

# Identifying and Managing Type III Endoleak After EVAR

Tips for optimal imaging protocols and endovascular treatment techniques to detect and repair type IIIa and IIIb endoleaks.

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Endovascular aneurysm repair (EVAR) has gained wide acceptance as the preferred method of treatment for infrarenal abdominal aneurysms. It is associated with lower 30-day mortality and morbidity rates, as well as faster discharge.<sup>1-5</sup> However, EVAR is also associated with higher reintervention rates compared with open repair, and endoleaks are the most common indication.<sup>1</sup>

*Endoleak* is defined as a persistent arterial perfusion of the aneurysm sac after endovascular treatment and was categorized in four types by White et al.<sup>6</sup> The most modern definition of type III endoleak is found in the reporting standards, which describe it as leakage between endograft components or fabric disruption.<sup>7</sup> Type III endoleak includes two subtypes. *Type IIIa* endoleak is described as a disconnection between the main body and the contralateral limb but can also be due to disconnection of the iliac limb from the ipsilateral distal extension or of a proximal cuff from the endograft main body. *Type IIIb* includes disruption of the fabric of the endograft, such as fabric tears and stent fractures, and is further subdivided into holes > 2 mm or < 2 mm. The underlying mechanism of the fabric defects is still being debated and may include processes occurring during the initial procedure where the fabric is damaged by the tip of a stent displaced by severe angulation of the neck or by friction through heavily calcified, tortuous iliac arteries. Another potential cause of intraoperative-related fabric defects might be excessive pressure during ballooning.<sup>8</sup> It is likely that as the durability of EVAR improves, a further very late fabric defect based on biologic degeneration may occur, similar to older open prosthetic grafts.

Early type III endoleaks are visualized during completion angiography in the operating theater. Conversely,

late type III endoleaks can develop months to years later, with a median time interval of 5.6 years (range, 1–13.2 years) between the index procedure and diagnosis and treatment.<sup>9</sup> Most are asymptomatic, but approximately 10% of patients will present with clinical symptoms of a rupture.<sup>9</sup> Disconnection is usually related to insufficient overlap among the stent graft components, but it has been hypothesized that late types can also occur because of conformational changes in the aneurysm sac, endograft migration, or dilatation of aortic and iliac attachment sites. The resulting endograft displacement is more prevalent with larger aneurysms and is associated with an increased incidence of type IIIa and type I endoleaks.<sup>9,10</sup> In fact, the modular design of grafts emerged, in part, to accommodate this intercomponent movement, and early practitioners observed that larger overlap allowed for accommodation of the device within a changing aortic sac without placing undue tension on the proximal and distal seal.

The incidence of type III endoleak, as described in randomized controlled trials including the EVAR 1 trial<sup>1</sup> and the OVER trial<sup>4</sup> or in prospective registries like the EUROSTAR registry,<sup>5</sup> ranges from 3% to 4.5% and includes different types of endograft implants. There was a relatively high incidence of early and late type III endoleaks in first- and second-generation endografts (mainly Stentor [MinTec, Inc.] or Vanguard [Boston Scientific Corporation] devices). The incidence ranged from 8% to 12%, probably because of the small overlap recommended for early multicomponent stents, as well as a slow-to-emerge understanding of the importance of affixing the fabric onto the stent. However, using currently available endografts, the incidence of type III

endoleaks can be reduced to 1%, keeping in mind that the follow-up period with these types of endografts is shorter.<sup>11</sup> Type III endoleak is a rare complication that has been mostly described in case reports or small case series. A recent literature review revealed 12 publications including 62 type III endoleaks. Type IIIa endoleak was the main cause in 22 of the 62 (35.5%) cases, and type IIIb endoleak was present in 16 (25.8%) cases.<sup>12</sup>

Although they are rare, type III endoleaks should be considered serious because they lead to blood flow into the aneurysm, which repressurizes the sac and can result in secondary aortic rupture. They are also associated with a nearly nine times increased risk of aortic rupture, emphasizing the need for early repair after imaging diagnosis.<sup>13</sup>

## DIAGNOSTICS

In most recommended surveillance protocols, long-term follow-up after EVAR is performed with annual surveillance duplex ultrasound. On surveillance scans, endoleaks are first defined with or without an increase of aneurysm sac size. CTA is the next diagnostic step to accurately define the type of endoleak and confirm the potential separation of endograft components. When we deal with more subtle forms like minor loss of overlap or a type IIIb endoleak, it can be challenging to detect the origin of the endoleak, even on CTA. The addition of contrast-enhanced ultrasonography and plain abdominal x-ray can be helpful in further analysis of the origin of the endoleak. These two modalities, in combination, can be an alternative for CTA to keep contrast load to a minimum in patients with renal impairment.<sup>14</sup> Type IIIb endoleaks are particularly difficult to diagnose. In the study by Pini et al, five out of the six cases were identified by digital subtraction angiography, either preoperatively or during the procedure.<sup>15</sup> Other case reports also describe difficulty with making the correct diagnosis, as it is often misinterpreted as a type I endoleak or endotension, with the identification of a structural tear or stent fracture only during the surgical conversion.<sup>16</sup>

## MANAGEMENT

Good preoperative planning and intraoperative assessment of component overlap after stent placement help prevent early type III endoleaks. However, if visualized during completion angiography, early leaks can be treated with extra ballooning or an extra stent to achieve better overlap. Placement of a second covered bridging stent has the dual benefit of securing a possible dubious connection and relining possible fabric tears.

In late type III endoleaks, endovascular repair is often the primary treatment method. It involves the place-

ment of a covered stent across the gap between the original endograft components or across the fabric disruption. The main technical challenge is cannulation of the second component, which can be difficult due to tortuosity and lead to significant displacement and distance between the main body and the separated limb. If retrograde cannulation from the groin fails, a second attempt can be performed with a brachial approach.

A guidewire is advanced through a parent guiding catheter through the gate into the sac. The wire can be successfully retrieved using a snare device from the groin, after which, the wire can be exchanged for a stiff wire and a new iliac limb graft can be deployed to bridge the separating components. Care should be taken to ensure that the wire has not crossed between the interstices of the stents of either component, which would make placement of a stent challenging. Other options are to deploy a new bifurcated stent graft, thereby relining the entire existing device or use an aorto-uni-iliac device with a femoral-femoral crossover when the existing main body is too short. These options can be particularly useful when the fabric tear is too close to the flow diverter, when the exact location of a tear is difficult to ascertain, or when dealing with multiple component separations.

Repair of component separation between the main body and an aortic extender cuff can be more complex. The simplest option is to deploy a new extension cuff to bridge the gap; however, the short length of aortic cuffs makes it difficult to achieve an adequate seal. Recurrent late type III endoleaks have been noted after simple relining of the cuff, which makes this technique prone to later separation and recurrent type III endoleak. Maleux et al describe a 25% recurrence rate after initial endovascular salvage. They mainly occurred in first- and second-generation endografts, and the main cause was fabric tears (80%).<sup>9</sup> Although endovascular options are minimally invasive compared with open repair, serious adverse events can occur. Acute limb ischemia, bowel ischemia, and retroperitoneal bleeding have been described.<sup>9,12</sup>

In a report by Eng et al, endovascular repair was the first line of treatment in 68% of patients, followed by open surgical repair in 10%, and hybrid procedures in 18%.<sup>17</sup> Open surgical conversion is indicated when endovascular repair does not seem feasible or the patient presents with an aortoduodenal or aortocaval fistula. Another indication is if the sac continues expanding despite relining of the iliac limbs and exclusion of other endoleaks. Not intervening can only be an option if the patient is not fit for any intervention at all or if the patient refuses invasive treatment. Combined endoleaks are a very rare complication after EVAR. In these cases, the treatment options are technically demanding, and a

combination of endovascular and open surgical procedures may be needed.

## CONCLUSION

Type III endoleaks may occur early and late in the lifespan of a stent for a variety of different reasons. There are two subtypes: type IIIa is a separation of components, whereas type IIIb is a fabric disruption. Although it is a rare complication in third-generation stent grafts, type III endoleaks need to be seen as an emergency, because they lead to repressurization of the aneurysm sac and a ninefold higher risk of secondary rupture. CTA is still considered the best diagnostic modality and endovascular treatment is the first choice of treatment. It is important to be aware that 25% of type III endoleaks will recur and long-term follow-up is paramount. ■

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