ROUNDTABLE DISCUSSION

Endoleak Embolization: Tailoring Techniques and Material Selection

Experts provide insights into the best strategies for treating endoleaks with embolization.

WITH M.W. DE HAAN, MD, EBIR; FABRIZIO FANELLI, MD, EBIR; ROBERT MORGAN, MBChB, MRCP, FRCR, EBIR; PARAG J. PATEL, MD, MS, FSIR; AND GEOGY VATAKENCHERRY, MD

How does the natural history of an endoleak affect your management decisions, and when is embolization the only treatment option?

Prof. de Haan: The natural history of an endoleak cannot be assessed separately from the type of endoleak; a direct postprocedural type Ia endoleak requires a different approach than a type Ia endoleak that results from progression of (aneurysmal) pathology during follow-up. In type II endoleaks, a wait-and-see approach is usually recommended, because most resolve spontaneously. In general, a persistent endoleak in combination with significant aneurysm sac expansion (> 5 mm in 6 months) is considered a reason to intervene, although scientific research for this policy is not very strong. If determined to be a type III endoleak, prompt intervention is needed where the natural history is usually not a factor.

I'm not familiar with endoleaks in which embolization is the only treatment option. In most cases, other endovascular or surgical options are also possible. However, for certain types of endoleaks, particularly type II endoleaks, transarterial or translumbar embolization is the preferred treatment. Regardless of the approach, the success of this procedure depends on the complete embolization of the nidus of the endoleak and all supplying vessels, which requires advanced endovascular skills and equipment.

Prof. Fanelli: Endoleaks—and type II in particular—are the most frequent complications after endovascular aneurysm repair (EVAR). Based on the literature, my decision is mostly a wait-and-see strategy in cases of type II endoleaks with no enlargement of the aneurysmal sac. However, in the presence of other endoleak types, I'm in favor of an aggressive reintervention that is planned immediately after the diagnosis in case of type I and type III endoleaks. In my clinical practice, embolization is the first therapeutic choice. Decision-making is done with a multidisciplinary team, with vascular surgeons evaluating of all the possible treatment options. Only in cases of type I or III endoleaks is a different strategy tailored case by case, and it can include realignment of the endoprosthesis as well as insertion of additional components.

Dr. Morgan: In general, type I endoleaks should be treated once diagnosed. Embolization may be a useful treatment option if other more standard methods have failed or cannot be used. Type II endoleaks are only treated if the sac is enlarging. Embolization is the main option in those cases, usually due to its minimally invasive nature, but it is not the only option.

Dr. Patel: It is not uncommon for a type II endoleak to be present at the time of initial implantation of an aortic endograft. Most initial type II endoleaks will spontaneously resolve over time. However, delayed or persistent type II endoleaks do occur, which necessitates continued imaging surveillance in EVAR patients. The presence of a type II endoleak alone does not indicate the need for intervention, but in the setting of continued sac expansion, we would proceed to embolization. All type I and III endoleaks are treated with placement of an endograft.

Dr. Vatakencherry: For type I or type III endoleaks, I will repair the leak in an urgent fashion. If it is a type II endoleak with no objective evidence of growth, I tend to continue with observation. If the type II endoleak shows at least 5 mm of associated aneurysmal sac growth, I lean toward more urgent repair.

What techniques and tools/materials do you use to treat type I and type III endoleaks?

Prof. Fanelli: The techniques and materials used are completely different. For type I endoleaks, the options, attentively evaluated on a case-by-case basis, can be either insertion of a cuff or embolization. In most cases of embolization, I'm used to performing a percutaneous puncture of the aneurysmal sac. In the presence of type I endoleak, intra-arterial access can be chosen. With regard to embolization materials, I prefer to use a liquid embolic agent alone or in combination with metallic coils.

For type III endoleaks, multiple options are available, depending on the situation. If the cause is a disconnection of the component or damage of the fabric, endoprosthesis relining is my first choice.

Dr. Morgan: For type I endoleaks, I use a reverse curve catheter to catheterize the proximal endoleak from a femoral approach. The embolic agents I use are the Onyx liquid embolic system (Medtronic) (or similar) or detachable coils deployed through a microcatheter. I have found a combination of coils and Onyx to be efficacious.

For type II endoleaks, the embolic agents I use are either Onyx (or similar) or pushable coils, generally deployed through a microcatheter.

Dr. Patel: Type I and III endoleaks typically require placement of an endograft to resolve continued filling of the aneurysm sac. The majority of type I endoleaks are proximal and require a cuff to span the remaining infrarenal neck. In a more complex morphology where the available infrarenal neck is minimal, we have utilized a renal snorkel with a cuff or a fenestrated endograft strategy. Of course, open repair and removal of the endograft is also an option.

Dr. Vatakencherry: For a proximal type I endoleak, I attempt to extend the coverage of graft material more superiorly into a disease-free segment of the abdominal aorta. I use adjunctive maneuvers to achieve circumferential seal of the endograft with the abdominal aortic wall. I often extend the seal with aortic cuffs and secure the graft with EndoAnchors (Medtronic) or a large-diameter Palmaz stent (Cordis, a Cardinal Health company). Sometimes I extend the graft with the use of adjunctive snorkels or even fenestrated grafts. If all else fails and the patient is a nonoperative candidate, I have even used coils and liquid embolic agents to plug the gutter of a type I endoleak.

For type Ib distal endoleaks, I extend as far as needed to get the seal and may reinforce with balloon-expandable stents to achieve circumferential wall apposition. If I need to extend past the hypogastric artery, I plug or coil the hypogastric artery and extend to the external iliac artery.

If it is a type III endoleak, I usually reline the overlapping segments with additional limbs or, on occasion, reline the entire endograft if it is a tear of the proximal main body.

Prof. de Haan: The simplest way to treat a (post-/periprocedural) type Ia endoleak is to (re)balloon the proximal attachment site. Sometimes, an additional proximal cuff and/or balloon-expandable stent are necessary to maximize the proximal wall apposition. Reballooning of the distal attachment site may also work in some type Ib endoleaks. However, iliac limb extension into the external iliac artery (with coil/plug embolization of the internal iliac artery) may prove to be a more durable solution in many of these cases.

In late type Ia endoleaks, a range of endovascular and/or surgical techniques can be considered, including EndoAnchors to enhance proximal fixation, proximal graft extension with a fenestrated and/or branched or aortic cuff with parallel chimneys, or surgical banding of the infrarenal neck. Selected cases of proximal type I endoleaks may require translumbar, transabdominal, or even transcaval embolization of the proximal attachment site.

Early type III endoleaks are usually noticed on completion angiography at the end of the procedure and are the result of an insufficient overlap between graft components and/or inadequate sizing or ballooning of the various connecting components. The options for treating these endoleaks are relatively limited and include reballooning with or without additional graft components. Late type III endoleaks may develop during follow-up and are often caused by endograft migration and/or (persistent) growth of the aneurysm sac. Sometimes, a type III endoleak is the result of a fabric tear. Late type III endoleaks are most often treated by relining the endograft and/or extension of the fenestration/branched stents.

What is your approach to embolization of type II endoleaks (transarterial vs translumbar), and what tools/materials do you use?

Dr. Morgan: I employ a transarterial-first strategy with the translumbar route reserved for the transarterial failures.

Dr. Patel: I have utilized both approaches for embolization of type II endoleaks. Each case is determined by identification of the suspected branch vessels supplying the endoleak, the patent sac lumen, and the presence of well-developed collateral pathways supplying the culprit branch vessels. In the absence of well-developed iliolumbar collaterals or a prominent marginal artery for an inferior mesenteric artery (IMA) source, I would approach with

a direct sac puncture. Review of a good-quality CTA can identify collateral pathways supplying the endoleak and provide a sense of if these are amenable to catheterization and embolization.

Dr. Vatakencherry: I typically begin with a CTA and time-resolved MRA to identify the site and type of leak. I use a transfemoral approach and interrogate the hypogastric arteries, primarily focusing on the iliolumbar to lumbar collaterals. I will also look at the superior mesenteric artery to IMA collateral network. If all this fails, I will consider direct sac access under CT guidance to where the leak is best seen on CTA/MRA and then transfer to the vascular and interventional radiology suites, where I will exchange for a 5-F, 25-cm sheath and use a combination of metal coils and liquid embolic to close the leak. Due to the extensive metallic artifact, I tend to perform MRA for follow-up because the nonferromagnetic coil and liquid embolic artifact are less of an issue.

Prof. de Haan: Isolated type II endoleaks have to be approached with caution because they may prove to be the devil in disguise, in the sense that these may represent a subtle type I or type III endoleak. To rule out these additional and potentially life-threatening leaks, scrutinous assessment of all imaging is of the utmost importance.

In cases in which the IMA is involved in a type II endoleak, I previously opted for a transarterial approach. However, after several unsuccessful attempts to get to the aneurysm sac via the lumbar arteries, I have abandoned that technique and currently use a translumbar (or transabdominal) approach using cone-beam CT and/or ultrasound guidance.

For both techniques, physicians must have a well-equipped stock with a wide range of guiding sheaths, microcatheters, and guidewires. The choice of the embolization material is determined from a number of parameters, including local anatomy, volume, and flow. Microcoils and plugs are mostly used, but glue, thrombin, and polymers (ie, Onyx) can be used as well.

Prof. Fanelli: Any embolization of a type II endoleak is performed by direct puncture of the percutaneous sac. Through my experience, I can say that this technique guarantees not only a better embolization of the aneurysmal sac and of the afferent and efferent branches, but also a faster procedure time. I never use an introducer, but after puncturing the sac with an 18-gauge needle, I insert a 4-F, 65-cm Bern-shaped catheter on a 0.035-inch hydrophilic guidewire, followed by a 2.7-F microcatheter compatible with dimethyl sulfoxide. This is necessary for allowing navigation within the sac and for injecting the liquid embolic agent. In such cases, I prefer to use liquid embolic agents (ie, Onyx) that can be supported by coils when the sac dimensions are remarkable.

In my opinion, transarterial embolization does not allow 100% success, especially in cases of type II endoleaks correlated to the lumbar arteries. Navigation in the iliolumbar arteries is quite challenging due to the high vessel tortuosity and multiple branches feeding the sac. Moreover, bilateral treatment is required in all cases.

How does sac morphology affect your approach to management?

Dr. Patel: Overall, sac size helps determine if we treat a type II endoleak. This requires review of all CT imaging of the aneurysm from immediately prior to EVAR to all subsequent post-EVAR CT scans. Sac morphology and diameters are measured at similar levels on each scan. This is the only way to truly determine if there is continued sac expansion, which is easiest within a true fusiform aneurysm. More complex sac morphologies such as bilobed, saccular, marked angulation, or elongated aortas may be more challenging. Some research has evaluated volumetric analysis of the aneurysm sac rather than aneurysm sac diameter alone.

Dr. Vatakencherry: A more saccular morphology theoretically has a higher risk for rupture at a smaller size, so I may be more aggressive on treating such a patient.

Prof. de Haan: An isolated type II endoleak may affect the sac morphology during follow-up and thus compromise the attachment site, potentially leading to the development of type I and/or type III endoleaks. In these cases, a more aggressive approach is warranted, where, in addition to the aforementioned interventions, surgical options should also be considered.

Prof. Fanelli: It is important to evaluate the sac morphology in case of a direct percutaneous puncture. The best strategy (access and needle trajectory) is decided on the basis of CTA images. Right posterior access is preferred because it is safe and avoids the vena cava, but left posterior, nontranscaval, or anterior accesses are also equally performed. Anterior access is preferred when the patient is slim and the sac is located totally in the front, almost touching the skin and with no interposition of any organ.

Dr. Morgan: In general, sac morphology doesn't affect my approach. If selecting the translumbar route for very large sacs, it may be possible to access the sac percutaneously via the anterior abdominal wall.

How do you manage persistent type II endoleaks?

Dr. Vatakencherry: The persistent type II endoleaks with continued aneurysm sac growth are the biggest challenge. First, I make certain that it is truly not a type I or III endoleak. Then, if I have obtained adequate proximal and distal seal, I will try to find the crevices of space that are filling on the 2- to 3-minute delayed sequence CTA/MRA and see if I can fill those spaces with coils and liquid embolic agents. If it continues to grow despite these efforts, I will see if the patient is willing and able to undergo surgical revision.

Prof. de Haan: In type II endoleaks, a conservative approach is usually recommended. Treatment is reserved for those with significant sac enlargement (> 5 mm). A variety of different embolization techniques are possible, including transarterial, transabdominal, and/or translumbar approaches, using various embolic agents such as coils, plugs, glue, and polymerizing agents. However, the results of these interventions are disappointing in many of our patients. Therefore, in persistent type II endoleaks, surgical options should be considered as well.

Prof. Fanelli: In such a condition, a multidisciplinary decision is made for each case. When contrast-enhanced ultrasound and CTA suggest the possible success of a second embolization, we proceed in that direction. However, when we realize that the morphologic situation is seriously complicated (eg, presence of a combination of different types of endoleaks), we recommend that the patient undergo surgical conversion. No more than two endovascular treatments are usually performed, and if the second isn't successful, surgery is required to explant the endoprosthesis. I want to stress that in the last 10 years, no recurring episodes have been observed thanks to improvement of the embolization technique (direct sac puncture) and better materials (ie, liquid embolic agents).

Dr. Morgan: In general, embolization is used first. Recurrent type II endoleaks following a previous embolization are treated by repeat embolization. Rarely are other methods such as banding used.

Dr. Patel: Careful evaluation of a well-performed CTA with delayed imaging should provide clues to the source of a type II endoleak. In our experience, persistent type II endoleaks with continued sac growth are generally complex. That is to say, they have more than a single source for inflow and/or outflow to the aneurysm sac.

We have been employing more advanced image guidance to identify and localize endoleaks during intervention. Image guidance with two-dimensional CT fusion allows us to fuse patients' CT scans to their position on the angiography table. We can then target the sac puncture to access within the patent portion of the aneurysm supplied by the branch vessels. Once in the aneurysm sac, we have chosen a liquid embolic strategy for the aneurysm sac with an attempt to reflux liquid embolic into the feeding branch vessels. Alternatively, we can catheterize the branch vessels and coil embolize near their origin prior to liquid embolization of the aneurysm sac.

Which endoleaks do not require management (at least, not yet)? Why?

Prof. de Haan: The natural history of type II endoleaks suggests that the majority of aneurysms will remain stable and will resolve spontaneously. The chance for rupture due to type II endoleak has been shown to be very small. Therefore, the criteria for intervention remain controversial and close surveillance is usually recommended.

Prof. Fanelli: As reported from the global experience, type II endoleaks associated with nonenlargement of the sac diameter are the only endoleaks that don't require treatment because a low percentage of aneurysm rupture has been reported in the presence of a stable sac.

Dr. Morgan: Type II endoleak and a nonenlarging sac do not require treatment but should be managed by follow-up imaging.

Dr. Patel: Any type I or III endoleak necessitates management because the aneurysm sac remains subject to systemic pressurization. In our practice, type II endoleaks in the absence of aneurysm sac growth do not require embolization. These patients are followed with annual surveillance, and any increase in sac size would mandate embolization. If the patients are being surveilled with ultrasound or noncontrast CT imaging and sac growth is noted, then CTA with delayed imaging is performed to identify the source of the endoleak.

Dr. Vatakencherry: If there is an endoleak with associated sac enlargement, then it should be repaired. If there is a type II endoleak and the sac remains stable or regresses, I would continue to observe those cases. ■

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