

Type I Endoleak Embolization With Liquids: Does It Work?

Indications, limitations, and outcomes of liquid embolization of type I endoleaks.

**BY SEYED AMELI-RENANI, MBBS, FRCR, EBIR; VASILEIOS PATSIOGIANNIS, MD;
AND ROBERT A. MORGAN, MBChB, MRCP, FRCR, EBIR**

Endoleaks are the most common complication after endovascular aortic aneurysm repair. Type I endoleaks result from an inadequate seal, more commonly seen at the proximal end of the graft (type Ia), but also occasionally at the distal end of the graft (type Ib). There is general consensus on the need for prompt treatment of such endoleaks, given the consequent sac pressurization due to the communication of high-pressure aortic flow with the perigraft space. The aim of treatment is closure of the endoleak to prevent sac size increase and rupture.

Transcatheter embolization is generally accepted as the primary treatment option for type II endoleaks. Embolization is less well recognized for the treatment of type I endoleaks. However, many interventionalists regard embolization as a useful option if other more standard methods have failed or cannot be employed, such as aortic cuffs, Palmaz stents (Cordis, a Cardinal Health company), fenestrated cuffs, or graft extension plus chimney grafts.

Although type Ib endoleaks have been treated using embolization, they can usually be treated by other

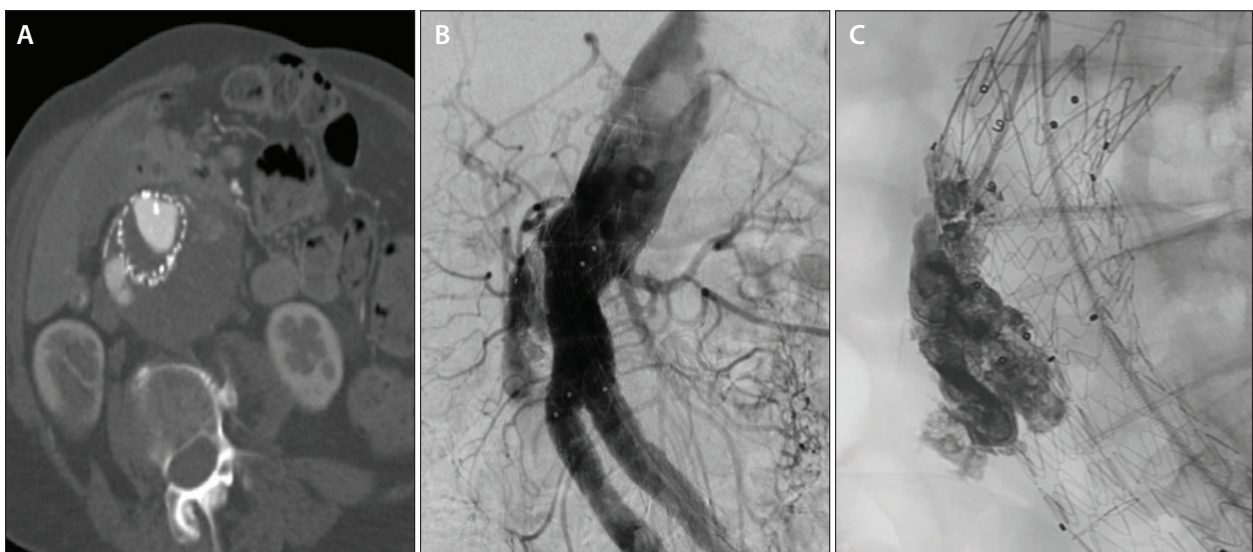


Figure 1. Example of type Ia endoleak embolization. Axial CTA image showing the type Ia endoleak (A). An aortic angiogram obtained via a flush catheter placed at the distal end of the endograft confirms a type Ia endoleak (B). Transcatheter embolization with Onyx performed until the endoleak cavity is completely occluded (C).

TABLE 1. SUMMARY OF PUBLICATIONS ON TYPE I ENDOLEAK USING LIQUID EMBOLIC AGENTS

Study	No. of Patients	Type Ia	Type Ib	Embolic Material	Technical Success	Clinical Success
Maldonado et al ²	17	13	4	NBCA (13), coils ± thrombin (4)	16/17	15/17
Choi et al ⁴	7	6	1	NBCA ± coils	6/7	6/7
Henrikson et al ⁵	6	5	1	Onyx	6/6	6/6
Eberhardt et al ⁷	8	6	1	Onyx ± coils	7/8	7/8
Graif et al ⁸	8	6	2	Onyx ± coils	7/8	6/8
Ameli-Renani et al ⁹	25	23	2	Onyx ± coils	25/25	18/25

Abbreviations: NBCA, N-butyl cyanoacrylate.

methods. This article focuses on the use of embolization for treating type Ia endoleaks.

EMBOLIC AGENTS

Several embolic agents have been used for type Ia endoleak embolization, including coils, thrombin, gelatin sponge, glue, and ethylene vinyl alcohol-based agents.¹⁻⁴ However, since 2011, all publications reporting type Ia endoleak embolization have used either Onyx (Medtronic) alone or Onyx in combination with coils.^{5-7,9} Initially used for embolizing cerebral aneurysms and arteriovenous malformations, Onyx has become well established for embolization of type I and II endoleaks.^{10,11}

Although other liquid agents may be used for endoleak embolization, the authors prefer Onyx for treating endoleaks. There are several properties of Onyx that are advantageous. Onyx contains tantalum powder and is therefore radiopaque and, unlike glue, is nonadhesive to the delivery catheter and can therefore be injected in a more controlled manner. Once injected through a microcatheter, Onyx exhibits a relatively long solidification time; it gradually precipitates in a dependent fashion, forming a spongy cast and enabling it to take the shape of the endoleak cavity.

However, the radiopaque nature of Onyx means that it can obscure the microcatheter tip as the endoleak cavity is filled, and awareness of the position of the microcatheter prior to commencing embolization is important to maintain a stable position and avoid nontarget embolization.⁶ The tantalum content also causes considerable streak artifact on CT, which can make identification of persistent/recurrent endoleak difficult. Other disadvantages of Onyx include its cost, and the transient patient experience of unpleasant breath and

potential for vasospasm if the dimethyl sulfoxide solvent is administered too quickly.

Other ethylene vinyl alcohol-based agents are now available. Some of them, such as PHIL (precipitating hydrophobic injectable liquid), use iodine instead of tantalum and may not cause artifact on CTA. However, there is scant knowledge about the use of this embolic agent for endoleak embolization.

EMBOLIZATION TECHNIQUE

The details of the embolization technique have previously been described.⁸ The basic procedure involves percutaneous retrograde femoral access. The endoleak is catheterized using a reverse-shaped catheter, and an endoleakogram is obtained to assess the size of the cavity. A microcatheter is advanced into the endoleak cavity and embolization is performed under close fluoroscopic monitoring until the endoleak cavity is satisfactorily occluded (Figure 1).

Early in our experience, Onyx was used as the sole embolic agent in all cases; however, we now favor a combination of detachable coils and Onyx. The coils are initially deployed in the endoleak cavity to form a frame before injecting Onyx to achieve complete occlusion of the endoleak. This approach appears to deliver better long-term results, perhaps by enabling more complete sealing of the endoleak and also minimizing the risk of nontarget embolization.

Patient selection is critical. Successful embolization is contingent on achieving complete occlusion of the endoleak cavity while avoiding nontarget embolization into adjacent visceral arteries or embolic reflux into the aortic lumen. Ideal type Ia endoleak characteristics for embolization include a narrow and long entrance

into the endoleak cavity. Large endoleaks also seem less suitable for embolization than small endoleaks. Large endoleaks require a large volume of embolic agent, and therefore it is difficult to occlude the cavity completely in these cases. Endoleaks with a short and/or wide neck also pose a challenge because they exhibit an inherent high risk of reflux of embolic agent into the aortic lumen. However, there are few situations where embolization cannot be attempted as long as the risks of non-target embolization and recurrence are recognized.

IS EMBOLIZATION WITH LIQUID EMBOLIC AGENTS EFFECTIVE FOR TYPE I ENDOLEAKS?

There is limited published evidence for the effectiveness of type I endoleak embolization in general. Golzarian and colleagues published on a cohort of 32 cases in 2005 using coils with or without gelatin sponge and thrombin, with technical success in 29 patients.³ Apart from a small cohort of cases embolized with coils only,¹² all published cohorts we have come across have used liquid embolic agents in the form of N-butyl cyanoacrylate or Onyx, with or without additional deployment of coils. As detailed in Table 1, overall, these case series demonstrate a high rate of technical and clinical success using this technique.

We have previously reported our experience on type I endoleak embolization with Onyx in 25 patients, encompassing 23 proximal and two distal endoleaks, with an average aneurysm sac size prior to embolization of 8.2 cm (range, 5.3–12.9 cm). Two patients underwent a repeat embolization procedure. Onyx alone was used in 16 cases and in combination with coils in 11 cases. Immediate technical success (defined as complete occlusion of the endoleak on completion angiography) was achieved in all cases. During an average follow-up period of 311 days, seven patients developed endoleak recurrence, some of whom underwent subsequent embolization. The overall freedom from endoleak recurrence was 80%, and freedom from sac growth was 85%. Six of the seven endoleak recurrences had originally been embolized using Onyx only, and only one recurrence was observed when a combination of coils and Onyx was used.⁹ However, most of the cases where a combination of coils and Onyx were used involved the Nellix endograft (Endologix), and it is unclear whether the recurrence was related to the specific embolic agents used or the aortic endograft associated with the endoleak.

CONCLUSION

There is limited evidence for the efficacy of embolization of type I endoleaks. However, the technical and

clinical success rates are high in most reported series. Durability is questionable, as no long-term follow-up is available. However, we believe that many patients experience ongoing occlusion of the endoleak with reduction or stabilization of aneurysm sac diameter, which is the aim of therapy. Because most reports involve the use of liquid embolic agents, especially Onyx, it must be assumed that liquid embolic agents are efficacious for type I endoleak embolization. Our experience, including our published data, suggests that a combination of coils and a liquid embolic agent may well be the optimal embolic combination to use for this procedure. ■

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Seyed Ameli-Renani, MBBS, FRCR, EBIR

Department of Radiology
St George's Hospital
London, United Kingdom
Disclosures: None.

Vasileios Patsiogiannis, MD

Department of Radiology
St George's Hospital
London, United Kingdom
Disclosures: None.

Robert A. Morgan, MBChB, MRCP, FRCR, EBIR

Department of Radiology
St George's Hospital
London, United Kingdom
robert.morgan@stgeorges.nhs.uk
Disclosures: Speaker for Penumbra, Inc. and Medtronic.