximating 50% could prevent regrowth of the cyst and limit recurrences.

Methods: We present four patients who had a stereotactic partial excision of the colloid cyst wall followed by aspiration of cyst contents for surgical therapy of colloid cysts. Two female and two male patients were followed for an average of 46 months after removal of symptomatic colloid cysts.

Results: All patients showed immediate improvement of symptoms and resolution of the cyst verified with repeat computerized tomography (CT) scans. One patient was found to have a recurrence on repeat CT/magnetic resonance imaging scanning while asymptomatic at 75 months post-operatively. The other three patients remain asymptomatic without evidence of recurrence on repeat CT scans.

Conclusion: Stereotactic partial excision and aspiration may offer an advantage over stereotactic aspiration alone as the removal of a portion of the cyst wall appears to limit recurrences.

P-104

Protein Inhibitor to Calmodulin-dependent Cyclic Nucleotide Phosphodiesterase from GMB

S. LAL, R. RAJU AND R. SHARMA (Saskatoon, Saskatchewan)

Introduction: It has been known that cyclic nucleotides play a role in the cell's growth and that the role may be altered in disease states such as cancer. This altered role may be due to changes in cyclic nucleotide levels resulting from changes in the activity of hydrolytic enzymes like *phosphodiesterases.* Taken together, in the non-CNS tumours, the results suggest that levels of phosphodiesterase activity are elevated and thereby affect the ration of cGMP to cAMP. Previous investigations from our laboratory have demonstrated a significant reduction in the catalytic activity of the 60 kDa and 63 kDa isozymes of calmodulin-dependent phosphodiesterase (CaMPDE) when comparing human cerebral tissue that was free of tumour and glioblastoma multiforme (GBM) and gliosarcoma ($p < 0.05$). The results suggested the possibility of an endogenously produced inhibitor to CaMPDE expressed in these tumours.

Methods: Cerebral tissue from patients free of tumour ($n = 4$) was obtained from patients with either glioblastoma ($n = 6$) multiforme or gliosarcoma ($n = 2$). Following homogenization and preparation, assays of bovine brain 60 and 63 kDa CaMPDE activity, in the presence of normal human cerebral tissue and tumour tissue, was undertaken. Partial purification of the protein inhibitor was done using Sephacryl S-200 gel-filtration column.

Results: Initial characterization of a heat-labile, protein inhibitor to CaMPDE, to both 60 kDa and 63 kDa isozymes was done. Sephacryl S-200 gel-filtration column chromatography suggested that the inhibitor has an apparent molecular weight of 22 kDa and experimental evidence demonstrates that this inhibitor protein acts independent of calmodulin (CaM).

Discussion: This is the first known inhibitor produced endogenously to act independent of CaM. Previous work on non-CNS tumours have shown high levels of CaMPDE activity and no inhibitor to CaMPDE. This suggests that a different mechanism may exist for the proliferation of these subsets of tumours.

P-105

Idiopathic Mastoid Plasma Cell Pseudo-tumour with Intracranial Extansion: Case Report

V. SALY, J. HOGAN, P. ELLIS, D. KYDD, L. PASZAT, R. SMITH AND J. ROSSITOR (Kingston, Ontario)

Background: Intracranial plasma cell pseudo tumour is a rare condition, especially when presenting as middle ear mass. This lesion consists of a non-neoplastic meningioma-like mass with a prominent component of plasma cells admixed with lymphocytes, histiocytes and collagen. These are usually dural based and occur at all levels of the neuraxis. Although often isolated outside the nervous system, intracranial lesions often spread by extension along arachnoid planes and into the cavernous and other sinuses. The principal symptoms are headache, cranial nerve palsies and seizures.

Methods: We present a case of a young woman with a 7 year history between initial deafness and definitive intracranial biopsy. The lesion consists of a mass of inflammatory cells including histocytes, lymphocytes, polys, mast cells, eosinophils and fibroblasts. The distinctive polyclonal plasma cell population is admixed with collagen and blood vessels. Isolated CNS PCG has been reported less than 30 times, and presenting like cholesteatoma of the middle ear is unique.

Conclusions: High dose steroids are often effective if resection is not possible. Radiotherapy is reserved for unresponsive cases.

P-106

The Accuracy of Patient Repositioning in Fractionated Stereotactic Radiotherapy

R. RAMANI, A.W. LIGHTSTONE, P.F. O'BRIEN, M.L. SCHWARTZ, C.S. YOUNG AND P. DAVEY (Toronto, Ontario)

Background: Our group has specialized in the treatment of acoustic neuromas and other brain lesions using stereotactic radiotherapy. To reposition the patient for fractionated treatments, a modified Laitinen frame has been used at our centre, both to immobilize and reposition the patient.

Methods: The accuracy of the Laitinen frame has been assessed by repeat CTs, MRI, X-ray compared to digitally reconstructed X-rays form the CT, portal images, and a new technique using lasers. These diode lasers are mounted to the Laitinen frame. Other modifications to the Laitinen frame include: moulded individual nose and ear pieces, as well as a fiducial box compatible with the CMI Inc. planning software.

Results: Our limited experience to date (ten patients) indicates that the Laitinen frame alone may have a re-application error of up to 3 mm when used to both immobilize and reposition. Patients with facial fat are more likely to be poorly repositioned. The use of the lasers has been very successful in identifying shifts, and the patient can be loosened and repositioned better.

Conclusion: When used to immobilize, the Laitinen frame exerts larger mechanical forces which can move the cartilage, etc., which the frame itself relies upon as reference points. Consequently, to simultaneously reposition and immobilize the patient, the Laitinen frame should be used with additional verification. Lasers are a promising solution.

P-107

CSF and Serum Cytokines Following Human Traumatic Brain Injury

F.X. REINDERS, J.I.M. BROWN, A.J. BAKER, R.J. MOULTON AND L. SCHLICHTER (Toronto, Ontario)

Background: Neurologic and electrophysiologic deterioration in patients who suffer severe traumatic brain injury (TBI) may occur for days. The precise mechanisms remain unclear. Recent laboratory and human studies have suggested that TBI may initiate a CNS inflammatory response. In this study, three cytokines were evaluated following human TBI in order to provide supportive evidence of CNS inflammation, to determine the temporal pattern of this response, and to establish a rational basis for an outcome and intervention study.

Methods: After institutional and ethical approval, 19 patients sufferent severe TBI (GCS 8) were intensively monitored for 5 days. They were sedated, paralyzed, and ventilated. Raised intracranial pressure was managed by CSF drainage, mannitol, and moderate hyperventilation, if necessary. At 12 hour intervals post injury, collection of both CSF (drained) and blood was completed for cytokine (IL-1β, IL-6, and TNF-α) analysis.

Results: Admission GCS of the 19 patients was 5.3 (3-8). The mortality rate was 26%. CSF and serum IL-6 concentrations were 800 pg/ml (± 240) and 260 pg/ml (± 80), respectively. CSF IL-1β was also elevated 5.2 pg/ml (± 1.2) (normal < 2). CSF and serum IL-6 levels peaked within the first 2 days after injury while both CSF IL-6 and IL-1β remained elevated for 5 days. CSF IL-6 and IL-1β levels were generally higher in non survivors than in survivors, at 48 hours post injury. CSF and serum TNF-α were within normal limits.

Conclusions: Supportive evidence of a CNS inflammatory response following TBI is presented. The ratio of CSF to serum cytokines suggests that cytokines were originating within the CNS. The prolonged elevation of CSF cytokines and the higher IL-6 levels in nonsurvivors suggest a role for cytokines in the pathophysiology of neurologic deterioration following TBI.

P-108

Meningeal Melanocytomas

D.B. CLARKE, R. LEBLANC, G. BERTRAND, G.J. SNIPES AND G.R.C. QUARTEY* (Montreal, Quebec; Moncton, New Brunswick*)

Introduction: Meningeal melanocytomas are rare tumours of the central nervous system whose natural history is poorly defined. Two cases of meningeal melanocytoma, one cranial and one spinal, are reported.

Methods: Two women, aged 21 and 30 years, had slowly progressive hearing loss (first patient) and progressive paraplegia (second patient). In the first case, CT and MRI demonstrated a large posterior fossa lesion suggesting either an acoustic neuroma or a meningioma. the patient underwent posterior fossa decompression and partial resection of the tumour followed by radiotherapy. The residual tumour evolved despite these measures and was further resected 6 months later. The second patient had an extradural tumour which was treated by laminectomy, subtotal resection and post-operative radiotherapy. Her symptoms recurred 16 years later and she underwent reoperation of the residual tumours, which was found to have an intradural component. In both cases the tumours were jet-black; the posterior fossa tumour initially bled with remarkable vigour which limited the extent of the initial resection. Histological examination revealed melanin-containing hypercellular tumours with rare mitotic figures in both cases.

Discussion: Meningeal melanocytomas are typically diagnosed in the fifth decade. Women are affected twice as often as men. The posterior fossa lesions can mimic acoustic neuromas and meningiomas in location and radiological appearance but the internal auditory canal is normal. In the spine, meningeal melanocytomas present with the clinical features of myelo-

radiculopathy. Diagnosis is made intra-operatively from the gross, jet-black appearance of the tumour and from the histological examination. Vascularity, size and location may render complete resection unfeasible. Because of the propensity to recur, radiotherapy has been recommended but its role remains to be elucidated.

P-109

Diffuse Craniospinal Seeding from a Fourth Ventricular Choroid Papilloma

R. LEBLANC, S. BEKHOR, D. MELANÇON AND S. CARPENTER (Montreal, Quebec)

Introduction: Choroid plexus papillomas can metastasize to the subarachnoid space (SAS) but extensive metastasis has only been reported when they are malignant. We report a case of diffuse and extensive metastasis to the craniospinal SAS and leptomeninges from a benign fourth ventricular choroid papilloma.

Case Report: A 19 year old woman had a 2 year history of headache, blurred vision, diplopia and ataxia. Magnetic resonance imaging of the brain and spinal cord revealed obstructive hydrocephalus from a 4 cm, partially calcified and inhomogeneously enhancing tumour in the fourth ventricle displacing the pons, medulla and cerebellum; and innumerable cystic lesions of varying sizes in the cranial and spinal SAS and leptomeninges. Histological examination of the resected fourth ventricular tumour and a few subarachnoid lesions revealed a benign choroid plexus papilloma with seedling to the leptomeninges.

Discussion: This singular case of diffuse and extensive metastasis to the craniospinal SAS and leptomeninges from a benign fourth ventricular papilloma adds to our understanding of the biological potential of these tumours and expands the differential diagnosis of posterior fossa lesions with subarachnoid seeding.

P-110

Glioma in Association With Parry Romberg Syndrome

A.M. WONG, C.M. YEGAPPAN AND F.B. MAROUN (St. John's, Newfoundland)

Background: Parry Romberg syndrome (PRS) is a rare disorder resulting in slowly progressive hemifacial atrophy of skin, soft tissue, and bone. Other abnormalities have included hyperpigmentation/vitiligo, enophthalmos, heterochromia iridis, hair blanching, alopecia, hemiatrophy of the tongue, dental malocclusion/delayed eruption, localized scleroderma, and atrophy of other parts of the body. Neurological problems include contralateral Jacksonian epilepsy, trigeminal neuralgia, and headache. Agenesis of the head of the caudate nucleus, arteriovenous malformation and progressive aneurysmal disease have also been reported. We report a case of glioma found in a patient with PRS. To our knowledge this has not been reported.

Methods: A case of 36 year old woman with known PRS found to have a glioma is described.

Case: The patient developed signs of PRS at 14 years of age. Features included right hemifacial atrophy, right atrophy of the tongue, arm, forearm, hand and foot, right coup de sabre lesion, heterochromia iridis and hyperpigmentation. ANA and RF were positive. Early CT scans taken for headache investigation proved negative. At the age of 35 she developed left sided Jacksonian seizures and these were presumed to be part of the natural history of PRS. Subsequent CT/MRI scan showed a right parietal mass which was partially resected. Pathology revealed a low grade glioma of the gemistocytic type. Further treatment by radiotherapy was given.

Conclusion: The etiology of PRS is unknown. Several theories have been advanced for this likely heterogeneous condition. These include an association with scleroderma, central sympathetic dysregulation, and neural crest defects. This first report of glioma in association with PRS may support the case of a neural crest defect. Radiological investigations are recommended for any new neurological developments.

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