



When Cabrol is not Feasible: Neo-Pericardial-Innominate Vein Fistula “Salhab-Said Shunt” for Bleeding Control in Primary Aortic Root Surgery

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Abstract

Cabrol in 1981, described the creation of an aorto-right atrial fistula to control oozing from the prosthetic graft that is used to replace the ascending aorta/root in a mix of aneurysmal or dissected aortic pathology. This was performed by sewing the aneurysmal native aorta around the prosthetic graft and then connecting it to the right atrium. Since then, several modifications have been done in the original Cabrol concept.

We present in the current case an alternate option to the peri-graft to innominate vein/right atrial connection that could be beneficial in difficult situations where the original or Modified Cabrol version is not feasible.

Keywords: Aortic root surgery; Cabrol shunt; Cabrol fistula; Aortic root bleeding; Perigraft-to-innominate vein fistula; Modified Cabrol

Introduction

Despite the advances in aortic surgery and the development of better prosthetic grafts, aortic root bleeding continued to be troublesome to many surgeons in certain circumstances. While Cabrol fistula [1] or its modifications [2] can be a bail-out in many of these cases, it is not always possible to perform especially in primary sternotomy cases and situations where the native aneurysmal sac tissue has been excised. A classic example is cases of acute aortic dissection.

In the current report, we present a novel, yet simple strategy to control aortic root bleeding in a case where Cabrol or modified Cabrol fistula were not feasible.

Case Presentation

A 63-year-old man with multiple comorbidities (chronic kidney disease, hypertension, type 2 diabetes mellitus, and history of minor strokes) presented with acute shortness of breath associated with acute sharp mid-sternal chest pain, radiating to his back and his abdomen. Emergency transesophageal echocardiogram showed acute type A aortic dissection with extension to the aortic root causing severe aortic regurgitation (Video 1). An initial Computed Tomography (CT) scan was not performed due to his chronic kidney disorder. Decision was made to proceed with emergency repair.

Surgical technique

After induction of general endotracheal anesthesia and placement of the necessary monitoring lines, the right axillary artery was exposed through a standard right infraclavicular incision and a 6 mm Dacron graft was anastomosed to the artery using running 6/0 polypropylene suture. This was further connected to the arterial limb of the cardiopulmonary bypass circuit. A standard median sternotomy was then performed, followed by pericardiotomy. The external features of the ascending aorta matched the picture of an acute aortic dissection where we noticed a large blue/purple hematoma in the ascending aortic wall, extending down to the sinuses of Valsalva. Cardiopulmonary bypass was initiated in the standard fashion with a single two-stage venous cannula, and the core temperature was brought down to 18 degrees Celsius. Once deep hypothermic circulatory arrest was achieved, all the dissected aortic tissue was excised and a modified Bentall

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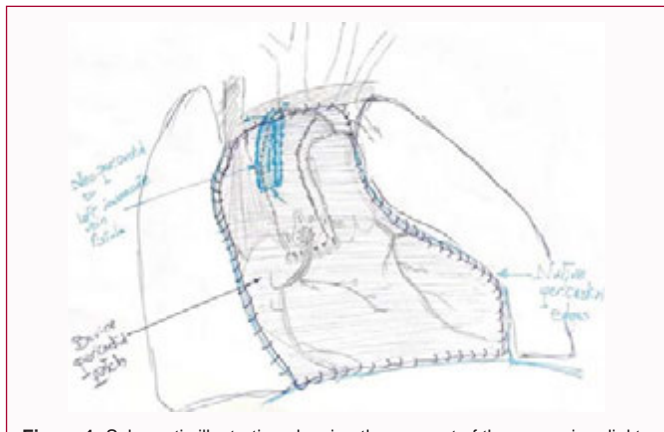
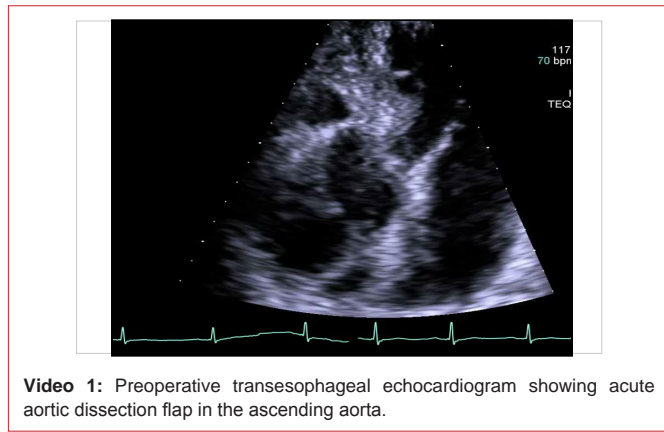


Figure 1: Schematic illustration showing the concept of the neopericardial to left innominate vein shunt.



Video 1: Preoperative transesophageal echocardiogram showing acute aortic dissection flap in the ascending aorta.



Figure 2: Initial postoperative computed tomography scan: (A) axial, and (B) coronal cuts showing complete occlusion of the neopericardial/left innominate vein shunt (single white arrow). The neopericardial cavity borders are seen (two white arrows).
A: Ascending Aorta; PA: Pulmonary Artery; DA: Descending Aorta



Figure 3: One and half-year postoperative follow-up computed tomography scan showing stable dissection flap in the distal aortic arch, and persistent occlusion of the neopericardial/left innominate vein shunt (white arrow).
AA: Aortic Arch; DA: Descending Aorta

aortic root replacement with a 23 mm bioprosthetic valved conduit was performed. The ascending aorta and hemi-arch were replaced as well. The patient was rewarmed back to normothermia and was weaned off cardiopulmonary bypass without difficulty.

Aortic root bleeding

There was significant bleeding from the aortic root that was not controllable easily with standard hemostatic measures despite correcting the patient’s coagulopathy status and placing the appropriate repair sutures. In this situation, performing the standard Cabrol or one of its modifications was not feasible as there are no native aneurysmal sac tissues that can be sewn around the new graft and the lack of adhesions which are helpful in reoperative settings

leaves the transverse sinus opened which will not allow performing the modified Cabrol’s procedure and connecting it to either the right atrium or to the left innominate vein. Therefore, we had to think of an alternate novel solution in such a desperate situation.

So, we decided to close the pericardial sac with a bovine pericardial patch which we then connected to the left innominate vein using a 10 mm Polytetrafluoroethylene (PTFE) graft (Figure 1). The pericardial patch was sutured to the right and left edges of the native pericardium on each side, the diaphragmatic surface inferiorly, the medial aspect of the superior vena cava, lateral aspect of the pulmonary artery, and the inferior margin of the left innominate vein, this closing the entire pericardial sac and creating a neo-pericardial/left innominate vein shunt.

This achieved significant hemostasis, and the chest was then closed in the standard fashion. There was no significant chest tubes output postoperatively, and the patient had overall uneventful postoperative course and was discharged on the 10th postoperative day. His follow-up CT scan shows thrombotic occlusion of the neo-pericardial/left innominate vein shunt (Figure 2A, 2B). He continued to do well with no symptoms two years later (Figure 3).

Discussion

The Achilles’ heel of aortic root surgery has been root bleeding which is troublesome specially in emergency situations. The idea of creating a controlled space for the blood that is oozing from the graft/ root and then draining it into the venous system, thus preventing patient’s exsanguination and achieving hemodynamic stability was initially performed as part of the modified Bentall procedure by Cabrol in 1981 [1]. This Cabrol fistula has been modified over the years to connect the peri-graft space to either the right atrium or to the left innominate vein whether directly or through a graft. The graft also can be valved [3] or valveless. All these modifications carry the basic concept. Some concerns were raised in regard to the possibility of persistent left-to-right shunt as a result of the Cabrol fistula [4], however, long-term follow-up showed that the majority of these shunts/fistulae close with no significant hemodynamic consequences and some even close prior to patients’ discharge from the hospital [5].

However, not all aortic root bleeding can be managed by a Cabrol fistula in our opinion. In primary operative settings, if the surgeon keeps the native aneurysmal tissue in place, then it can be used to create the fistula easily. In reoperative settings, the transverse pericardial sinus is obliterated which helps in maintaining the integrity of the peri-aortic root space, then closing the area between the pulmonary artery and the superior vena cava on one side and the

lower margin of the left innominate vein and the upper margin of the right ventricle on the other side, with a pericardial patch achieves the same concept of the Cabrol and then this can be connected to the right atrium/left innominate vein with a graft as deems appropriate. The challenge is when it is primary operative settings and no native aortic tissues to contain the bleeding such as in the above-described case. We have used the same Cabrol concept, but we found that it is easier to just close the entire pericardium with a pericardial patch and then connect this to the left innominate vein with the graft. This achieves the same goals as the primary/modified Cabrol in terms of preventing patient's exsanguination and achieving hemodynamic stability. The graft thrombosed and there were no concerns regarding persistent left-to-right shunt. This technique may be helpful in such difficult circumstances and should be part of the aortic surgeon's armamentarium.

Conclusion

Our modification of the Cabrol shunt could be useful in primary operative settings and in emergency cases where the amount of native aortic tissues is not sufficient to construct a standard/modified Cabrol shunt.

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