Anaesthetic implications of aortic stent surgery

J. M. C. GREIFF, M. M. THOMPSON AND B. T. LANGHAM

Summary
We present a case of abdominal aortic aneurysm repair using a new technique of aortic stenting and discuss the anaesthetic technique used and the perioperative advantages of the technique. (Br. J. Anaesth. 1995; 75: 779–781)

Key words

Elective abdominal aortic aneurysm surgery is a routine procedure, but it carries significant risks for the patient and has major implications for hospital resources. The operative mortality is 1–6 % and morbidity occurs in 38 % of patients [1]; pulmonary diseases account for 40 %, congestive heart failure 37 %, myocardial infarction 2–15 % and renal failure 4–7 %.

An alternative technique of aortic stent graft [2] has been introduced recently for aortic aneurysm repair. The concept of minimally invasive treatment of aneurysmal disease was described initially by Dotter in 1969 [3]. Pioneering work by Parodi, Palmaz and Barone [4], coupled with advancement in stent and graft technology have allowed endovascular aneurysm repair to reach preliminary clinical trials. Endovascular aortic aneurysm repair involves transfemoral placement of an intraluminal prosthetic graft into the infrarenal aorta, with the aim of excluding the aneurysm sac from the circulation. The intraluminal prosthesis is anchored to the normal aortic wall both above and below the aneurysm using a balloon expandable or self-expandable metallic stent [5].

We describe a case in which an aortic stent graft was used to treat an abdominal aortic aneurysm and discuss the modifications that were made to the anaesthetic technique compared with the conventional open operation, together with the differences in the postoperative care required.

Case report
A 64-yr-old man with a 5.8-cm infrarenal abdominal aortic aneurysm was admitted 24 h before operation. His general health was good and he had no previous history of cardiovascular or cerebrovascular disease, but he smoked 7–8 cigars per day. Examination, apart from an abdominal pulsatile mass, was unremarkable. Investigations, including full blood count, serum urea and electrolyte concentrations, electrocardiogram and chest x-ray, were normal.

After placing appropriate monitoring and cannulating suitable veins, preoxygenation was carried out and anaesthesia was induced with alfentanil 0.5 mg and propofol 200 mg. Neuromuscular block was provided by atracurium (initial bolus of 35 mg, followed by two doses of 15 mg and 10 mg), and the lungs were ventilated with 1.5 % isoflurane and 67 % nitrous oxide in oxygen using a circle system. Augmentin 1.2 g i.v. was given according to the protocol for vascular surgery in this hospital. Arterial pressure was monitored using a 20-swg radial arterial cannula, and CVP was monitored via a right internal jugular triple lumen catheter. Other sites of venous access included a 14-swg i.v. cannula in the left arm and a 16-swg i.v. cannula in the right arm. The patient’s bladder was catheterized and a renal dose of dopamine 3 μg kg⁻¹ min⁻¹ i.v. was infused via the right internal jugular catheter.

Arterial pressure was maintained at 130/70 (+/−10 %) mm Hg and heart rate at 65 (range 60–75) beat min⁻¹. Oxygen saturation remained at 97 % and end-expired carbon dioxide partial pressure was maintained at 4.6 (0.5) kPa throughout the procedure. I.v. fluid requirements consisted of Hartmann’s solution 2 litre and 2 u. of packed red blood cells. Morphine to a total of 7 mg was given i.v. during the procedure. Temperature was monitored via a nasopharyngeal probe and this remained at 36.5 °C. Intraoperative urine output was in excess of 50 ml h⁻¹.

During placement of the aortic endoprosthesis, via a femoral arteriotomy, the surgeons requested that mean arterial pressure be reduced to 70 mm Hg for two periods of 1 min; this was achieved with an i.v. infusion of 0.01 % sodium nitroprusside. After placement, correct positioning was confirmed using 50 ml of contrast medium.

Total anaesthetic and surgery time 2.5 h, and at the end of the procedure residual neuromuscular block was antagonized with neostigmine 2.5 mg with glycopyrronium 0.5 mg. The patient’s trachea was extubated after return of spontaneous respiration. He remained in the recovery room for 2 h where he received another 9 mg of i.v. morphine.

J. M. C. GREIFF, MB, BS, BMEDSCI (HONS); M. M. THOMPSON, MB, BS, MD, FRCS (Department of Anaesthetics); M. T. LANGHAM, MB, BS, MD, FRCS (Department of Surgery); Leicester Royal Infirmary, Infirmary Square, Leicester LE1 5WW. Accepted for publication: June 30, 1995.

*Present address: Derbyshire Royal Infirmary, London Road, Derby.

Correspondence to J. M. C. G.
The postoperative period was uneventful. The patient received only six doses of co-proxamol over the subsequent 3 days for pain relief and he did not require any additional morphine. He became mobile on the first day after operation, at which time i.v. fluids were stopped and a normal diet commenced. He was discharged home 6 days after operation and has remained well since.

**Discussion**

Aortic stent surgery is a new surgical technique that places an endovascular graft into the aortic lumen from a femoral arteriotomy without the need for laparotomy. These grafts may be either tube stents for the aorta or tapered for aorto-iliac reconstruction.

Parodi, Palmaz and Barone [4] described the first clinical trials on the exclusion of an abdominal aortic aneurysm by placement of an intraluminal, stent-anchored, Dacron prosthetic graft using retrograde cannulation of the common femoral artery. This was carried out in five patients in whom traditional abdominal aortic aneurysm repair would have carried significant risks as a result of coexisting serious medical disease. All five cases had a successful outcome.

Since that time, clinical experience has expanded rapidly, Parodi’s series now encompasses 50 patients [personal communication] with a success rate of 84 % for tube grafts and 75 % for tapered aorto–iliac reconstructions. There have been four early deaths, two from massive microembolization. Five patients had continued blood leakage around the graft into the aneurysm sac (perigraft extravasation), and one late death occurred in one of these cases because of aneurysm rupture.

May and colleagues [6] recently reported 75 % success rate in 43 endovascular repairs; these comprised 28 tube grafts, 11 tapered aorto–iliac reconstructions and four bifurcated procedures. Interestingly, only 25 % of these patients had severe systemic complications (renal failure, cardiac failure and cerebrovascular accident), and the perioperative mortality rate was 3.8 %.

Endovascular tube repair is suitable for use in patients who fulfil the following criteria: 1.5 cm of aneurysmal neck below the renal arteries, 1 cm of aneurysmal neck above the aortic bifurcation and one femoral artery free from limiting occlusion and with a diameter greater than 7.7 mm. The femoral artery is cannulated and the device is threaded as shown in figure 1. Correct positioning of the device is confirmed by x-ray image intensification and this accounted for a large proportion of the 2.5 h of surgical time, which is somewhat longer than normal for aortic replacement surgery in our hospital.

The aortic lumen is occluded for 1 min on two occasions while the stent is opened by the use of a balloon (fig. 1). Normotension can therefore be maintained throughout most of the procedure, apart from the reduction of mean arterial pressure to approximately 70 mm Hg during both periods of balloon inflation. This period of hypotension is required to prevent the stent moving during balloon inflation because higher pressures in the aorta encourage stent movement, and it is also the only time during the procedure that the aorta is occluded. While this short period of hypotension may carry potential problems, we believe it compares favourably with conventional open aortic aneurysm repair where the aortic cross clamp time may vary between 30 and 60 min. Prolonged cross clamp time may be associated with increased afterload, acidosis and the risk of myocardial ischaemia.

One of the potential problems of endovascular repair is distal embolization during manipulation of the prosthesis within the aneurysm sac. Parodi, Palmaz and Barone [4] and Thompson and colleagues [7] have documented cases of microembolization during their initial clinical experience, although further data are required to establish the true incidence of this complication. Graft thrombosis

---

*Figure 1* Placement of the aortic stent. A: Insertion and positioning of the endovascular grafting system. B: Retraction of the jacket and exposure of the superior attachment system. C: Positioning and inflation of the balloon in the superior attachment system to the seat hooks. D: Positioning and inflation of the balloon in the inferior attachment system.
has not been a significant problem in either the tube grafts or aorto-iliac reconstructions performed to date. However, early clinical results of bifurcated reconstructions did show a tendency to limb thrombosis [8], although these problems have been largely resolved by placement of secondary intraprosthetic stents.

Aortic stent placement does not require an abdominal incision, which has several intraoperative and postoperative benefits. First, intraoperative temperature control is considerably easier than during open operation as the viscera are not exposed to the environment. Also, this technique should avoid the need for large fluid requirements as a result of reduced blood and third space fluid loss. However, the use of contrast media to confirm correct graft placement may have implications for patients with impaired renal function. After operation there is reduced analgesic requirement, improved respiratory function and early mobilization. In our patient only 9 mg of morphine was required after operation (given in the recovery room). The average morphine requirement in our hospital in patients undergoing elective abdominal aortic surgery and who do not require intensive care is 132 mg (given by PCA). Because there is no abdominal incision, splinting of the diaphragm as a result of pain does not occur. Paralytic ileus is less likely than in the conventional open procedure as the intra-abdominal contents are not handled during the procedure. Our patient was mobile on the first postoperative day and was eating and drinking. Early discharge was achieved: he went home 6 days after operation compared with an average of 11.9 days in conventional elective aortic aneurysm surgery.

In healthy patients the advantages of aortic stent insertion over aortic grafting are clear. Aortic stenting may well offer greater benefits to the patient with multisystem disease in whom conventional surgery would not be contemplated because of associated serious morbidity and mortality.

**Acknowledgement**

We thank Dr O. A. Williams for providing the illustrations for this case report.

**References**

2. Endovascular Technologies Inc, 1360 O’Brien Drive, Manlo Park, CA 94025, USA.