Proposal for bail-out procedures - Aortic and aneurysmal

Failure to exclude a saccular arch aneurysm during hybrid repair: arch replacement without cerebral circulatory arrest

Vamsidhar B. Dronavalli, Mahmoud Loubani, Peter Riley, Robert S. Bonser*

University Hospital Birmingham NHS Trust, Queen Elizabeth Hospital, Edgbaston, Birmingham, B15 2TH, UK

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Abstract

Thoracic endovascular aortic reconstruction (TEVAR) is increasingly used in the management of descending aortic pathology including aneurysms, dissections and transaction. When treating aortic arch pathology, hybrid procedures have been devised, in which major supra-aortic arteries are translocated using a variety of techniques. Such hybrid procedures offer an attractive alternative to open arch procedures in frail elderly patients in whom the risks of open repair are considerable. We describe a surgical bail-out procedure which was used during a hybrid aortic arch replacement when endovascular aneurysm exclusion could not be achieved.

Keywords: Aorta; Aneurysm; Endovascular repair; Hybrid

1. Introduction

Hybrid aortic arch replacement comprising, translocation of the supra-aortic arteries and endovascular stent deployment across the transverse aortic arch may offer an alternative to open arch replacement [1–4]. Supra-aortic arterial translocation may be performed via the neck with interposition grafts connecting the left subclavian and left carotid arteries with a further connection to the right carotid across the midline [5, 6]. In circumstances when the innominate artery (IA) also requires translocation to allow effective aneurysm exclusion, the translocation can be performed within the mediastinum via a median sternotomy [7]. This approach also allows antegrade deployment of the stent device when peripheral access is limited by occlusive disease or when such deployment is preferred because of descending or intra-abdominal aneurysmal disease potentially preventing arterial thrombus and atheroma embolisation. Effective hybrid aneurysm management is dependent upon complete aneurysm exclusion. We describe the intraoperative management of a case in which exclusion could not be achieved.

2. Case report

An 80-year-old man, under surveillance for infra-renal abdominal and saccular aortic arch aneurysms was considered for hybrid arch replacement after a rapid increase in the size of the arch aneurysm (Fig. 1a). The 8 cm aneurysm was located on the inferior aspect of the aortic arch opposite the ostia of all supra-aortic vessels and stenting necessitated coverage of all vessels for adequate exclusion. In addition, pre-procedure coronary arteriography demonstrated critical left main coronary artery stenosis. Thus, the need for innominate translocation and concomitant coronary artery surgery dictated a mediastinal approach and the presence of the infra-renal aneurysm made antegrade stent deployment preferable.

After a preliminary left subclavian artery (LSA) – left common carotid artery (LCCA) bypass procedure undertaken via a cervical incision, surgery was performed via a median sternotomy. During a period of cardiopulmonary bypass, a pedicled left internal mammary artery graft was placed to the left anterior descending artery and a reverse saphenous vein graft to the first obtuse marginal artery. Bypass was secured via right atrial drainage and ascending aortic return proximal to the aneurysm. Following a proximal vein graft anastomosis and cross-clamp release, the three branch crown of a multi-limbed prosthetic graft (Gelweave–Valiant Medtronic Inc, Minneapolis, USA) was anastomosed to the right lateral greater curvature aspect of the healthy ascending aorta using a side-biting clamp. The IA was then doubly clamped and divided, oversewing the proximal stump and the 10 mm graft limb anastomosed end-to-end allowing IA reperfusion. The LCCA was similarly clamped, divided, anastomosed and reperfused using an 8 mm graft limb. Each anastomosis performed without shunts or perfusion catheters with anastomotic times <10 min. Bypass was then discontinued, the aorta decannulated and the second 8 mm graft limb instrumented with a guidewire (GW) for stent delivery. Two endovascular stents (Valiant-Medtronic Inc, Minneapolis, USA) were deployed antegrade, the first to a landing zone in the proximal descending aorta and the second to exclude the...
arch aneurysm with an intended proximal landing zone of the distal ascending aorta. Satisfactory distal deployment was confirmed but proximal stent deployment failed to achieve adequate aneurysm exclusion. Further attempts at stenting were abandoned due to the concern that satisfactory proximal deployment without compromising the translocation site would be difficult to achieve.

2.1. The bail-out procedure

To complete repair, bypass was re-established with arterial return via the graft side-limb previously used for stent deployment. The patient was cooled to 22 °C and a clamp placed on the ascending aorta distal to the translocation site (containing the graft limbs supplying the IA and LCCA and the arterial return) allowing a period of corporeal circulatory arrest whilst perfusion of the heart and brain continued. The distal ascending aorta was transected above the clamp at the level of the IA stump and at the edges of both the aneurysm and the proximal stent. The proximal uncovered cage of the stent was excised and a further prosthetic graft (Gelweave–Vascutek Anteflo, Renfrewshire, UK) was invaginated and passed into the stent as a trunk. A distal anastomosis was then constructed, during a 20-min corporeal arrest period, incorporating the full thickness of the native aorta, the residual stent material and the prosthetic graft. Disinvagination of the graft allowed re-institution of corporeal flow via a side-arm and clamping of the graft proximally. Thus, two arterial returns, one via the ascending aorta supplying the heart and supra-aortic branches and one supplying the distal body were used at this stage. This permitted construction of a final proximal anastomosis of the clamped distal graft and the clamped ascending aorta (Fig. 2b). The patient weaned from bypass without incident and made a full postoperative recovery. The postoperative computed tomographic scan (CT-scan) (Fig. 1b) demonstrates the elephant trunk (ET) within the stent.

3. Discussion

In this case, hybrid arch replacement was considered a desirable alternative to open arch repair in view of the patient’s age and frailty. However, failure to achieve aneurysm exclusion necessitated a customised bail-out procedure to adequately exclude the aneurysm. This was facilitated by the prior translocation of the supra-aortic vessels which meant that a period of cerebral circulatory arrest was unnecessary and satisfactory aneurysm exclusion could be ultimately achieved during a limited period of corporeal arrest with distal reperfusion via a graft side-arm. The technique described has two potential roles. Firstly, it provides an opportunity to complete repair when endovascular exclusion cannot be achieved. Secondly, by bringing the proximal anastomosis to a more accessible site, it may facilitate hybrid arch replacement when using frozen ET techniques without recourse to hypothermic cerebral circulatory arrest [2]. Our decision to deploy the repair graft as an ET was based on the possibility of needing to manage distal endo-leakage should this become necessary in the future. In this situation, the trunk could be used as a proximal landing zone.

Endovascular treatment of descending and aortic arch aneurysms is a rapidly developing field but there remain concerns regarding a high risk of endo-leak phenomena that may require secondary interventions [8]. Nevertheless, hybrid endovascular repair will continue to be an option in selected patients. This case illustrates what can be done if this is not successful and highlights the importance of a joint approach between interventional radiologists and cardiothoracic surgeons when dealing with unanticipated difficulties.

References


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Fig. 1. (a) Preoperative reconstructed CT-scan demonstrating a saccular aneurysm (dashed arrow) on the under-surface of the transverse aortic arch. The need to deploy a stent covering the innominate artery (IA) is evident. (b) Postoperative CT-scan demonstrating the translocation grafts (1), the elephant trunk (ET) (2) and the distal arch stent (3). Bilateral pleural effusions are present. LCCA, left common carotid artery; LSA, left subclavian artery.

Fig. 2. (a) Schematic representation of the initial procedure. A preliminary bypass has been constructed between the left subclavian artery (LSA) and the left common carotid artery (LCCA). The LCCA and innominate artery (IA) have been translocated using the limbs of the prosthetic graft crown (GC). The deployed stent (DS), inserted via a guidewire (GW), fails to exclude the saccular aortic aneurysm (SAoA). The proximal supra-aortic vessels have been ligated at their origin. (b) Schematic representation following the bail-out procedure. The proximal (PA) and distal (DA) anastomoses are identified together with the elephant trunk (ET) within the stent. The ligated limbs of the grafts used for cardiac/distal (DA) anastomoses are identified (LPL1 and LPL2).


