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Management of endoleaks following endovascular aneurysm repair

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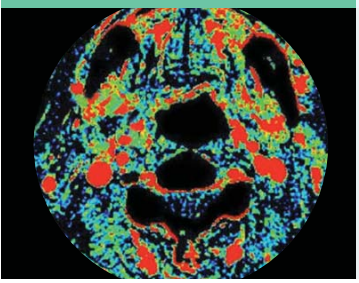

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Abstract

The term endoleak was defined in 1996 as the persistent perfusion of the aneurysm sac after endovascular aneurysm repair (EVAR) due to the incomplete sealing or exclusion of the aneurysm sac or vessel segment. An endoleak implies failure to exclude the aneurysm and the patient may be at continued risk of aneurysm rupture. Treatment depends on the type, site and size of the endoleak. Treatment of type I and type III endoleaks is mandatory, while treatment of type II endoleaks is only necessary in the presence of increasing aneurysm sac size. This article discusses the various options for treatment that are available.

Introduction

The aim of aortic aneurysm repair is to exclude the aneurysm from the systemic circulation. Endovascular aneurysm repair (EVAR) first came into clinical use in the early 1990s.[1] In this procedure, the aneurysmal segment of the aorta is relined with a covered stent 'graft', held in place by radial force, friction and (in some devices) barbs. Figure 1 illustrates an example of a successful EVAR before (a) and after (b) the procedure has taken place.

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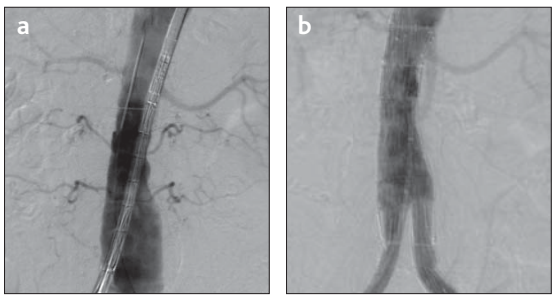


Figure 1. An example of a successful EVAR before (a) and after (b) the procedure.

Classification and treatment

The classification of endoleaks is based upon the source of the inflow into the aneurysm sac and may be proximal or distal. The initial definition differentiated between four types of endoleak[3,4] but was expanded in 1999 to include endotension (type V).[5]

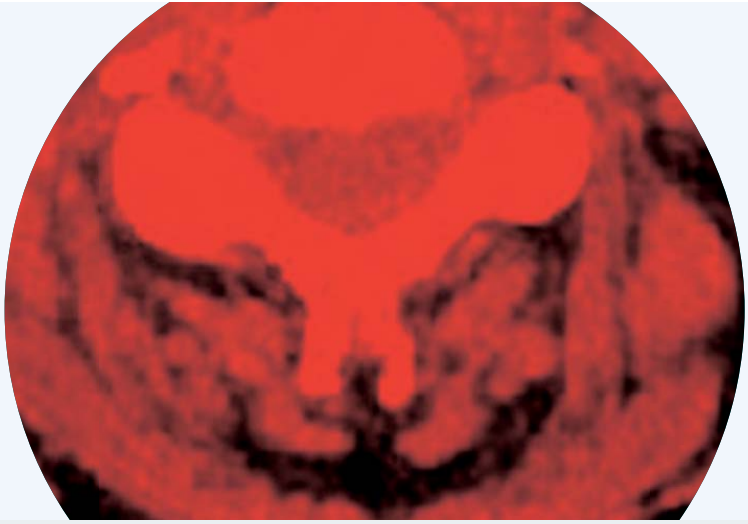
There is evidence that endoleak and late rupture are linked. A review of EUROSTAR data suggested that the presence of an endoleak can predict rupture, since 69% of patients whose aneurysm ruptured following EVAR had a pre-existing endoleak.[6]

Type I endoleaks

These are caused by failure of the seal at the fixation points of either the proximal graft (type IA) or the distal graft (type IB). This may be a primary failure at initial deployment or late failure due to graft migration. Treatment is mandatory because the aneurysm sac is at systemic pressure. Untreated type I or III endoleaks are at high risk of rupture and a rupture rate of 3.37% has been quoted.[7]

The treatment requires satisfactory circumferential apposition between the endoluminal surface of the vessel and the external aspect of the stent-graft. Gentle expansion of the device with a compliant moulding balloon will seal the majority of primary leaks. Occasionally, despite prolonged moulding, the leak will persist. A giant Palmaz® stent may then be used to prevent recoil and encourage stent apposition to the proximal neck. If this procedure fails, and the leak is significant, a limited laparotomy will enable an external band to be placed around the proximal neck, without opening the aneurysm sac.

Open conversion was occasionally required in the past for very large endoleaks due to the migration of 'home-made' devices. If the endoleak is due to graft malposition or moderate distal migration, the stent graft is extended to increase the length of neck contact or the distal seal in the case of a leaking limb. Hence,



a proximal aortic cuff or a graft extension limb may be required and these are generally oversized by 10–20% to prevent further endoleaks.

Type II endoleaks

In this type of endoleak, one or more cavities are formed within the organised thrombus inside the aneurysm sac, via retrograde flow through small aortic side-branch vessels. The leak always communicates with another 'outflow' vessel and most commonly involves the inferior mesenteric artery (IMA), lumbar or internal iliac arteries. These are the commonest endoleaks, affecting up to 43% of cases.[8] They are associated with a low (0.52%) risk of rupture[7] and a significant rate of spontaneous closure. The current consensus is that treatment is required only for endoleaks that persist for more than a year in an aneurysm of increasing size.[9]

Intervention is usually by percutaneous embolisation, either by a trans-arterial or a trans-lumbar route. The trans-arterial approach requires catheterisation either of the IMA or a lower lumbar artery. These are super-selected with a micro-catheter passed into the superior mesenteric artery (SMA) or an ascending ilio-lumbar branch of the internal iliac artery, respectively. Catheterisation of the aneurysm sac may occasionally be possible by passing a catheter directly alongside the stent graft limb from a trans-femoral approach. The trans-lumbar route involves direct needle puncture of the cavity in the aneurysm sac under CT or US guidance (Figure 2). After passage of a guidewire and catheter under fluoroscopic control, the inflow and outflow vessels can be occluded and the problematic cavity directly embolised. Many different embolic materials have been used, including platinum coils, usually with an additional agent such as thrombin or Gelfoam®.

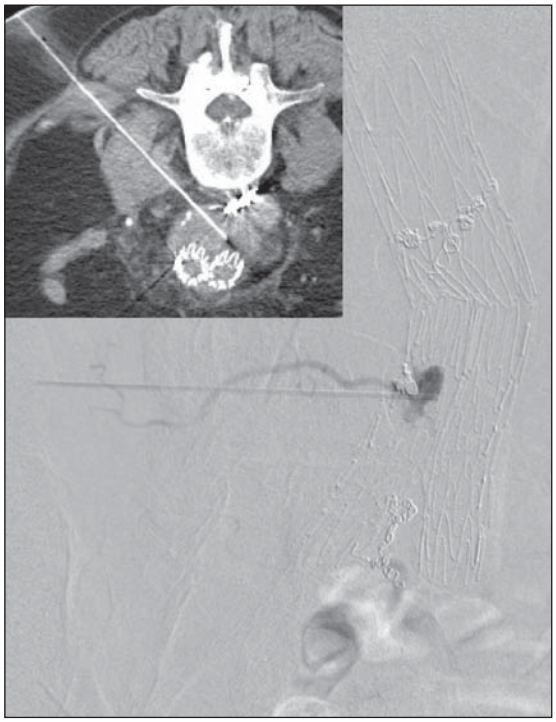


Figure 2. Treatment of a type II endoleak via a trans-lumbar route. Evidence of previous endovascular coiling of other branch vessels is visible.

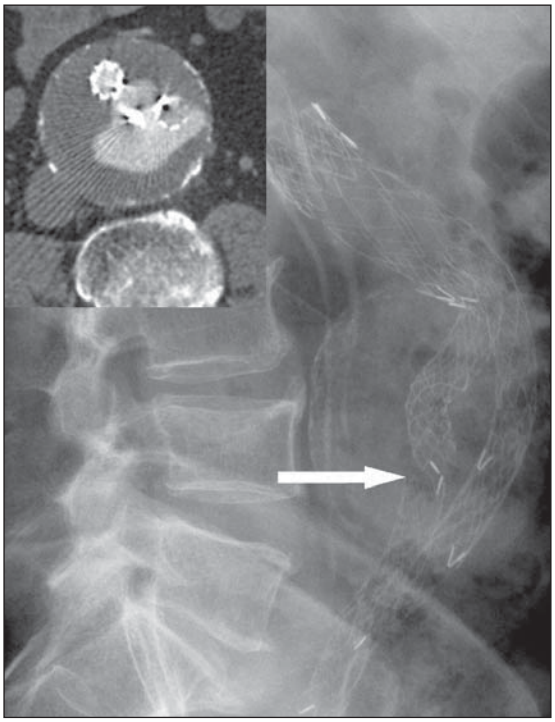


Figure 3. The inset figure shows a large type III endoleak, due to the disconnection of two components in the extended limb of a bifurcated endograft (arrowed in the main image).

Management of endoleaks following endovascular aneurysm repair *continued*

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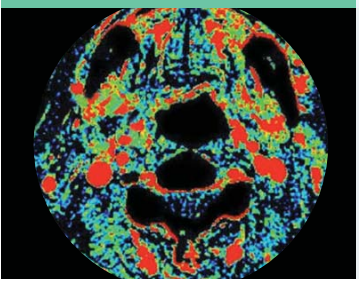


Type III endoleaks

This type of endoleak is caused by structural failure of the stent-graft due to separation of the modular components of the graft (type IIIA) or a tear in the graft material (type IIIB). As in the case of type I endoleaks, type III leaks represent direct perfusion of the aneurysm sac at systemic pressure and have a relatively high rupture rate.[7]

Primary type III endoleaks are readily apparent during the initial procedure but can be difficult to differentiate from a type I leak. They are usually caused by inadequate overlapping of the junctional sections of a modular stent-graft, but rarely there may be defects in the graft material.

Primary type IIIA leaks almost always resolve after balloon moulding of the junction(s). If there is insufficient overlap of the components then an additional component may be required. If the leak is from the main body of the graft or at the flow-divider, a second stent graft needs to be deployed within the first. Use of an aorto-mono-iliac device and a surgical fem-fem crossover helps reduce the total amount of graft material. If no suitable graft is available, open surgical conversion must be considered.

Delayed type III endoleaks were seen commonly in the first generation of devices. They are generally due to sac remodelling causing the graft components to separate or mechanical stress causing stent and fabric failure. They should be treated as primary type III leaks, accepting that there is a significant open conversion rate (Figure 3).

Type IV endoleaks

Type IV endoleaks are caused by porosity of the graft fabric during the primary procedure. They were reported almost exclusively with first-generation devices and were seen most commonly while the patient was anti-coagulated. Rupture has not been reported.

Type V endoleaks

This type of endoleak is caused by continued expansion of the aneurysm sac in the absence of a visualised endoleak on conventional imaging. The term 'endotension' has also been applied to this phenomenon,[10] which is thought to reflect the continued pressurisation of the aneurysm sac. It is important to exclude the presence of a subtle endoleak by further investigation such as contrast enhanced ultrasound.[11] If found, these need to be treated as described previously.

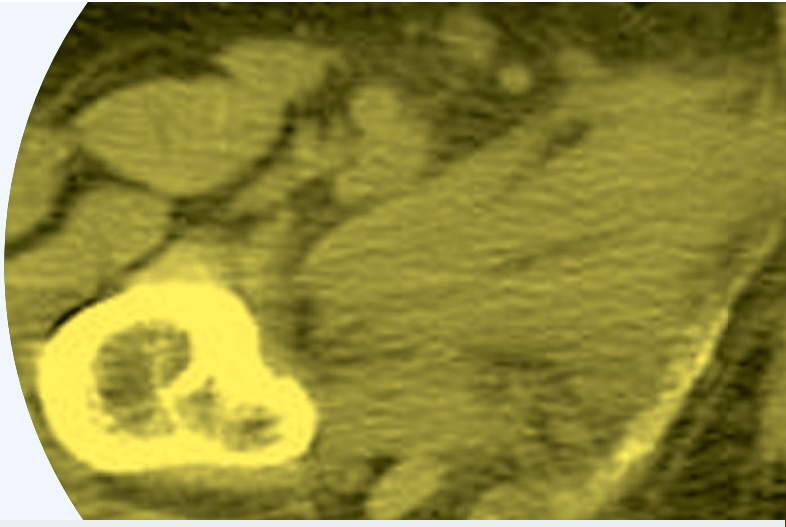
In some cases, the expansion may be due to ultra-filtration through a first-generation ePTFE graft, resulting in the formation of a hygroma[12] or tiny endoleaks through suture holes in the graft material.[13] Sac expansion due to ultrafiltration of serous material can be left untreated even if rupture occurs. However, the inside of the endograft can be re-lined with a second device and open surgical conversion remains an important option.

Conclusion

The treatment used is selected according to the type of endoleak (Table 1). As a general rule, all endoleaks where the aneurysm sac is in direct communication with the systemic arterial circulation and other leaks causing aneurysm sac expansion should be treated. Endoleaks with no sac expansion or a reduction in sac size can be left untreated.

	Endovascular	Open surgery
Type I	Moulding balloon angioplasty Giant Palmaz stent Stent-graft cuff/ extension	External banding of aneurysm neck Surgical conversion
Type II	Trans-arterial embolisation Trans-lumbar injection	30% decrease
Type III	Angioplasty/ stenting of junctions Secondary graft placement	Open conversion
Type V	Co-axial graft ('re-lining')	Evacuation of hygroma Open conversion

Table 1. Treatment of endoleaks.



Key Learning

- Endoleaks are defined as persistent filling of the aneurysm sac after EVAR.
- Type I endoleaks indicate direct communication with the circulation and cannot be ignored. They require timely treatment, most often by the endovascular route.
- Type II endoleaks need only be treated if the aneurysm is increasing in size.
- Type IIIA endoleaks are extremely unusual with accurately deployed modern endograft. Holes in the graft are very rare but must be considered when other sources of endoleak have been discounted.

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