CASE REPORT

Type B aortic dissection after standard endovascular repair of abdominal aortic aneurysm

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SUMMARY

Dissection of the aorta is a rare yet potentially serious complication following endovascular abdominal aortic aneurysm (EVAR). These can lead to visceral branch hypoperfusion, compromise of aneurysm exclusion, arterial dilation or rupture. Intimal injury and dissection in the context of EVAR may be associated with a number of risk factors that include adverse infrarenal neck morphology, device oversizing, barbed fixation and wire manipulation in the proximal aorta. Herein, we describe three cases of type B aortic dissection following EVAR and discuss possible causes. As the applicability of endovascular technology widens, clinicians are reminded of the importance of early recognition and detection of unusual sequelae following EVAR.

BACKGROUND

Unfavourable anatomy is the major limits to the applicability of endovascular abdominal aortic aneurysm (EVAR), with the morphology of the aneurysm neck being an important determinant. In daily practice, however, patients with challenging anatomy which may also include thrombus at the sealing zone or aneurysm necks that are short, conical or angulated are commonly encountered. Accordingly, EVAR is being performed increasingly in patients with challenging neck anatomy. The risk of aortic dissection following thoracic EVAR (TEVAR) has been previously acknowledged; reports have estimated the risk of aortic dissection after TEVAR to range between 1.9% and 2.4%¹ to as high as 6.8%.² There have been no reports published to date indicating the risk of aortic dissection following abdominal EVAR. We have observed aortic dissection in three cases from a total of 500 EVARs performed in our institution, two of which were asymptomatic and found incidentally on CT scan. This report reiterates the need for post-operative regular surveillance of endovascularly treated aneurysms, and that it is essential and absolutely unavoidable, particularly in cases of challenging anatomy.

CASE PRESENTATION

Case 1

During the evaluation of a Dukes A rectal carcinoma, a 78-year-old man was found to have a 5.4 cm, asymptomatic infrarenal abdominal aneurysm. His medical history included benign prostatic hypertrophy, hypertension and coronary artery bypass graft. A CT scan revealed a suitable infrarenal neck with 52° angulation. There was evidence of bilateral severe common femoral artery and external iliac

artery calcification. He was admitted for elective EVAR and bilateral femoral artery reconstruction prior to anterior resection of his rectum. The procedure was carried out with a Zenith device (Cook Medical, Bloomington, Indiana, USA). The main body proximal diameter was 15% wider than the aneurysm neck. There were no intraoperative complications and completion angiography showed good positioning of the stent and complete exclusion of the aneurysm. He subsequently underwent an anterior resection of his rectal carcinoma after 6 weeks. Two days following his anterior resection, he became hypertensive and developed chest pain. The CT scan (figure 1) revealed a Stanford type B aortic dissection, extending from the EVAR endograft with true lumen compression. There was no evidence of an endoleak. The patient was managed medically with blood pressure control and was discharged a month later with no sequelae.

Figure 1 Case 1. Postoperative CT scan, revealing the presence of a type B thoracic dissection, with the dissection flap extending proximally (A) from the sealing stent as far as the highest slice which is at the level of the left atrium (B), with true lumen compression (red arrow).

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Case 2

An 84-year-old man was found to have an incidental finding of an 8.8 cm infrarenal asymptomatic abdominal aneurysm. There was no significant medical history. Preoperative CT scans revealed an angulated infrarenal neck with no calcification. He underwent an EVAR with an Endurant (Medtronic, Minneapolis, USA) graft. The main proximal body diameter was 30% greater than the aneurysm neck. Intraoperatively, there was difficulty capturing the top cap of the stent graft delivery system once the main body of the stent graft was deployed. This was achieved by snaring the top cap from a contralateral approach. The top end of the stent-graft was balloon moulded which allowed the stent main body deployment system to be extracted. The remainder of the implant was unremarkable and completion angiography was satisfactory. On the first postoperative day, the patient developed a marked abdominal distension, but was otherwise asymptomatic. The CT scan revealed a thoracic type B dissection, extending from just below the level of the main pulmonary artery down to the aortic hiatus (figure 2). There was no evidence of an endoleak. He was treated conservatively, and was discharged on day 10 with no sequelae.

Case 3

During abdominal aortic aneurysm surveillance, an 81-year-old man was found to have an asymptomatic 6.7 cm AAA with a left 29 mm aneurysmal common iliac. His medical history included a diaphragmatic hernia repair and transurethral prostatectomy. He underwent EVAR in 2006 using a Talent graft (Medtronic). The main proximal body diameter was 24 mm and this was not oversized. He presented 3 weeks later with a sudden onset of chest pain. He was treated with acute coronary syndrome protocol and glyceryl trinitrate infusion. The CT scan revealed an uncomplicated type B aortic dissection arising at the level of the celiac axis which then ran down into the aorta behind the stent graft and tapered-off (figure 3). He was managed medically with blood pressure control. Three months postoperatively, a further scan showed the true dissection flap with blood filling the aneurysm sac indicating a type II endoleak. There was an increase in aneurysm diameter from 6.7 to 7.7 cm. Arteriography showed

the false lumen supplied via a lower left renal accessory artery and right lumbar artery, both of which were embolised.

INVESTIGATIONS

Concerns regarding radiation exposure, contrast-induced nephropathy and financial burden have led some institutions to reconsider the necessity of the annual contrast-enhanced CT. Contrast-enhanced ultrasound (US) and plain radiographs are beginning to replace CT as the chief follow-up imaging modality. However, US will not be able to detect dissections. The presented cases illustrate the need for contrast-enhanced CT imaging as a 'gold standard' for EVAR follow-up especially in cases where US is inconclusive, or in the presence of complications and unfavourable anatomy.

DIFFERENTIAL DIAGNOSIS

- ▶ Acute coronary syndrome
- ▶ Pericarditis
- ▶ Aortic aneurysm
- ▶ Musculoskeletal pain
- ▶ Pulmonary embolus
- ▶ Mediastinal tumour

TREATMENT

Most cases of type B dissections are uncomplicated and can be managed by medical therapy, including antihypertensives.³ Blood pressure control to a target systolic pressure of 110 mm Hg can be achieved using morphine sulfate and intravenous β -blockers or in combination with vasodilating drugs. Patients presenting with symptoms of aortic dissection following EVAR such as chest pain, uncontrolled hypertension, syncope, new onset focal neurological deficit and ischaemic peripheral neuropathy should be admitted to an intensive care or monitoring unit and undergo diagnostic evaluation immediately with contrast-enhanced CT. However, a small percentage of type B dissections can lead to complications such as device collapse and limb malperfusion. Treatment may be in the form of endovascular exclusion of the false lumen and side branch

Figure 2 Case 2. Postoperative CT scan revealing a thoracic type B dissection, extending from just below the level of the main pulmonary artery (red arrow) down to the aortic hiatus (pink arrow).

Figure 3 Case 3. CT image depicting the presence of the true dissection flap (red arrow) arising immediately below the coeliac axis and extending down to the level of the most caudal of coils with a patent lumen past the most cranial coils.

reperfusion, or open repair depending on anatomical extent and the patient's physiological reserve.

OUTCOME AND FOLLOW-UP

All three patients were alive at the most recent follow-up appointment with no further adverse outcomes relating to the aortic dissection.

Case 1: Follow-up images revealed no progression of the dissection. The stent graft remained patent throughout its length with no evidence of endoleak, migration or graft kinking.

Case 2: Follow-up images showed a stagnant dissection with satisfactory graft performance.

Case 3: Follow-up CT showed that the aneurysmal sac was no longer filling with a reduction in diameter to 7.0 cm.

DISCUSSION

Dissection of the thoracic aorta following EVAR is a serious but rare occurrence. There are three reports of similar events in the literature^{4–6}; however, their aetiology remains elusive. Of the 500 EVAR procedures that have been carried out in our institution, these three are the only cases of postimplantation aortic dissection. We postulate the several potential mechanisms for post-EVAR aortic dissection in the presented cases.

In the first case, after approximately 2 months post-EVAR, the dissection was identified following symptomatic presentation in a different institution. This patient had a highly angulated infrarenal neck with significant intimal calcification. The angulated aneurysm neck is an essential parameter that directly influences accurate graft deployment at the proximal landing zone. However, if it is also short, thrombosed or calcified, an angulated neck may influence whether there is sufficient sealing of the aneurysm sac and stent graft fixation during the long-term follow-up. During stent placement, vascular surgeons often oversize the proximal main body due to hostile anatomy as was the case here. Thus, the proximal anchoring pins of the oversized stent-graft on an unstable plaque could have initiated a dissection. Moreover, stent application can generate two atmospheres of pressure or more, which may have compounded the problem.⁶ We presume the intimal damage would have occurred immediately following EVAR; however, it did not cause any symptoms initially. The gold standard investigation for complications that arise post-EVAR is a contrast-enhanced CT. However, with an uneventful recovery period post-EVAR, the gold standard investigation is an US scan (USS). This patient was asymptomatic for the entire duration post-EVAR, and as a result underwent a routine USS: there was no evidence of dissection.

In the second case, it is likely that the dissection occurred due to stent oversizing. Other probable contributing factors include difficulty in manoeuvring the stiff guide wire and difficulty in extracting the main body system. This repair was performed in a patient who had anatomy outside standard anatomical constraints for EVAR, but was considered prohibitively high risk for open surgical repair. Advances in technology, imaging, graft design and operator experience which have led to an extension of the use of EVAR beyond initial manufacturer's guidelines, with approximately 30% of EVARs being performed outside 'instructions for use' resulting in potentially increased rate of complications.

The third patient developed a dissection post-EVAR despite having favourable aortic anatomy. It is thus difficult to draw firm conclusions regarding the aetiology of this event. Interestingly, this case revealed an unusual complication post-EVAR dissection: a type II endoleak. Imaging prior to

discharge demonstrated no endoleak. Type II endoleaks represent retrograde blood flow through aortic branch vessels into the aneurysm sac. The number of patent branch vessels and the amount of thrombus in the aneurysm scan preoperatively appear to correlate with the risk of endoleak development.⁷ In this case, the pressure from the false lumen created by the dissection and a subsequent change in true vessel diameter may have caused displacement of the overlying thrombus in the right lumbar and lower left renal accessory resulting in patency of these vessels—a type II endoleak.

In our institution, a thorough assessment of patient physiology, aneurysm morphology and patient choice is undertaken to aid decision between EVAR and open repair. However, the anatomical limits of EVAR can nowadays be overcome in many cases; however, as new endovascular devices emerge, the management should be approached by a multidisciplinary team with a vascular surgeon as a leader to ensure optimal treatment.

Learning points

- ▶ Aetiology of aortic dissection following endovascular abdominal aortic aneurysm (EVAR) remains unknown; however, factors such as angulation, device oversizing, bare metal stents with barbs, wire manipulation and use outside 'instructions for use' may instigate a type B dissection.
- ▶ As some centres move towards contrast-enhanced ultrasound as their main follow-up imaging modality, symptoms suggestive of dissection such as chest pain, uncontrolled hypertension, syncope, new onset focal neurological deficit and ischaemic peripheral neuropathy should be followed up using contrast-enhanced CT.
- ▶ Patient and procedural factors influence outcome following EVAR; therefore, it is vital that both surgeons and radiologists work in unison to recognise the risk factors for future complications and detect any unusual symptoms following EVAR.

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