Management of Endoleaks following Endovascular Aneurysm Repair

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ABSTRACT

Endovascular aneurysm repair (EVAR) has emerged as a viable alternative to open repair for abdominal aortic aneurysms. Endoleaks are a complication unique to EVAR and can occur in up to 25% of patients. In this article, the management of endoleaks following EVAR will be discussed.

KEYWORDS: Endovascular aneurysm repair (EVAR), endoleak, embolization

Objectives: Upon completion of this article, the reader should interpret that endoleaks can occur after endovascular aneurysm repair and repair can be achieved.

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Endovascular aneurysm repair (EVAR) is a minimally invasive technique to repair abdominal aortic aneurysms (AAAs) that has emerged as an alternative to open aneurysm repair.¹ EVAR, however, is complicated by endoleaks in 20 to 25% of patients.^{2,3} There are five different types of endoleaks, which are classified based by the source of vessels that causes the inflow into the aneurysm sac. Type I endoleaks are leaks at the proximal or distal attachment sites. Type II endoleaks are caused by retrograde flow through collateral vessels into the aneurysm sac. Type III endoleaks are holes, defects, or separations in the stent-graft material. Type IV endoleaks represent porous graft walls. Type V endoleaks have been described as being due to endotension with an enlarging aneurysm sac without a visible endoleak.⁴

Patients who have had EVAR undergo lifelong surveillance to evaluate for the presence of aneurysm expansion and endoleaks. Detection of endoleaks is essen-

tial, as endoleaks are associated with aneurysm expansion and even rupture.⁵ Triphasic computed tomographic angiography (CTA) is the most commonly utilized imaging modality to evaluate postoperative EVAR and is highly sensitive and specific at detecting endoleaks.^{6,7} Other techniques commonly utilized for detection of endoleaks are magnetic resonance and duplex ultrasonography. Once an endoleak has been detected on CTA, patients at our institution are referred for digital subtraction angiography (DSA) to classify the endoleak. DSA is more accurate than CTA in classifying endoleaks because the direction of blood flow can be seen during DSA. Endoleak repair is then performed following the DSA exam.⁸

MANAGEMENT OF ENDOLEAKS

Type I and type III endoleaks represent direct communication with the systemic blood flow and the aneurysm

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sac and require immediate repair. Type I endoleaks occur at either the proximal (Ia) or distal (Ib) attachment sites and can be seen during insertion of the initial stent graft or during a follow-up surveillance imaging exam. Because as many as 10% of patients require reintervention due to type I endoleaks seen on 30-day surveillance CTAs, optimizing intraoperative imaging is under investigation. Initial studies have demonstrated that using Dyna CT, axial CT images that are reconstructed from fluoroscopic data, improves intraoperative detection of type I endoleaks.⁹ Type I endoleaks are always repaired when they are detected. Initial attempt at repair involves angioplasty of the affected attachment site. If this is not successful, a bare metal stent can be placed over the attachment site. This is usually done with a balloon expandable stent because of the need for large stent sizes with strong radial force. If this is not successful, insertion of an overlapping stent graft in the nonadherent portion of the stent graft can be performed.¹⁰ Fig. 1 demonstrates a type Ib endoleak in a patient with a stent graft that was placed ~8 months earlier. The endoleak arises from the right distal limb of the endograft. Initial attempts were made to seal the leak with angioplasty alone, which were unsuccessful. Therefore, a Palmaz stent (Cordis Corporation, Miami Lakes, FL) was placed (Fig. 1B) and post-stent deployment DSA demonstrated resolution of the endoleak (Fig. 1C). Type I endoleaks occurring at the proximal docking site, however, can be more technically challenging, as they typically arise just distal to the takeoff of the renal arteries, and open repair can be required. Maldonado et al described a series of type 1 endoleaks that were embolized using N-butyl-2-cyanoacrylate (n-BCA). The endoleaks were accessed using a reverse-curve catheter at the proximal attachment site. A microcatheter was then advanced into the sac, and n-BCA was used to embolize the endoleaks.⁵

The management of type II endoleaks continues to be the topic of debate, and type II endoleak rates are as high as 10 to 25%.³ Type II endoleaks arise from branch vessels that were excluded from the aneurysm sac during the initial stent-graft placement. These vessels then feed into the aneurysm sac via retrograde flow and most commonly arise from the inferior mesenteric artery (IMA) or lumbar artery. Increased blood flow into the aneurysm can cause enlargement of the aneurysm sac, which can increase pressure and can cause rupture.¹¹ It has been shown that type II endoleaks can spontaneously thrombose. Recent work has shown that if a type II endoleak is present without an associated increase in size of the aneurysm sac, immediate intervention is not needed, as this endoleak can spontaneously thrombose. It has been shown that with increased time, the rate of spontaneous resolution increases.¹² Others authors treat type II endoleaks more aggressively, as the collateral vessels can transmit arterial pressures into the sac, which

may increase the chance of aneurysm expansion and rupture.¹³

Repair of type II endoleaks is routinely done via a transarterial or translumbar approach. Initially, type II endoleaks were treated by doing single-vessel embolization of the feeding artery. Using a microcatheter, the collateral branch vessel supplying the endoleak was selectively embolized with coils near the aneurysm sac. Success rates of the single-vessel transarterial approach, however, were poor, and in one study as many as 80% of type II endoleaks recurred after transarterial embolization.¹⁴ The etiology of the failure of embolization to repair the endoleak stems from the idea that these endoleaks are not fed by a single vessel but rather a network of vessels. When one artery supplying the endoleak is embolized, other vessels communicating with the endoleak will continue to supply the endoleak sac. The next step to further refine the transarterial approach is to feed the microcatheter into the aneurysm sac, and coil embolize the sac itself and then embolize the feeding vessels as the microcatheter is withdrawn, thereby treating the nidus or sac of the endoleak as well as the major feeding artery. This technique has shown results comparable to translumbar endoleak embolization discussed below.¹⁵ Fig. 2 demonstrates a type II endoleak discovered on CTA nearly a year and half after the initial placement of a aorto-uni-iliac endograft. DSA demonstrated the endoleak receiving inflow from branches arising from the IMA (Fig. 2). Postembolization DSA demonstrated complete resolution of the endoleak with coils in place (Fig. 2D).

A second approach to repairing type II endoleaks is via a translumbar approach. This technique involves embolizing the endoleak sac nidus, which breaks the communication between the multiple arteries that supply the endoleak, leading to more durable results.¹⁴ The endoleak sac is accessed by using set landmarks as determined by prior CTA and/or flush aortography done in a supine position. Translumbar embolization is usually done from the left (as the inferior vena cava need not be traversed), but it is also safe to perform right-sided translumbar (transcaval) embolization.^{16,17} The patient is placed prone, and the endoleak is accessed via a direct puncture under fluoroscopic guidance. A sheath needle (Translumbar Access needle, Boston Scientific, Natick, MA) is directed toward the anterolateral aspect of the vertebral body until the needle enters into the aneurysm sac. When the endoleak cavity is accessed, blood return will be seen coming from the catheter. Contrast injection can confirm needle placement into the sac and will often demonstrate the feeding vessels. Coils can then be used to embolize the endoleak sac. There are two main types of coils that can be used for embolization: stainless steel or platinum coils. Stainless steel coils provide fewer artifacts on follow-up CTA,

Figure 1 (A) Type I endoleak. An arteriogram demonstrates a type I endoleak arising from the right iliac limb of an Endologix stent graft (Endologix, Inc., Irvine, CA). (B) A balloon expandable stent was used to treated the type I endoleak seen at the right distal limb of the endograft. (C) Post-stent deployment. After a Palmaz stent was deployed within the right distal limb of the endograft, there was complete resolution of the endoleak.

which will be important in further surveillance, but are stiffer than platinum coils. The platinum coils, however, form a tighter nest in the endoleak. N-BCA (Trufill, Cordis, Miami, FL) “glue” or Onyx (ev3, Plymouth, MN) can also be directly injected into the sac. Care must be taken not to reflux liquid embolics into the feeding vessels, as colonic ischemia or paralysis can result. For this reason, endoleak embolization with thrombin or small particles is not recommended. From a translumbar approach, the feeding vessels can be directly accessed using a microcatheter. The feeding arteries can then be embolized using coils prior to embolization of the endoleak sac. Translumbar embolization has been shown to be more durable than single-vessel transarterial endoleak embolization.^{14,18}

Other techniques have been attempted to treat type II endoleaks. Lin et al reported a case of robotic ligation of the IMA using the da Vinci Surgical System with no recanalization of the endoleak at the 3-month follow-up.¹⁹ Ling et al describe deployment of an endovascular graft with simultaneous operative extraperitoneal dissection and Onyx to treat a type II endoleak.²⁰ Zhou et al used a similar combined endovascular and laparoscopic approach to repair a type II endoleak. Laparoscopy was used to identify the distal IMA, which was surgically clipped. Angiography was then performed to determine whether there was persistent filling of the endoleak. In this case report, there was persistent filling of the aneurysm sac and further laparoscopic dissection was performed until a branch of the left colic was found

Figure 2 (A) Type II endoleak after endovascular aneurysm repair. A postoperative computed tomographic (CT) angiogram performed approximately a year and half after the initial placement of the endograft demonstrates contrast within the aneurysm sac. The aneurysm had increased in size since the prior CT performed a year earlier. (B) Type II endoleak angiogram. Selective catheterization of the superior mesenteric artery demonstrates filling of the type II endoleak. (C) Arteriogram of the endoleak sac was performed from a microcatheter that has been used to select the inferior mesenteric artery (IMA) endoleak via the superior mesenteric artery. (D) Postembolization image shows coils in endoleak sac and IMA.

and clipped. Completion angiography demonstrated no further filling of the endoleak.²¹ Mansueto et al have described a transcatheter transcaval technique for endoleak embolization with results at 1 year that are comparable to translumbar embolization.²²

Type III endoleaks are usually caused by a defect within the graft material or are due to structural failures causing separation between the components or inadequate overlap. These endoleaks require immediate repair because there is direct communication between the systemic circulation and the aneurysm sac. Repair of type 3 endoleaks involves placement of a new stent-graft component across the defect or junctional separation. This is often followed by further angioplasty to remold the structural components of the stent graft.

Type IV endoleaks are generally seen on the immediate postdeployment aortogram, as the patient is fully anticoagulated with heparin perioperatively. These endoleaks are self-limited and resolve as the patients coagulation returns to baseline.

Type V endoleaks are classified as an enlarging aneurysm sac without a visible endoleak. Endotension can require conversion to open repair. Mennander et al describe a nonoperative approach to endotension in five patients. Three of these patients had a rupture of the aneurysm sac but did not have retroperitoneal bleeding or hematoma.²³ A small case series out of Vienna described two cases of type V endoleaks in patients who had undergone endovascular repair of thoracic aortic aneurysms. These endoleaks were treated by redoing the stent-graft placement, which had good results in both cases.²⁴ Another group reported three cases of type V endoleaks in patients who underwent EVAR for AAA. The authors' technique for repair of the endoleak was to reinforce the indwelling stent graft by placing iliac or aortic cuff extenders, which had good results.²⁵

CONCLUSION

EVAR is a widely used alternative to open repair of AAAs. Endoleaks are one of the unique complications to endovascular repair of aneurysms and can lead to aneurysm expansion and rupture if not repaired. Type 1 and type 3 endoleaks are repaired in all instances because they represent direct communication of the aneurysm with the systemic circulation. Type 2 endoleak management is more varied, with roles for observation and embolization depending on changes in the aneurysm size.

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