Safe and fast proximal aortic control using an aortic balloon through direct graft puncture for the explantation of an abdominal endograft with suprarenal fixation

Miltiadis Matsagkas*, George N. Kouvelos and Michalis Peroulis

Department of Surgery, Vascular Surgery Unit, Medical School, University of Ioannina, Ioannina, Greece

* Corresponding author. Department of Surgery, Vascular Surgery Unit, Medical School, University of Ioannina, Ioannina University Campus, S. Niarchos Avenue, 45110 Ioannina, Greece. Tel: +30-26-51007422; fax: +30-26-51033379; e-mail: mimats@cc.uoi.gr; milmats@gmail.com (M. Matsagkas).

Received 8 November 2013; received in revised form 12 December 2013; accepted 20 December 2013

Abstract

The late removal of an abdominal aortic endograft is technically challenging and can be associated with significant blood loss, especially when a graft with active suprarenal fixation is involved. The main issue in safe explantation of the endograft is control of the aorta above the proximal fixation site. We report an adjunctive technique for the safe and fast proximal control of the suprarenal aorta using an aortic balloon. The endograft is directly punctured and an aortic balloon is deployed and inflated above the fixation site in the supracoeliac aorta. The time for supracoeliac control in our 2 patients was <5 min. This simple technique offers a safe and fast aortic control during the removal of the endograft, especially when active suprarenal fixation is used, avoiding the risks from a technically demanding dissection in a potentially inflammatory region.

Keywords: Open conversion • Graft explantation • Suprarenal fixation • Endovascular aortic aneurysm repair

INTRODUCTION

Endovascular aortic aneurysm repair (EVAR) has gained wide acceptance as the preferred method of treatment of suitable patients with infrarenal abdominal aortic aneurysms (AAAs), accounting for more than half of all AAA repairs [1]. The technique is associated with significantly lower short- and mid-term mortality and reduced hospital stay, but also with increased late reintervention rates in comparison with open surgical repair [2].

The incidence of late open conversion of EVAR has been estimated near 2%, although this incidence will undoubtedly rise with the increasing number of patients treated endovascularly nowadays [3]. The explantation of an aortic stent graft is often technically demanding, especially in grafts with suprarenal active fixation. Several techniques have been proposed for the removal of an endograft, in addition to the traditional ‘clamp and pull’ method [4–8]. These techniques have mainly focused on useful manoeuvres that may assist in graft removal, however, without addressing issues regarding the proximal aortic control. Proximal control, unlike most primary treated infrarenal aneurysms, has to be often supraceliac to enable endograft explantation [3].

We report an adjunctive simple technique for safe and fast proximal control of the supraceliac aorta during the explantation of an abdominal aortic stent graft using an aortic balloon.

TECHNIQUE

The aneurysm sac and the infrarenal neck of the aorta are exposed and prepared as in a standard open AAA repair. An incision is then made in the AAA sac to reveal the main body of the endograft. The main body is punctured and a 0.035 J type guidewire is introduced up to the descending thoracic aorta. An aortic occlusion balloon is then deployed cephalically over the wire for ~10 cm from the punctured site. The balloon is inflated above the coeliac artery up to a volume that provides a diameter just larger than the native aorta diameter (according to the manufacturer’s instructions), which has been measured beforehand in the preoperative computed tomography scan (Fig. 1). After the occlusion of the aorta, the endograft can be safely removed in a clear and bloodless field by applying simple traction and attempting to reduce the diameter of the graft and detach its hooks, as others have previously proposed [4, 6, 7]. After explantation of the graft, the aorta can be clamped infrarenally in a standard manner, while the aortic balloon is deflated and removed.

In our institution, we performed this technique in 2 patients so far, who needed late conversion and explantation of an aortic endograft with active suprarenal fixation (in both cases, Endurant aortic grafts, Medtronic, Inc., Santa Rosa, CA, USA). The first patient (male, 70 years) experienced a significant increase of the aneurysm sac size (from 6 to 7.1 cm) at the third year after EVAR without evidence of stent-graft migration, damage or endoleak on imaging methods. That increase was considered an endovascular treatment failure and the patient underwent an open conversion (Fig. 2). The other patient (male, 64 years) was admitted to our department 2 months after EVAR with acute limb ischaemia due to complete stent-graft thrombosis, so he underwent an open conversion to aortobifemoral bypass. Proximal suprarenal aortic control was successfully accomplished with the aortic balloon (Reliant Stent Graft...
Balloon Catheter, Medtronic, Inc., Santa Rosa, CA, USA) in both patients with no further complications (Fig. 2). The time needed from supracoeliac control to graft removal was <5 min with minor bleeding, while the aortic clamp after explantation was successfully applied below the renal arteries in both patients.

**DISCUSSION**

Although most of the complications after EVAR for AAA are successfully addressed by endovascular means, open conversion remains an important issue, having no significant difference in frequency among different devices [5, 7]. Late conversion is technically more challenging than primary open repair, presenting with higher 30-day mortality rates [7, 9, 10]. Kelso et al. [7] reported an average blood loss of 6 l after late conversion of aortic stent grafts, a rate that is clearly higher than in conventional open AAA repair, exerting the need for more meticulous control of blood loss [1].

Control of the aorta above the proximal fixation site is of utmost importance in safe removal of the endograft. In grafts with infrarenal fixation, suprarenal clamping is usually sufficient as long as an adequate length between the renal ostia and the superior mesenteric artery exists. Grafts with suprarenal fixation, however, require additional dissection and supracoeliac clamping to achieve proximal aortic control and to avoid injury to the native aorta during the removal of the bare stents of the graft. Furthermore, the periaortic inflammation sometimes noted at the proximal aortic neck, especially when barbs or hooks are involved, makes dissection above the renal arteries tedious. The use of an aortic balloon for the proximal control obviates the need for a technical demanding dis-

![Figure 1](https://academic.oup.com/icvts/article-abstract/18/4/519/646385)

**Figure 1:** (A) The sac is opened to reveal the main body of the endograft. (B) The endograft is directly punctured and a 0.035” guidewire is introduced. (C) An aortic balloon is inserted and inflated to gain proximal aortic control, while the graft limbs are also clamped. (D) The proximal graft is dislodged from the aorta and pulled down. (E) A clamp is placed in the infrarenal aorta. (F) The balloon is deflated and removed along with the guidewire.

![Figure 2](https://academic.oup.com/icvts/article-abstract/18/4/519/646385)

**Figure 2:** (A) Three-dimensional reconstruction of computed tomography angiography (CTA) 3 years after the initial deployment of the suprarenal stent graft. (B) Axial image of CTA showing the enlargement of the aneurysmal sac (from 6 to 7.1 cm). (C) Postoperative result 2 months after open conversion. Proximal control details during operation. (D) The sac is opened to reveal the main body of the endograft. (E) The endograft is directly punctured and a 0.035” guide-wire is introduced. (F) An aortic balloon is inserted and inflated to gain proximal aortic control before explantation of the endograft.
section in an inflammatory region, avoiding simultaneously the damage of surrounding structures. On the other hand, supraceliac control just below the diaphragm needs additional dissection in a different surgical field and sometimes can also be technically demanding and time consuming. Successful proximal control with an occlusion balloon via a brachial approach has also been described [8]. This strategy, however, usually requires surgical exposure of the brachial artery and a large introducer sheath, ranging from 12 to 16 F, thus raising the chance for additional complications, especially in the aortic arch, while it is also time consuming. Delivery of the same balloon by a femoral artery approach through a large sheath could also be an option, though certain issues such as time consumption for exposure of a previously operated femoral artery and possible regional complications as well as the need for adequate consumption for exposure of a previously operated femoral artery should be acknowledged. On the contrary, by direct puncturing of the stent graft, we achieved the same goal without needing a secondary access point. This technique may also be useful in cases of rupture after EVAR when time plays a more significant role.

CONCLUSION
This simple technique offers a safe and fast solution for aortic control during the removal of an endograft, especially when active suprarenal fixation is involved, avoiding the risks from a technically demanding dissection in a potentially inflammatory region.

Conflict of interest: none declared.

REFERENCES


eComment. A note on proximal aortic control in the era of increasing endovascular aortic interventions

Author: Nicolas J. Mouawad
Division of Vascular Diseases and Surgery, The Ohio State University, Columbus, OH, USA
doi: 10.1093/icvts/ivu043
© The Author 2014. Published by Oxford University Press on behalf of the European Association for Cardio-Thoracic Surgery. All rights reserved.

I read with keen interest the article by Matsagkas and colleagues [1] proposing a bail-out technique in the management of open explantation of endografts with suprarenal fixation. The authors were able to successfully control the aorta in the supraceliac position by puncturing the endograft after open exposure of the infrarenal aorta, facilitating explantation.

The use of balloon occlusion catheters for control of the proximal aorta has been previously described [2] and is standard in the endovascular management of ruptured abdominal aortic aneurysms. The transfemoral route is generally utilized contralateral to the anticipated deployment of the main body; this is preferred in order to avoid potential complications due to risk of injury to the smaller calibre upper extremity arteries, as well as minimizing the stroke risk with manipulations near the aortic arch when a transbrachial or transaxillary route is selected [3].

Unfortunately, the increased emphasis given to training on the endovascular treatment of aortic aneurysms has made younger vascular surgery trainees more uncomfortable navigating the abdomen and the retroperitoneum for quick and adequate open aortic exposure. This is a double-edged situation: more endografts are being placed but fewer individuals feel experienced or comfortable enough to manage open explantation with open supraceliac control. Although ultimately vascular surgery trainees obtain the necessary operative open case volume, the frequency of repetition of open aortic procedures has decreased, in keeping with current management trends. Therefore, the proposed bail-out technique is quick and efficient, and should be in the armamentarium of any vascular surgeon.

Conflict of interest: none declared.

References