Seizures in the Elderly: Etiology and Prognosis

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ABSTRACT: ***Purpose:*** To determine the etiology, early mortality, predictors of prognosis and diagnostic yields of EEG and CT scans of the head in new-onset seizures in elderly patients. ***Methods:*** EEG records for the north-central region of Saskatchewan, between 01/94 and 12/95 were reviewed to identify all adults aged 60 years or older with new-onset seizures. Information on demographics, seizure type, etiology, EEG and neuroimaging studies, anti-epileptic treatment and course of epilepsy was obtained by review of medical records and interview with the patient and/or family member. ***Results:*** Of 88 eligible subjects, 61 (69%) were contacted for follow-up, 19 (22%) were deceased (12 of whom who had a serious underlying etiology to their seizures, which was obvious at the time of initial presentation and led shortly to their demise), 4 (5%) were lost to follow-up and 4 (5%) refused participation. Excluding those refusing participation, 74/84 (88%) patients presented with partial or secondarily generalized seizures. Seizures were cryptogenic in 38/84 (45%), and due to stroke in 19/84 (23%). EEGs were abnormal in 61/84 (73%) cases, with epileptiform discharge in 33/84 (39%). CT scans were abnormal in 57/84 (68%) cases with acute pathology in 29/84 (35%). Of the 61 patients participating in the follow-up interview, 54 (89%) were treated with anti-epileptic medication and seizure control was usually successful. Predictors for ongoing seizures were more than 3 seizures at presentation, epileptiform activity on initial EEG and discontinuation of anti-epileptic medication for lack of efficacy. ***Conclusion:*** Prognosis of new-onset seizures in elderly patients is favorable if seizures are not symptomatic of a life-threatening disorder.

RÉSUMÉ: Les crises convulsives chez les gens âgés: mortalité précoce et pronostic. ***But:*** L'objectif de cette étude était de déterminer l'étiologie, la mortalité précoce, les prédicteurs du pronostic et la valeur diagnostique de l'ÉEG et du CT scan cérébral chez les patients présentant des crises convulsives d'apparition récente. ***Méthodes:*** Les enregistrements ÉEG provenant de la région du centre nord de la Saskatchewan entre 01/94 et 12/95 ont été révisés pour identifier tous les adultes âgée de 60 ans et plus qui présentaient des crises convulsives d'apparition récente. Nous avons révisé les dossiers médicaux et procédé à des entrevues des patients et/ou des membres des familles pour obtenir de l'information sur la démographie, le type de crises, l'étiologie, l'ÉEG et les études de neuroimagerie, le traitement anti-épileptique et l'évolution de l'épilepsie. ***Résultats:*** Des 88 patients éligibles, 61 (69%) ont été contactés pour un suivi, 19 (22%) sont décédés (dont 12 présentaient une pathologie sous-jacente sérieuse qui était évidente à la consultation initiale et a précipité leur décès), 4 (5%) n'ont pas pu être retracés pour le suivi et 4 (5%) ont refusé de participer. En excluant ceux qui ont refusé de participer, 74/84 patients (88%) ont consulté initialement pour des crises partielles ou secondairement généralisées. Les crises étaient cryptogéniques chez 38/84 patients (45%) et dues à un accident vasculaire cérébral chez 19/84 (23%). Les ÉEGs étaient anormaux chez 61/84 (73%) avec des décharges épileptiformes chez 33/84 (39%). Les CT scans étaient anormaux chez 57/84 des patients (68%) dont 29/84 (35%) présentaient une pathologie aiguë. Parmi les 61 patients qui ont participé à l'entrevue de suivi, 54 (89%) étaient traités avec succès par une médication anti-épileptique. Les prédicteurs du non-contrôle des crises étaient plus de 3 crises au moment de la consultation initiale, une activité épileptiforme à l'ÉEG initial et un arrêt de la médication anti-épileptique par manque d'efficacité. ***Conclusion:*** Le pronostic des crises convulsives d'apparition récente chez les patients âgés est favorable en autant que les crises ne sont pas un symptôme d'une pathologie mortelle.

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The etiology and outcome of epilepsy are related to the age at onset. In children, most cases of epilepsy are idiopathic and consequently have a favorable outcome, with seizures being relatively easy to control and remission rates being high.[1] With increasing age at the time of seizure onset, secondary causes of epilepsy become more prevalent.[2] In these cases, outcome is often less favorable and remission rates lower. One may presume that many seizures that have their onset in the elderly would be symptomatic of an underlying cause, and therefore would have a poorer outcome.

Although the incidence of epilepsy in the elderly is high, few studies have looked at the epidemiology of new-onset seizures in this age group and many of these have been derived from selected populations.[3-10] We carried out this retrospective, population-based study to define the diagnostic yields of electroencephalogram (EEG) and computerized tomography scanning of the head (CT), etiology, early mortality and prognosis in new-onset seizures in the elderly population.

Methods

EEG reports of all patients aged 60 years or older, who had a recording at the Royal University Hospital EEG laboratory between January 1, 1994 and December 31, 1995 were reviewed.

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The Royal University Hospital EEG laboratory performs all EEGs in the northern and central regions of Saskatchewan, with a population base of 514,054, of which 81,213 were aged 60 or older during the study period.[11]

All patients who had an EEG performed for their first possible seizure were identified. We initially included as potential subjects all patients sent in for possible seizures, syncope or "spells" and all patients where the reason for EEG was not specified on the requisition. Those who had onset of seizures before age 60 years, or who had an EEG for reasons other than possible seizures were excluded. For each potential subject, the family doctor and/or referring physician was contacted to verify the patients address and phone number and to confirm that the patient was still living.

Between June 1 and July 31, 1997, potential subjects were sent an information letter outlining the study and contacted one week later to request participation. After obtaining informed consent, further information about possible seizures was obtained by review of the patient's hospital chart, and by discussion with the patient, and where possible, a family member and witness to any possible seizure activity. We did not contact families of deceased patients. However, we did review their medical record and, where possible, spoke to their referring physician/family doctor to determine whether they truly had a seizure, and if so, seizure type, etiology, EEG and neuro-imaging findings and cause of death.

Events were classified into definite, probable and unlikely seizures, based on clinical history obtained by chart review and interview with the patient and witnesses, and review of clinical investigations. All patients were questioned regarding aura, loss of bowel and bladder continence, tongue-biting and post-ictal state. Episodes in which there was a clear history of tonic-clonic activity followed by a post-ictal state, or motor, sensory, visceral or psychic symptoms with altered consciousness with or without automatisms were considered *definite seizures*. Episodic motor, sensory, visceral or psychic symptoms without altered level of consciousness were considered to be *probable seizures* only if migraine and transient ishemic attacks were felt to be unlikely. Migraine was considered probable if unilateral throbbing headache followed symptoms, or if the patient gave a history of a similar aura in association with a migraine headache. Transient ischemic attack was considered probable if there was a discrete event of sudden onset, without a progressive march of symptoms from one body area to another, in a patient with vascular disease and no focal epileptiform activity on EEG in a region which could explain the clinical symptoms. Episodes in which patients were found confused and sleepy following a period for which they had not been observed, but recovered over a few hours, were considered *probable seizures* only if the patient gave a history of aura consistent with a partial onset seizure, if there was associated bladder or bowel incontinence, or if epileptiform activity was seen on EEG. Episodes were considered *unlikely seizures* if the history suggested syncope, pseudoseizures or panic attacks.

Only those with definite or probable seizures were included in the study. For these patients, further information was obtained, including sex, age at seizure onset, seizure type (primarily generalized, secondarily generalized, partial simple, partial complex, other, unknown), presumed etiology, results of investigations including EEG, CT, magnetic resonance imaging (MRI), treatment (specific anti-epileptic medication used, side effects, efficacy, duration of treatment) and course of epilepsy (status epilepticus, number and type of seizure recurrences, ease of initial seizure control, current seizure frequency and type).

Seizure type was determined by clinical history from the hospital chart, and for participating subjects, collaborated by interview with the patient and witness to any seizure. A generalized tonic-clonic seizure was classified as *probable primarily generalized* if there was no history of aura prior to the generalized tonic-clonic seizure, there were no clinical focal signs or symptoms, the initial EEG did not show focal epileptiform activity or focal slowing and there was no focal acute pathology on neuroimaging studies. All other generalized tonic-clonic seizures were considered *secondarily generalized.* Partial seizures were considered to be *partial complex* if there was a history of alteration in level of consciousness or if a post-ictal state was present. All other partial seizures were considered to be *partial simple. Status epilepticus* was defined as a single seizure lasting longer than 30 minutes, or serial seizures recurring over 30 minutes without the patient regaining consciousness between the seizures. With regards to etiology, seizures were classified as *acute symptomatic* if investigation revealed an acute onset central nervous system (CNS) insult which could cause seizures, *remote symptomatic* if the subject had a history of a temporally remote CNS insult which has been demonstrated to cause seizures and *cryptogenic* if the seizures were unprovoked and there was no historical insult capable of greatly increasing the risk of seizures.

With regards to EEG interpretation, *epileptiform activity* was defined as spikes or sharp waves on EEG which were not benign variants. Temporal slow waves which were clearly intermittent between long periods of normal background activity, and were restricted in distribution to the anterior and mid-temporal area were considered benign. Abnormal *focal slowing* was defined as slow waves which were more continuous, extended outside the anterior and mid-temporal regions, or were associated with generalized slow waves.

Statistical method

Statistical analysis was performed using EPI INFO 6.0.[12] Tabular data were examined by Chi square statistics and a value of $p < 0.05$ was considered significant. Subjects were divided into two groups based on seizure control. Seizures were considered controlled if the subject had not suffered a seizure in the three months prior to follow-up and uncontrolled if they had suffered a seizure during that time. The results of univariate analysis of adverse prognostic factors for seizure control are expressed as odds ratios (OR). A OR greater than one indicates a higher risk of uncontrolled seizures if the factor is present. A 95% confidence interval that includes 1.0 is not considered significant at $p < 0.05$.

Results

Eighty-eight patients aged 60 or older, with new-onset seizures were identified, and, of these, 61 (69%) agreed to participate in the study, 19 (22%) were deceased, 4 (5%) were lost to follow-up and 4 (5%) refused participation. Twelve of 88 (14%) patients had a serious underlying etiology for their seizures which led to their death shortly after presentation. Of these 12, 6 had primary or metastatic malignancies involving the brain, 3 had extensive cere-

bral infarctions, 2 had multi-organ failure and one had sustained a severe, global hypoxic-ischemic insult. Cause of death is known for only 2 of the 7 patients who died more remotely, and cerebral infarction was responsible in both cases.

Fifty-four percent of patients were male. Hospital and/or neurology clinic charts were reviewed for 51/61 participating subjects and for all those who were lost to follow-up or deceased. The 10 other participating subjects did not have a hospital or neurology clinic chart. Phone interviews were completed for all 61 participating subjects, however we did not contact families of deceased patients. For the 61 patients who participated in the follow-up interview, mean follow-up from seizure onset was 39 months (range 19-159, SD 26).

Seizure Etiology

Seizure etiology, type, EEG and CT results were determined for all subjects except the four who did not consent to participation. Seizures were cryptogenic in 38/84 (45%), acute symptomatic in 41/84 (49%) and remote symptomatic in 5/84 (6%). Of those with acute symptomatic causes, nearly half (19/41) were due to acute ischemic stroke, but other causes included metabolic (8/41), intracranial tumor (7/41), head injury or subdural hematoma (4/41), alcohol withdrawal (2/41) and brain abscess (1/41). Patients with intracranial tumors did poorly, with 6/7 deceased and 1/7 having ongoing seizures at follow-up. Metabolic etiologies had an intermediate prognosis. Those who had seizures due to multi-organ failure or hypoxia all died shortly after presentation, whereas those with other metabolic etiologies did well. Ischemic stroke had an excellent prognosis as long as the stroke itself was not life-threatening, with seizures resolving in all but one patient. Of those with remote symptomatic causes, 3/5 (60%) were due to prior brain infarction, 1/5 (20%) to previous encephalitis and 1/5 (20%) to prior head injury.

Ten of 84 (12%) patients presented clinically with probable primarily generalized seizures, 3 (4%) had partial simple seizures alone, 36 (43%) had partial complex with or without partial simple seizures and 35 (42%) had secondarily generalized seizures with or without partial seizures.

The median number of seizures at presentation was 2 (25th - 75th% 1-2). Presentation in status epilepticus was rare, seen in only 4/84 (5%) patients, and was partial in two and generalized in two. Although one patient died shortly after presentation of a massive cerebral infarction, the remaining three patients were seizure-free at follow-up.

Diagnostic Yield of EEG and CT Scan of the Head

The initial EEG was abnormal in 61/84 (73%) of cases. Fifty-four 54/84 (64%) showed focal slowing and epileptiform discharge was seen in 33 cases (39%), always being focal.

CT scans were performed in all patients and were abnormal in 57 (68%). Twenty-two only showed chronic changes (15 - diffuse atrophy, 12 - old ischemic lesion, 1 - calcification of the basal ganglia) while 29 showed new acute lesions (19 - new area of ischemia, 2 - subdural hematoma, 7 - tumor, 1 - abscess). Only 11 patients underwent MRI scanning and abnormalities were detected in 7, three of whom had no abnormality detected on CT.

Seizure Treatment and Control

Anti-epileptic drug treatment and seizure control were considered only for those 61 patients for whom full follow-up data are available. Thirty-two of the 61 presented with a single seizure, and of these, 17 (53%) suffered at least one more seizure during the follow-up interval from seizure onset.

The median number of recurrent seizures since presentation for all 61 patients was 1 (25-75%ile 0-4). Overall, 26 (43%) suffered no further seizures, 7 (11%) had only one further seizure (all within one month of initial presentation), 21 (34%) had two or more seizures after presentation but none in the preceding three months before follow-up, and 7 (11%) had two or more seizures after presentation and continued to have seizures in the three months preceding follow-up. Seizure frequency for the worst three months since initial presentation was documented for those 21 subjects who had suffered more than one seizure since presentation but none in the three months preceding follow-up. Of these, 12 had seizures less than monthly, 8 had seizures less often than once per week to once per month and only 1 had seizures on at least a weekly basis.

Fifty-four of 61(89%) patients were treated with anti-epileptic medication. Although all patients who had 3 or more seizures were treated, 12 patients were treated after only one seizure, half of whom had no identifiable etiology for their seizure. Only 5 patients discontinued medication and 4/5 remained seizure-free off medication. Seizures were due to cerebral infarction in three and were cryptogenic in two.

Seizure control was generally successful. At follow-up, 7/61 patients had suffered seizures in the preceding three months and 6/7 were on anti-epileptic medication at the time. A variety of anti-epileptic medications were used, including phenytoin, carbamazepine, phenobarbital, valproic acid and clobazam, and none appeared superior to the rest, either in seizure control or lack of side effects (Table). Blood levels of anti-epileptic medications were not assessed.

Predictors of ongoing seizures at follow-up

The 61 surviving patients who participated in the follow-up interview were stratified into two groups, depending on whether they had ongoing seizures in the three months preceding follow-up. Potential prognostic factors for ongoing seizures, including sex, age at presentation, seizure type, number of seizures at presentation, status epilepticus, etiology, EEG and CT findings and response to anti-epileptic drug treatment were assessed. Only three factors predicted against remission; (1) more than three seizures at presentation, (2) epileptiform discharge on the initial

Table: Use, efficacy and side effects of anti-epileptic drugs.

Drug	Number treated	Seizure control[1]			Side effects		
		seizure free	good[2]	poor[3]	none	mild[4]	severe[5]
Phenytoin	45	66%	9%	25%	52%	26%	22%
Carbamazepine	14	60	30	10	36	36	29
Valproic acid	6	50	25	25	33	33	33
Phenobarbital	5	80	0	20	40	60	0
Clobazam	5	80	0	20	60	40	0

[1]Excluding patients who stopped medication due to side effects
[2]2 or fewer seizures since starting medication
[3]3 or more seizures since starting medication
[4]side effects not requiring discontinuation of medication
[5]side effects requiring discontinuation of medication

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EEG, and (3) discontinuation of any anti-epileptic drug for lack of efficacy.

Increased seizure number at presentation correlated significantly with ongoing seizures at the time of follow-up. Only 5/9 (55%) subjects with more than 3 seizures at presentation were seizure-free in the three months prior to follow-up compared to 49/52 (94%) of those with 3 or fewer seizures (OR 11.21, 95% confidence intervals 1.58-109.13, $p < 0.01$).

Patients who had ongoing seizures in the three months preceding follow-up were significantly more likely to have shown epileptiform discharge on their initial EEG. Only 19/25 (76%) subjects with paroxysmal discharge on their initial EEG were seizure-free in the three months preceding follow-up compared to 35/36 (97%) without epileptiform discharge (OR 11.05, 95% confidence intervals 1.16-522.49, $p < 0.02$). Although there was a trend for focal background abnormalities to be seen in those with ongoing seizures at follow-up, this trend was not significant ($p = 0.06$).

Discontinuation of any anti-epileptic medication for lack of efficacy was a poor prognostic sign. Only 1/4 (25%) patients who discontinued medication for lack of efficacy was seizure-free at follow-up compared to 46/50 (92%) who did not (OR 34.50, 95% confidence intervals 2.23-1132.51, $p < 0.01$).

Discussion

The incidence of seizures in the elderly is at least as high as in the first decade of life.[3-5] Moreover, with increasing age, secondary causes of seizures become more frequent and consequently seizures are more likely to be focal in onset. In our study, only 12% of patients presented with probable primarily generalized seizures and most of these were due to alcohol withdrawal or metabolic causes. Furthermore, this probable primarily generalized group may still have had a focal onset to their seizures noted if repeated EEGs had been performed. Hauser et al. found that just over half of elderly patients with epilepsy had an identifiable etiology.[2] However, many of his patients were investigated before neuroimaging techniques such as CT scans were available, which would have probably elicited an etiology in several of the "idiopathic" cases. More recent studies have shown that seizures in the elderly are cryptogenic in 11-50%, secondary to stroke in 22-39%, and secondary to tumor in 2-22%.[6-10] Our results are similar. Forty-nine percent of seizures in our subjects were acute symptomatic, with nearly half of these being due to acute ischemic stroke. Forty-five had no identifiable etiology. Our method of subject identification by EEG records probably underestimated the true number of elderly patients with new-onset seizures, particularly those with acute symptomatic causes, as an EEG may not be requested in a patient with a seizure due to a known underlying etiology.

The EEG was a fairly sensitive test, with initial recordings showing epileptiform activity in 39% and abnormal focal slowing in nearly two-thirds of cases. Only one-quarter of our patients had a completely normal initial EEG recording. Most CT scans were abnormal and showed new acute lesions in 35% of cases. The majority of subjects did not have an MRI, which is more sensitive than CT for detecting tumors, lacunes and periventricular white matter disease and may be safer in elderly patients as it avoids the risk of contrast-induced reactions and renal failure.[13-15] In the idiopathic group, it is possible that the MRI may have shown a small lesion that was undetectable on CT scan.

In our study, the prognosis for elderly patients developing seizures was generally quite favorable, as long as the seizures were not symptomatic of a life-threatening disorder. Fourteen percent of patients were found to have a serious underlying etiology for their seizures that was readily apparent at the time of seizure diagnosis and all of these patients died of their underlying disease shortly after presenting with seizures. Of the remaining, 5% were lost to follow-up and 8% had died, presumably of other causes as a life-threatening etiology for their seizures was not found. A mortality of 8% over a three-year follow-up period is not excessive, given that this was an elderly population. Luhdorf et al. also noted the death rate in elderly patients with seizures of unknown cause did not differ from normal elderly controls.[6] Of survivors, 89% had been seizure-free for at least three months at the time of follow-up and only 11% continued to have ongoing seizures. The favorable prognosis for elderly patients with seizures is consistent with the results of Luhdorf et al., who reported that 72% of elderly patients with new onset epilepsy enter remission within the first year.[5] In our study, three factors were found to predict for ongoing seizures at the time of follow-up; increased seizure number at presentation, epileptiform activity on the initial EEG and discontinuation of an anti-epileptic medication for lack of efficacy. Increased seizure number at presentation may be a marker for more refractory epilepsy. Our study included patients who had presented with only a single seizure, who therefore do not have epilepsy, defined as two or more unprovoked seizures. One could argue that our incorporation of these patients would cause higher seizure number at presentation to be significant. However, even when we excluded patients presenting with a single seizure, higher seizure number at presentation continued to significantly predict for ongoing seizures at the time of follow-up. Kuhl et al. also reported that high seizure frequency prior to treatment was an unfavorable prognostic indicator.[16] Our findings that epileptiform discharge on EEG predicts for ongoing seizures is in keeping with the results of Luhdorf et al.[5] They found that paroxysmal abnormalities on EEG were significantly correlated with seizure recurrence, but that neither seizure type nor etiology correlated with severity of epilepsy. Finally, other studies have shown that discontinuation of an anti-epileptic drug for lack of efficacy is a poor prognostic sign and a marker of more severe epilepsy.[17]

The majority of our patients were treated with anti-epileptic medication, even after their first seizure. Although 89% of our treated patients were seizure-free in the three months prior to follow-up, Hauser noted that recurrent seizures occur in only between 15-60% of patients presenting with their first seizure and unacceptable side effects to anti-epileptic medication are seen in 30%.[18] He concluded that drug therapy should be deferred in patients presenting with a single seizure, particularly if no specific brain lesion is found. Nearly half of our elderly patients experienced side effects to anti-epileptic medications, often severe enough to require discontinuation of medication.

Acute ischemic strokes accounted for the majority of acute symptomatic seizures. Kilpatrick et al. found that 4.4% of patients admitted with strokes or transient ischemic attacks developed seizures, usually within 48 hours or presentation,[19] however, epilepsy persisted in the long term in only a third of these patients.[20] Although elderly patients developing seizures as a result of cerebral ischemia may warrant anti-epileptic therapy during the

acute phase, long-term medication could probably be avoided. Although our numbers are small, all three patients who had seizures during the course of a cerebral infarction and attempted to discontinue anti-epileptic medication were successful.

We conclude that the prognosis for the majority of elderly patients presenting with new-onset seizures is favorable, if serious underlying etiologies are ruled out. Given the frequency of side effects with anti-epileptic medication, we agree that elderly patients presenting with a single seizure, in the absence of an underlying brain lesion, should not be treated. However, for those who do require medication, the majority will have their seizures controlled without serious side effects.

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