Open Abdominal Aortic Aneurysm Replacement in the Awake Patient

L. Meecham, MBBCH, MRCS¹ A. Torrance, MBCHB, MRCS¹ S. Vijay, MB, BS, FRCR³
A. Burtenshaw, MBCHB, FRCA² R. Downing, MBCHB, MD, FRCS¹

¹Department of Vascular Surgery, Worcestershire Royal Hospital, Worcester, England

²Department of Anaesthesia, Worcestershire Royal Hospital, Worcester, England

³Department of Radiology, Worcestershire Royal Hospital, Worcester, England

Address for correspondence Lewis Meecham, MBBCH, MRCS, ST4 Vascular surgery, Shrewsbury Royal Hospital, Shrewsbury, SY3 8XQ, United Kingdom (e-mail: meechaml@doctors.org.uk).

Int J Angiol 2017;26:64–67.

Abstract

Keywords

- abdominal aortic aneurysm
- epidural anesthesia
- regional anesthesia

Nonintubated aortic surgery using various techniques has been reported, but despite publication of favorable outcomes in select patient groups, awake aortic surgery remains unpopular. Our patient had an abdominal aortic aneurysm that was unsuitable for endovascular repair. Because of the significant respiratory disease, general anesthesia represented an unacceptably high risk. As a result, he underwent open AAA repair via a retroperitoneal approach with the aid of epidural anesthesia. Here, we highlight the benefits of the procedure which offer a select cohort of patients the chance of life-saving surgery.

We report a case of open replacement of an abdominal aortic aneurysm (AAA) under regional anesthesia alone. The potential benefits of the procedure are presented.

Case Report

A 78-year-old man was found to have an asymptomatic 5.1-cm diameter AAA during investigation of hematuria for which no cause was ascertained. His medical history included type II diabetes mellitus, hypertension, vertebrobasilar insufficiency, cerebrovascular event, and emphysema. He was independent in daily living activities and had smoked daily for the past 60 years. Following initial assessment, he was enlisted in our ultrasound AAA surveillance program.

Overall, 10 months from initial diagnosis, his aneurysm had increased in size to 5.6 cm diameter with a short dissection flap extending from the neck to the origin of the left common iliac artery (CIA) as defined by CT angiography. Two marked neck angulations were present, the most proximal measuring 58 degrees (► **Fig. 1**) and the second 71 degrees (► **Fig. 2**). Neck length was 30 mm and diameter was 19 mm. As such aneurysm neck angulations precluded endovascular stent grafting (endovascular aneurysm repair [EVAR]), he underwent

preoperative anesthetic assessment of his suitability for open repair.

The assessment included a full blood count, renal and coagulation profiles, and electrocardiogram, which were all within normal parameters. Echocardiography revealed normal left ventricular function with mild diastolic impairment. A chest radiograph showed gross emphysematous changes with an enormous bulla at the left lung base as confirmed by CT scan. Lung function tests revealed a forced expiratory volume over 1 second (FEV₁) of 1.0 L (36%) predicted and a forced vital capacity (FVC) of 2.56 L (70% predicted) (FEV₁: FVC = 53). FEF 25 to 75/FVC = 16% predicted values. He described his exercise limit as being able to walk 100 yards on the flat and cardiopulmonary exercise testing demonstrated an anaerobic threshold of 12.7 mL/kg/min.

In view of his poor respiratory function and in the face of particular concerns over intraoperative bullous rupture during positive pressure ventilation, it was felt that, because of an excessive perioperative risk, an open procedure would be performed under combined spinal and thoracic epidural anesthesia with bilateral transverses abdominis plane blocks, supplemented with intravenous sedation. No tracheal intubation or inhalation agents were used. A retroperitoneal approach

Fig. 1 Proximal angulation.

(RP) was adopted to minimize postoperative complications and gain better access to the juxtarenal neck of the aneurysm.

Following peripheral venous, central venous, and arterial cannulation a thoracic epidural catheter at the level of T9/T10 was placed, followed by a subarachnoid block at the level of the L3/4 interspace using 2.7 mL 0.5% marcaine with 300 µg diamorphine. Bilateral transversus abdominis plane block catheters were also inserted to supplement the epidural in the event of a patchy block should a transperitoneal surgical approach become necessary, to limit the risk of requiring positive pressure ventilation as far as possible. He then received target controlled propofol infusion to achieve conscious sedation and maintained oxygen saturations of 100% throughout the case breathing 2 L O₂/min via a facemask with capnography monitoring.

Retroperitoneal exposure of the infrarenal aorta and proximal CIAs was performed using a left lower quadrant muscle

Fig. 2 Distal angulation.

cutting incision (Rutherford Morison). The left renal vein remained intact. The infrarenal aorta and CIAs were clamped following intravenous heparin administration and a 14-mm Dacron prosthesis (Vascutek Ltd., Inchinnan, Renfrenshire, Scotland) anastomosed to the infrarenal aorta and aortic bifurcation using a standard inlay procedure. The abdominal wall was closed in layers.

The surgery lasted for 3.5 hours. During the time of surgery, he received two boluses of 5 mL 0.5% marcaine via the epidural catheter at 1.5 and 2.5 hours after entering the theater. He received a total of 2 L crystalloid, 1 L colloid, and 267 mL cell salvaged blood during surgery, guided in part by Edwards Lifesciences Vigileo (Edwards Life Sciences, Newbury, West Berkshire, England) cardiac output monitoring in addition to standard monitoring. Anesthesia was entirely uncomplicated, and the patient was transferred in an alert and comfortable condition to a high-dependency unit via the theater recovery room. Thereafter, he made a rapid, uncomplicated recovery. Diet was commenced the following day and his epidural removed 2 days later. He was discharged on the 5th postoperative day. On review at 4 weeks, he had signs of cholesterol embolization to both feet with the development of digital ulceration, treated with antibiotics, naftidrofuryl oxalate, and clopidogrel. After 8 weeks, the lesions had healed.

Discussion

Nonintubated aortic surgery using various techniques has been reported, but despite publication of favorable outcomes in select patient groups, awake aortic surgery remains unpopular. Our case highlights the benefits of the procedure which offers a select cohort of patients the chance of life-saving surgery.

The advantages of epidural anesthesia are well documented; namely, less cardiovascular instability, decreased respiratory complications in patients with chronic obstructive airway disease, and excellent postoperative pain relief.¹ Although early studies claimed improved mortality rates recent meta-analysis has suggested this is equivocal, although the procedure does confer improved morbidity in the postoperative period, with an earlier return to normal function and decreased hospital stay.²

As abdominal aortic surgery is associated with significant cardiopulmonary risk, epidural anesthesia has been incorporated into regular practice alongside general anesthesia (GA) resulting in reduced postoperative morbidity.³

The transperitoneal approach (TP) for open aortic surgery is most commonly used, although evidence suggests that the RP has comparable mortality but decreased immediate postoperative morbidity and hospital stay. A study conducted by Cinar et al, compared postoperative outcomes using the following two approaches: RP was favored as it resulted in a shorter intensive care unit (ICU) stay postoperatively and decreased requirement for nasogastric decompression.⁴ A study reported by Kalko et al supports these following findings: TP and RP provided comparable results for operating time, aortic cross-clamp time, and intraoperative blood loss. However, RP resulted in a shorter intubation time and ICU

and hospital stays with an earlier return of bowel function and resumption of diet. Significantly, RP was associated with a lower incidence of pulmonary complications (4.4 vs. 7.3%).⁵ Unfortunately, no studies have compared the two approaches under epidural anesthesia used exclusively.

Rosenbaum et al in 1994 reported a case series of 69 patients using the RP under epidural anesthesia for occlusive infrarenal aortoiliac disease.⁶ They reported a mortality rate of 1.6% and major morbidity rate of 11%. No pulmonary complications were reported which the authors ascribe to the absence of endotracheal intubation. McGregor et al published a case series of awake aortic aneurysm repair in six patients with severe chronic obstructive pulmonary disease (COPD). All patients had severe pulmonary disease ($FEV_1 = 23 \pm 5\%$ of predicted, $FVC = 34 \pm 5\%$ of predicted and $P_{O_2} = 62 \pm 2$ mm Hg). Overall, five patients underwent AAA repair under epidural anesthesia using an RP. No significant pulmonary complications were described. One patient who did not tolerate the procedure under sedation because of agitation was intubated to complete the operation under GA with resultant prolonged postoperative hospital stay.⁷ In both case series, no comment is made about the suitability of the aneurysms for EVAR.

The nonintubated AAA repair has been compared to AAA repair under general anesthetic in a study from 1990 by Pecoraro et al.⁸ Overall, 10 patients with low cardiopulmonary risk undergoing AAA repair under epidural anesthesia via an RP approach were compared with 20 low-risk patients receiving both epidural and GA. The authors reported a combined morbidity of 13% in the epidural alone group compared with 31% in the combined epidural and GA group. A patient's death from aspiration pneumonia caused them to abandon the exclusive epidural technique.

These early reports focused on a retroperitoneal approach using epidural anesthesia alone and suggested favorable results when compared with open repair under GA. However, many of these unfit patients can now be managed by EVAR, which can be performed under locoregional anesthesia thereby ameliorating the cardiorespiratory complications of a general anesthesia. However, not all aneurysms are suitable for standard EVAR. In 2010, Berardi et al published a case series of seven patients with severe COPD undergoing open AAA repair under combined spinal and epidural anesthesia.⁹ All the seven patients were unsuitable for EVAR or GA. They reported no significant morbidity with a 100% survival at 12 months' follow-up.

In recent years, more sophisticated aortic stents have allowed more aneurysms to be treated by EVAR. Such is now the case for some juxtarenal aneurysms using fenestrated EVAR technology and those with highly angled necks using, for example, the Aorflex system by Lombard Medical (Plainview, NY). However, there are drawbacks; juxtarenal stents must be custom made and are expensive, costing in the region of £20,000.¹⁰ It is also recognized that increasing neck angulation is associated with a higher rate of complications. Neck angulation of more than 60 degrees is associated with a significantly higher 30-day mortality; acute conversion to open surgery; aneurysm expansion; graft migration; and

type I endoleak.¹¹ We believed that the patient would not have survived acute or delayed conversion to open surgery.

"Off label" techniques to address excessive neck angulation have been developed; for example, the application of multiple proximal aortic extension cuffs to give a flexible excluder to traverse severe aortic angulation. Another technique involves placement of a thoracic stent graft to the infrarenal aorta and connect a standard short body bifurcated graft to its distal end to effect aneurysm exclusion.¹² However, it must be stated that these "off-label" techniques are user dependent with uncertain long-term results and have not received universal approval.

A TP under combined spinal and epidural has also been described. Flores et al in 2002 presented a case series of three patients with severe COPD (categorized by either a $P_{aO_2} \leq 60$ mm Hg, $P_{aCO_2} \geq 45$ mm Hg, $FEV_1 \leq 50\%$ of predicted, and/or $FVC \leq 75\%$ of predicted).¹³ In this group, transperitoneal open repair was performed with no reported post-op respiratory complications. In 2007, Kalko et al reported 23 cases of open, infrarenal AAA repair through a minilaparotomy (7–10 cm midline incision).¹⁴ Overall, 10 operations were performed under epidural alone (group 1) and 13 under GA (group 2). Endovascular aneurysm repair was prohibited by either cost or health insurance policy. There were no significant differences between the groups in the characteristics of the aneurysm or operation, cross-clamp time, operative time, or blood loss. No postoperative respiratory complications occurred in patients from group 1, with one death attributed to pulmonary infection from prolonged intubation in group 2. They showed a statistically significant difference in the duration of ICU and overall hospital stay between the two groups.

Conclusion

Nonintubated AAA replacement under combined spinal and epidural anesthesia provides an alternative for aortic surgery in high-risk patients where predicted perioperative respiratory complications preclude GA and endovascular treatment is either technically or financially prohibitive. Combining regional anesthesia with an RP in selected patients may have cumulative benefits for high-risk patients, but structured studies are needed to confirm this suspected benefit.

Funding

None.

Note

The content in this article has not been published or is being considered for publication elsewhere.

Acknowledgments

All the authors have contributed significantly and are in agreement with the content of the article. There is no conflict of interest to report.

References

- 1 Werawatganon T, Charuluxanun S. Patient controlled intravenous opioid analgesia versus continuous epidural analgesia for pain after intra-abdominal surgery. *Cochrane Database Syst Rev* 2005; (1):CD004088
- 2 Kettner SC, Willschke H, Marhofer P. Does regional anaesthesia really improve outcome? *Br J Anaesth* 2011;107(Suppl 1):i90–i95
- 3 Panaretou V, Toufektzian L, Siafaka I, et al. Postoperative pulmonary function after open abdominal aortic aneurysm repair in patients with chronic obstructive pulmonary disease: epidural versus intravenous analgesia. *Ann Vasc Surg* 2012;26(2):149–155
- 4 Cinar B, Goksel O, Kut S, et al. Abdominal aortic aneurysm surgery: retroperitoneal or transperitoneal approach? *J Cardiovasc Surg (Torino)* 2006;47(6):637–641
- 5 Kalko Y, Ugurlucan M, Basaran M, et al. Comparison of transperitoneal and retroperitoneal approaches in abdominal aortic surgery. *Acta Chir Belg* 2008;108(5):557–562
- 6 Rosenbaum GJ, Arroyo PJ, Sivina M. Retroperitoneal approach used exclusively with epidural anesthesia for infrarenal aortic disease. *Am J Surg* 1994;168(2):136–139
- 7 McGregor WE, Koler AJ, Labat GC, Perni V, Hirko MK, Rubin JR. Awake aortic aneurysm repair in patients with severe pulmonary disease. *Am J Surg* 1999;178(2):121–124
- 8 Pecoraro JP, Dardik H, Mauro A, et al. Epidural anesthesia as an adjunct to retroperitoneal aortic surgery. *Am J Surg* 1990;160(2):187–191
- 9 Berardi G, Ferrero E, Fadde M, et al. Combined spinal and epidural anesthesia for open abdominal aortic aneurysm surgery in vigil patients with severe chronic obstructive pulmonary disease ineligible for endovascular aneurysm repair. Analysis of results and description of the technique. *Int Angiol* 2010;29(3):278–283
- 10 British Society for Endovascular Therapy and the Global Collaborators on Advanced Stent-Graft Techniques for Aneurysm Repair (GLOBALSTAR) Registry. Early results of fenestrated endovascular repair of juxtarenal aortic aneurysms in the United Kingdom. *Circulation* 2012;125(22):2707–2715
- 11 Sternbergh WC III, Carter G, York JW, Yoselevitz M, Money SR. Aortic neck angulation predicts adverse outcome with endovascular abdominal aortic aneurysm repair. *J Vasc Surg* 2002;35(3):482–486
- 12 Silingardi R, Lauricella A, Tasselli S, Trevisi Borsari G, Mistral Klend Sasha N, Coppi G. Use of combined thoracic and abdominal endografts for proximal severe neck angulation in abdominal aortic aneurysms. *J Endovasc Ther* 2012;19(4):517–524
- 13 Flores JA, Nishibe T, Koyama M, et al. Combined spinal and epidural anesthesia for abdominal aortic aneurysm surgery in patients with severe chronic pulmonary obstructive disease. *Int Angiol* 2002;21(3):218–221
- 14 Kalko Y, Ugurlucan M, Basaran M, et al. Epidural anaesthesia and mini-laparotomy for the treatment of abdominal aortic aneurysms in patients with severe chronic obstructive pulmonary disease. *Acta Chir Belg* 2007;107(3):307–312