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REVIEW

Evidence for Ethylene-Vinyl-Alcohol-Copolymer Liquid Embolic Agent as a Monotherapy in Treatment of Endoleaks

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WHAT THIS PAPER ADDS

Twelve studies report the use of ethylene-vinyl-alcohol-copolymer liquid embolic agent (Onyx) monotherapy in treatment of endoleaks. Only four studies included more than 10 patients, with most patients having a Type II endoleak treated by transarterial embolization. Although technical success was high (96%), clinical success was lower (79%) with very limited follow-up available and no cost-effectiveness data. This review highlights the need for more centres to document their experience with Onyx, both as a monotherapy, and where used in conjunction with other modalities to allow evaluation of the role for Onyx in treatment of endoleaks.

Objective: Endoleak remains the Achilles heel of endovascular aneurysm repair and the exclusion of Type II endoleaks, in particular, remains challenging. This systematic review presents the evidence for ethylene-vinyl-alcohol-copolymer liquid embolic agent as a monotherapy in the treatment of endoleaks.

Methods: A systematic literature search was performed for all studies reporting the use of liquid embolic agent as a sole agent in the treatment of endoleaks. Patient numbers, clinical details (endoleak type, route of delivery) and outcome in terms of survival, technical and clinical success with freedom from endoleak together with follow-up period were examined.

Results: Only 12 articles reporting the use of liquid embolic as the sole treatment modality for endoleaks in 174 patients were identified. All but 21 patients had a Type II endoleak. Transarterial embolization was attempted in 73% of patients with 48 patients having direct sac puncture. Technical success was high at 96%, but in patients with adequate imaging, the clinical success rate dropped to 79%. Complications were sparsely reported and follow-up ranged from 0 to 75 months.

Conclusions: This review highlights the lack of data regarding the use of liquid embolic agent as a monotherapy with only 4 studies including more than 10 patients. Data from the largest series suggests a learning curve exists and no study reports on cost effectiveness. Technical success does not always translate into clinical success and with the largest series only reporting median 4-month follow-up no claims regarding durability can be made. In problematic Type II endoleaks, however, liquid embolic agent is a welcome addition to the treatment armamentarium.

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INTRODUCTION

Endovascular aneurysm repair (EVAR) has emerged as viable treatment for abdominal aortic aneurysms (AAAs) with favourable anatomy. One major Achilles heel for EVAR is failure in some cases to maintain aneurysm exclusion leading to sac expansion from endoleaks and the need for secondary interventions. Since their initial description by White et al.[1] the management of endoleaks has been controversial. Whereas Type I and III endoleaks are accepted indications for intervention and their treatment protocols well established, the management of Type II endoleaks is less clearly defined.[2] Control of Type I and III endoleaks at the time of initial EVAR often can be obtained by additional balloon moulding or further lining stent grafts.

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Type II endoleaks may, however, either not be noted on completion angiography or only occur during surveillance. Type II endoleaks are commonly seen on surveillance imaging (10% of patients) and may, if persistent, lead to sac expansion and aneurysm rupture.[2] Intervention for persistent Type II endoleaks and late Type I endoleaks can be difficult and several strategies have emerged. One innovative technique is the use of Onyx liquid embolization agent to close refractory endoleaks.

Onyx is a non-adhesive liquid embolic agent comprising ethylene vinyl alcohol copolymer dissolved in DMSO (dimethyl sulfoxide) and suspended micronized tantalum powder to provide contrast for visualization under fluoroscopy. It has obtained US Food and Drug Administration approval for embolization of brain arteriovenous malformations and comes in three forms with varying viscosity. Delivery is via a DMSO compatible catheter under fluoroscopic control; the copolymer and tantalum powder solidifies into a spongy embolus within 5 minutes once the DMSO dissipates into the blood. Care must be taken to avoid trapping the catheter tip in the mixture.

Objective

The use of Onyx for the treatment of EVAR endoleaks was initially seen in conjunction with more traditional techniques such as coils and plugs. Now several groups have reported the use of Onyx as a single agent to close endoleaks and this systematic review aims to appraise the evidence supporting the utility of Onyx as a monotherapy.

METHODS

Data sources and search strategy

A systematic literature review was undertaken investigating the use of Onyx to treat EVAR endoleaks up to April 1, 2015. Studies were identified by an electronic search of the National Centre for Biotechnology Information, U. S. National Library of Medicine PUBMED using the search exploded medical subject heading (MeSH) terms “Onyx Copolymer” combined with “Endoleak,” “Aortic Aneurysm, Abdominal,” “Endovascular Procedure,” and “Embolization, Therapeutic” and the combination of “Embolization, Theraputic” and “Endoleak.” The same search terms and combinations with the exception of “Onyx Copolymer AND Embolisation” were then used to query Ovid, EMBASE, and the Cochrane Library. Only English language articles were considered.

Review methods and article selection

Articles were selected based on their abstract and two independent reviewers produced a combined list. Duplicates were removed and the full text retrieved. As expected search terms with “Onyx Copolymer” yielded the most relevant publications. Patients treated with Onyx in combination with other embolic agents, glues, or coils were excluded, as were patients in whom Onyx was used prior to EVAR or where the Onyx was used to treat rupture at the time of EVAR.

Data extraction

Patient numbers, clinical details (endoleak type, route of delivery), and outcome in terms of survival, technical success, and freedom from endoleak were examined together with follow-up period by two authors.

RESULTS

In PubMed 422 articles were identified, with a further 134 identified in Ovid and EMBASE. After excluding duplicates only 21 were considered relevant based on their abstract. Nine were then excluded after full-text review typically because of the combination of Onyx with other agents. One recent paper includes nine patients treated solely with Onyx, in addition to others treated by Onyx in combination with coils and glue, but unfortunately the Onyx-only results are not reported separately.[3] One study included patients with multiple attempts to treat endoleaks including attempts involving coils and Onyx.[4] This study did, however, have six patients where, following failed attempts at other techniques, direct sac puncture and Onyx embolization was employed. These cases are identifiable and have been included. Twelve eligible studies in total were identified; a review of the references failed to yield any additional studies (Fig. 1).

The twelve articles describe 174 patients who underwent treatment for an EVAR endoleak with Onyx.[4–15] The results are summarized in Table 1. All but 21 patients were treated for persistent Type II endoleaks. Fourteen patients were treated for a Type Ia, five for a Type Ib, and two for a Type IIIb endoleak. One-hundred and twenty-six (72%) patients underwent transarterial embolization and 48 had a direct aneurysm sac puncture.

Technical success for all studies was defined as exclusion of the endoleak on the completion angiogram with Ling et al. and Martin et al. including a reduction in the sac pressure when a direct sac puncture was performed.[11,12] In total, 167 (96%) patients were considered a technical success.

The definition of clinical success was variable, with some studies happy to accept no evidence of an endoleak on follow-up imaging, others preferring a stable or decreasing sac size, and some seeking both a stable sac and no visible endoleak. Post-procedure follow-up imaging in all cases was CT angiography, although two studies mention serial ultrasound follow-up in addition to interval CT angiography.[7,8] In all of the smaller studies post-procedure imaging was complete with no patients lost to follow-up. In the largest series from Massis et al. not all patients had adequate pre-procedure and post-procedure CT angiography, and, of their 101 cases, only 53 had comparable imaging to allow assessment of clinical success.[13] In this series clinical success was defined by a reduction in the elliptical area of the aneurysm sac at the point of maximal dilation. A decrease or stabilization (<1 cm^2 increase) in sac size was observed in 39 of 53 cases, giving a clinical success rate of 74%. The overall clinical success rate for all studies (as defined by the