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Correspondence

Anaesthesia for non-cardiac surgery in a patient with Becker's muscular dystrophy supported with a left ventricular assist device

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EDITOR:

Recent developments in mechanical circulatory support devices and the limited supply of donor hearts for transplantation have meant that ventricular assist devices (VADs) have become an important therapeutic modality for patients with refractory cardiac failure [1]. Mechanical circulatory support devices may be used as a bridge to cardiac transplantation, as a bridge to recovery or as a permanent alternative to transplantation. Patients supported with VADs may require anaesthesia for various non-cardiac surgical procedures and may present with a wide range of illness severity and differing underlying causes of cardiac failure. Patients who are discharged from hospital with long-term devices may present for non-cardiac surgery to non-specialist centres. Anaesthesiologists require a knowledge of the function of these devices and an understanding of the implications for anaesthesia for non-cardiac surgery. We describe a case of anaesthesia for abdominal surgery in a patient with Becker's muscular dystrophy (BMD) supported with a left ventricular assist device (LVAD) and discuss the anaesthetic considerations for this patient.

A 19-yr-old male with BMD-related cardiomyopathy was admitted to our centre with acute decompensated cardiac failure. He received a Thoratec (Thoratec Laboratories, Pleasanton, CA, USA) paracorporeal LVAD as a bridging therapy to cardiac transplantation. He recovered well postoperatively. Satisfactory device function resulted in resolution of multi-organ dysfunction syndrome associated with acute cardiac failure. Two weeks after device implantation he developed fever, nausea, vomiting and abdominal pain. Examination revealed temperature 37.8°C, pulse 110 beats min^{-1}, arterial pressure 90/60 mmHg, central venous pressure (CVP) 8 mmHg and right-sided lower abdominal tenderness. An abdominal computed tomographic scan, which was technically limited because of the proximity of the LVAD, suggested acute appendicitis. The patient proceeded to emergency appendicectomy.

Previous general anaesthesia for LVAD implantation had been uneventful. Battery power was utilized for the device during the patient's transport to the operating theatre. Anticoagulation with intravenous (i.v.) unfractionated heparin was discontinued immediately preoperatively. Arterial and CVP monitoring was continued intraoperatively. Suxamethonium and inhalational anaesthetic agents were avoided to prevent triggering malignant hyperpyrexia and the availability of dantrolene was confirmed. The anaesthetic technique consisted of the use of an anaesthetic machine free from inhalational agents, a modified rapid sequence induction using low-dose atracurium, tracheal intubation, mechanical ventilation with oxygen and air, total i.v. anaesthesia using propofol and i.v. opioid-based analgesia. Nasopharyngeal temperature and neuromuscular blockade were monitored during anaesthesia. Prophylactic antibiotics were administered and care was taken to exclude the paracorporeal LVAD components from the surgical field. Stable device output was maintained during surgery. No changes in patient positioning were necessary and cardiovascular pharmacological support was not required. A total of 1 L of crystalloid solution was given and no blood products were transfused. There was no evidence of malignant hyperthermia during anaesthesia. Intraoperative findings were in keeping with acute appendicitis and an appendicectomy was performed through a right lower quadrant incision. Diathermy was utilized during surgery without causing electrical interference with LVAD function. He was extubated in the operating theatre and transferred to the ICU. Anticoagulation with i.v. unfractionated heparin was

Correspondence to: Stephen T. Webb, Department of Anaesthesia, Papworth Hospital, Papworth Everard, Cambridge CB23 8RE, UK. E-mail: stephentwebb@doctors.org.uk; Tel: +44 (0)1480 364406; Fax: +44 (0)1480 364936

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recommenced. There were no postoperative complications and he was subsequently discharged to a ward. The patient remained in hospital and underwent successful cardiac transplantation 2 months after LVAD implantation.

BMD is a type of muscular dystrophy, a group of inherited disorders of skeletal muscle caused by an X-linked recessive mutation resulting in abnormal or absent dystrophin protein. The incidence of BMD is 1 in 30 000 male births. Cardiac muscle may also be affected and patients may develop cardiomyopathy requiring cardiac transplantation [2]. The anaesthetic considerations for patients with muscular dystrophy relate to the increased risk of malignant hyperpyrexia and the increased sensitivity to non-depolarizing neuromuscular blockers.

Mechanical circulatory support devices are considered for patients with cardiac failure refractory to medical therapy and intra-aortic balloon counter pulsation [3]. VADs are mechanical pumps that assist ventricular function and restore end-organ perfusion by collecting blood returning to the heart and pumping it downstream of the ventricle. Devices may be classified depending on the mechanism of pumping blood, the site with respect to the patient, the ventricle assisted and the duration of support. The Thoratec VAD is a pulsatile, paracorporeal device that consists of a blood chamber located on the upper abdomen just outside the patient's body, two cannulae connecting the chamber to the heart and great vessels, and a drive console supplying power to pump the blood. The blood chamber operates by vacuum-assisted filling and pneumatically driven ejection to create an effective stroke volume of 65 mL and pulsatile blood flow up to 7 L min^{-1}. It can be used to assist the left ventricle or right ventricle separately or both ventricles simultaneously for an intermediate period of time (weeks to months). Continuous anticoagulation is necessary to prevent VAD-related thromboembolic events. There are a limited number of reports of anaesthesia for non-cardiac surgery in VAD-supported patients [4,5]. Despite the restricted access to the surgical site, abdominal surgery has been reported in patients supported with VADs [6].

For a patient with a mechanical circulatory support device presenting for anaesthesia for a non-cardiac procedure, the key consideration is communication with the team responsible for the management of the device [7]. The type of device should be discussed and established and a strategy for the management of perioperative anticoagulation agreed. Adequate battery power must be ensured during patient transport to and from the operating theatre. The potential for electrical interference with VAD function by defibrillation and diathermy should be recognized. Unlike other types of VAD, the Thoratec device is shielded from electrical interference and both defibrillation and diathermy are safe to use. Strict sterile technique and appropriate prophylactic antibiotics are essential to avoid VAD-related infection. Anticoagulation increases the risk of complications with regional anaesthesia and general anaesthesia is usually the technique of choice. Local anaesthesia infiltration and sedation may be a suitable alternative. For patients with intracorporeal or paracorporeal VADs, the risk of pulmonary aspiration of gastric contents should be considered during induction of anaesthesia. Arterial and CVP monitoring are valuable but not essential for all patients. Pulmonary artery catheter monitoring may be useful in a patient with a LVAD with right ventricular dysfunction but one should not be placed in a patient with a right VAD. Transoesophageal echocardiography may provide a valuable intraoperative assessment of an unassisted ventricle in a patient with a single VAD during non-cardiac surgery. Most of the commonly used types of VAD operate on an automatic volume mode so that the blood chamber will automatically eject as soon as it is full. The two most important factors resulting in reduced device output are incomplete chamber filling (decreased preload) and incomplete chamber emptying (increased afterload). Maintenance of haemodynamic stability during anaesthesia requires correcting hypovolaemia, ensuring appropriate pharmacological support and excluding tamponade or failure of an unassisted ventricle. Care should be taken during changes in patient positioning as preload may be significantly altered. Haemodynamically significant arrhythmias should be treated appropriately with pharmacological or electrical means. External chest compression should be avoided because of the risk of cannula dislodgement.

As the use of mechanical circulatory support devices continues to expand, patients with these devices are likely to require anaesthesia for non-cardiac diagnostic and surgical procedures with increasing frequency. We conclude that the perioperative management of this complex patient population for non-cardiac surgery requires a knowledge of mechanical circulatory support devices and an understanding of the underlying disease causing cardiac failure.

S. T. Webb, V. Patil, A. Vuylsteke
Department of Anaesthesia
Papworth Hospital
Papworth Everard
Cambridge, UK

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Positioning of the univent tube with bronchial blocker without fibreoptic bronchoscopy

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One-lung ventilation is desirable for open thoracotomy or video-assisted thoracoscopic surgery to facilitate lung exposure for the surgical procedure by collapsing the lung. Double-lumen endotracheal tubes are commonly used for this purpose. The univent single-lumen tube with an endobronchial blocker, has some advantages over the double-lumen tube: easier insertion in patients with difficult airways [1] and no need for tube exchange when postoperative mechanical ventilation is required. Fibreoptic bronchoscopy has been considered necessary to verify the position of the univent tube blocker [2,3]. This study was designed to evaluate whether correct position of the endobronchial blocker could be achieved without using a fibreoptic bronchoscope in right lung surgery patients.

The study was approved by our hospital review board. Written, informed consent was obtained from all patients. Sixty patients (18–75 yr old), undergoing thoracic surgery for which one-lung ventilation was required, were enrolled. In Group 1 ($n = 30$) the endobronchial blocker was advanced blindly as described below, and in Group 2 ($n = 30$) fibreoptic bronchoscopy was used.

Correspondence to: Yong-Shin Kim, Department of Anesthesiology, St Vincent Hospital, College of Medicine, The Catholic University of Korea, #93 Ji-Dong, Paldal-Gu, Suwon 442-723, South Korea. E-mail: aneskim@catholic.ac.kr; Tel: +82 31 249 7212, 7214; Fax: +82 31 258 4212

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The cuffs of the univent tube (Fuji Systems Corp, Tokyo, Japan) and bronchial blocker were tested for leaks before intubation. The bronchial blocker was lubricated with 10% lidocaine spray. The tube size was adapted to sex, height and weight of the patients (6.5 or 7.0 mm for females and 7.0 or 7.5 mm for males). Anaesthesia was induced with lidocaine 40 mg, propofol 2.5 mg kg^{-1} and rocuronium 0.6 mg kg^{-1} intravenously. The univent tube was inserted under direct laryngoscopy. In Group 1, once the tube cuff had passed the vocal cords, the tube was rotated 90° towards the right. The bronchial blocker was advanced sufficiently, and 4 mL of air was injected into its cuff. Breath sounds were auscultated to confirm whether the blocker was in the right bronchus (the case was considered a failure if it was in the left bronchus). The lumen at the distal end of the bronchial blocker was connected to a capnograph for analysis of end-tidal CO_2 ($ETCO_2$) wave forms. If necessary, 1 mL at a time was added to the endobronchial cuff until the $ETCO_2$ wave form ceased, indicating complete blocking of the bronchus. Then, the bronchial blocker was slowly withdrawn until $ETCO_2$ reappeared. The scale mark on the blocker was noted and it was advanced 2.5 cm into the right bronchus again until $ETCO_2$ ceased. If breath sounds could be heard over the right upper lung field due to an unobstructed right upper lobe bronchus, the bronchial blocker was withdrawn 0.5 cm at a time until the sounds disappeared. At this stage, the position

