An effective strategy for optimizing hemostasis following aortic root replacement

Uma estratégia eficiente para otimização da hemostasia após substituição da raiz da aorta

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Abstract

For patients undergoing aortic root replacement with a prosthetic composite valve graft, bleeding from the annular and coronary artery suture lines remains problematic. The purpose of this article is to describe our current strategy for optimizing hemostasis during composite valve graft placement, which employs several recent modifications, including a double-layered annular suture line.

Key words: aortic aneurysm, ectasia, Marfan syndrome, graft, hemostasis.

Resumo

Para pacientes submetidos a substituição da raiz da aorta por um enxerto composto valvado, o sangramento nas linhas de sutura do anel aórtico e da artéria coronária permanece problemático. O objetivo deste artigo é o de descrever uma estratégia atual para a otimização da hemostasia durante a colocação de enxerto composto valvado. Essa técnica emprega várias modificações recentes, incluindo uma linha de sutura anelar dupla.

Palavras-chave: aneurisma aórtico, ectasia, síndrome de Marfan, enxertos, hemostasia.

"There is no disease more conducive to clinical humility than aneurysm of the aorta."
Sir William Osler

Isolated aortic root dilatation is typically a degenerative process associated with Marfan syndrome, bicuspid aortic valve, aging, or long-standing hypertension. In annuloaortic ectasia (AAE), the diameter of the aortic annulus and aortic sinuses increases out of proportion to the size of the aortic leaflets resulting in aortic regurgitation[1] (Figure 1). Cardiac surgery in patients with AAE may be required because of aortic insufficiency, dilatation of the aortic root, acute dissection, or a combination of these processes.

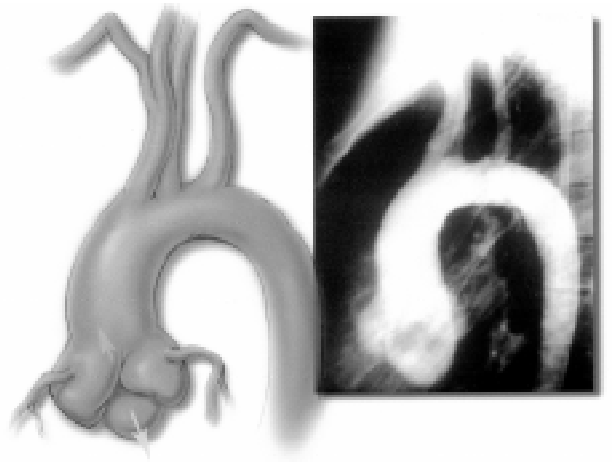

Figure 1 - Drawing illustrating annuloaortic ectasia.

The most common repair of AAE involves aortic root replacement with a composite valve graft (CVG). Since the original description by Bentall & DeBono[2], several modifications - including the Cabrol technique[3] and Kouchkoukos' "open-button" technique[4] - have

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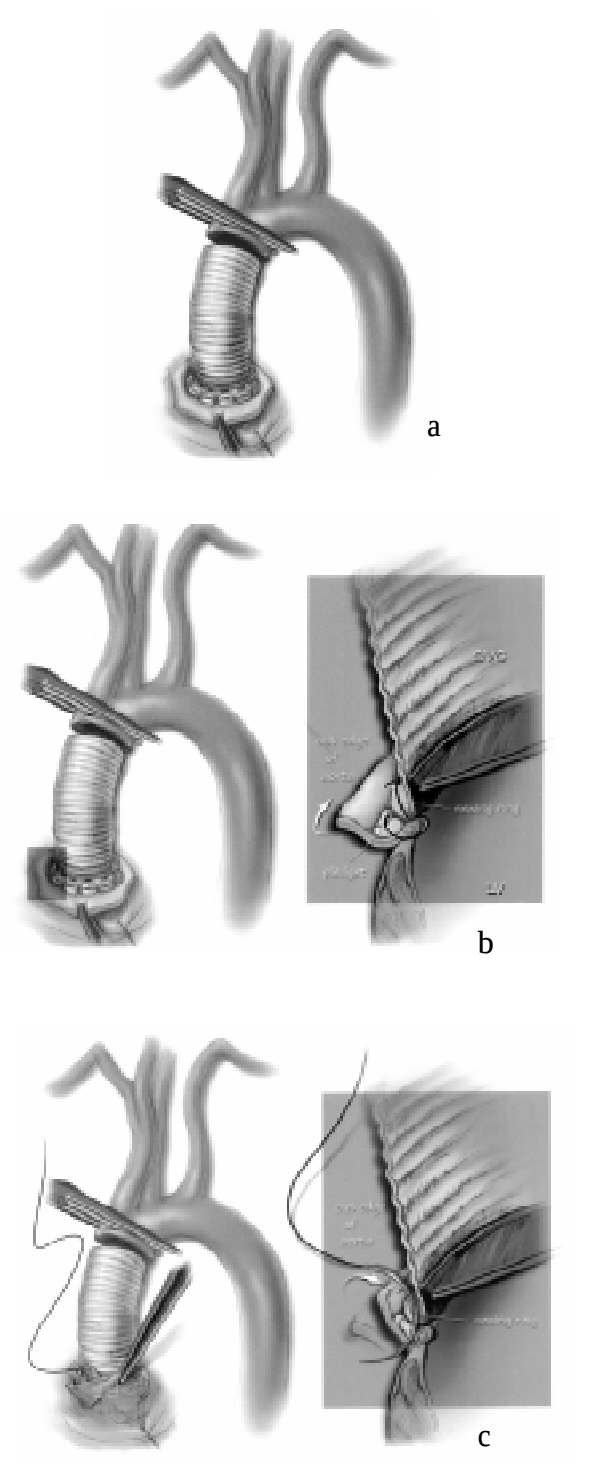
been developed to reduce bleeding complications and pseudoaneurysm formation. Despite these improvements, tissue fragility and suture line inaccessibility continue to create problems involving the annular and coronary artery anastomoses[5,6].

To further reduce the incidence of these complications, we recently added a few technical modifications to our standard operation[7-9]. The purpose of this report is to describe our current strategy for optimizing hemostasis during CVG placement, which includes placing an additional suture line with aortic wall wrap at the annular anastomosis; reinforcing the coronary artery button anastomoses with Teflon felt "donuts" in patients with friable aortic tissue; and reinforcing all suture lines with BioGlue surgical adhesive.

Material and methods

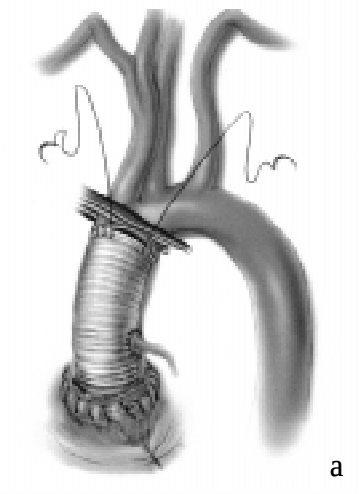
Our standard surgical approach for excision and graft replacement of an aortic root aneurysm employs a median sternotomy, standard cardiopulmonary bypass, and combined antegrade/retrograde cold blood cardioplegia[6]. However, cannulation and cardiopulmonary bypass techniques vary depending on clinical and anatomic circumstances. For example, if the aneurysm extends into the arch, adjustments are made allowing for hypothermic circulatory arrest.

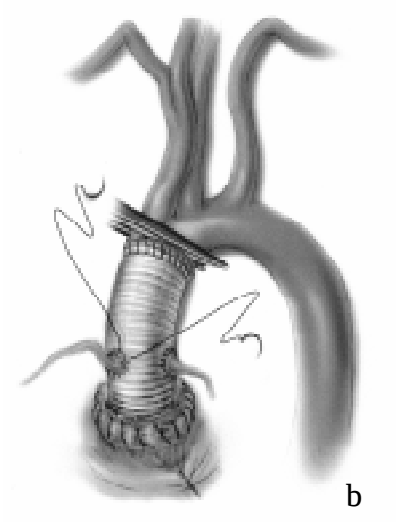
Following cardioplegic arrest, the ascending aneurysm wall distal to the sinotubular junction is completely excised. Following inspection of the aortic valve, the leaflets are removed, and dissection is carried down externally to the aortic valve annulus. The aortic wall at the sinus level is then excised, leaving approximately 5 mm of aortic wall adjacent to the annulus. The coronary artery origins are mobilized on buttons of 3-5 mm of full-thickness aortic wall. Pledgeted 2-0 Ticron mattress sutures are placed along the aortic annulus. An appropriately sized CVG is selected, and the annular sutures are placed through the sewing ring (Figure 2a). After seating the valve and tying the annular sutures, the second layer of the proximal anastomosis is performed by placing a running 2-0 polypropyline suture that incorporates the 5 mm rim of native aortic wall, the prosthetic sewing ring, and the pledgets (Figures 2b and 2c). The left main coronary artery button is reattached posteriorly to an opening in the graft using a running 4-0 or 5-0 polypropyline suture. Following reattachment of the left coronary artery, the distal graft-to-aortic wall anastomosis is performed. Finally, the



Figures 2a, 2b and 2c - (a) The composite valve graft sewing ring is secured to the annulus with a series of 2-0 pledgetted mattress sutures. (b) A 5 mm ring of native aortic wall remains along the entire annular circumference. (c) The superior aspect of the prosthetic sewing ring is sutured to the rim of native aortic wall using running 2-0 polypropyline.

right coronary artery button is reattached anteriorly, thereby, completing the reconstruction (Figures 3a and 3b). The coronary button anastomoses are often reinforced with individual Teflon felt pledgets, selectively placed as needed. If the aortic tissue is unusually friable, the coronary artery buttons are reinforced by incorporating Teflon felt "donuts" or pericardium in the suture line (Figure 4). Following the completion of each anastomosis, BioGlue surgical adhesive (CryoLife, Inc., Kennesaw, Georgia) is applied to further reinforce the suture line.





Figures 3a and 3b - The reconstruction is completed by (a) reattaching the left main coronary artery, performing the distal aortic anastomosis, and (b) reattaching the right coronary artery.

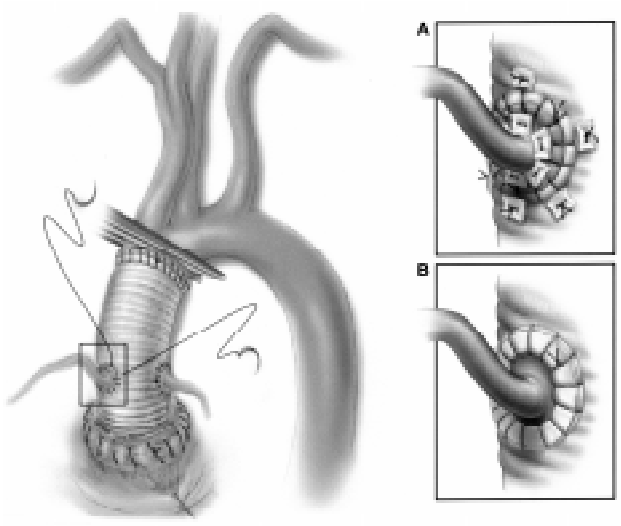


Figure 4 - The coronary buttons are usually reinforced by placing individual Teflon felt pledgets along the anastomosis, as needed. In patients with extremely friable aortic wall, Teflon or pericardium "donuts" are incorporated into the initial suture line.

Comment

Composite valve graft replacement is a widely accepted treatment for annuloaortic ectasia and other complicated pathology involving the aortic root. The early and long-term results have been favorable with 30-day mortality rates ranging from 0.7% to 10% in recent reports[4,5,10] and 5-year survival rates between 76% and 89%[5,11].

The evolution has largely been influenced by postoperative bleeding and pseudoaneurysm formation. The most widely accepted modifications to the classic Bentall procedure are those described by Cabrol[3] and Kouchkoukos[4], both of which effectively reduce bleeding complications at the coronary arterial anastomoses. Over the past decade, several authors have described additional technical modifications designed to further reduce suture line problems. As a way of preventing bleeding from the coronary suture lines, Miller & Mitchell described making "life-saver" rings out of Teflon felt or autologous pericardium (tanned in 0.625% glutaraldehyde solution for 10 to 15 minutes) and placing them around the coronary buttons (on the adventitional aspect) to prevent tearing during suturing, particularly in those patients with friable aortic tissue[7].

Other authors have reported success using Teflon felt "donuts"[12]. As an alternative, Passage et al. have applied a thin layer of BioGlue to the adventitial surface of the coronary buttons to strengthen the tissue prior to suturing[13].

Recent technical modifications have also been advocated for the annular anastomosis. Although most authors advocate a single suture line at the aortic annulus[5], as early as 1993, Copeland and associates[8] described using an additional suture line to strengthen the proximal anastomosis. The addition of an aortic cuff incorporated within the second suture line was described two years later by Bayfield & Kron[9].

In summary, our current strategy for optimizing hemostasis after CVG placement employs a combination of these approaches. We routinely reinforce the annular anastomosis with a wrap of adjacent aortic tissue and a second suture line. For the coronary anastomoses, we use Kouchoukos' "open button" technique in most cases and often reinforce them with either pledgeted sutures or "donuts," depending on the degree of fragility. We reserve the Cabrol method for cases in which coronary mobilization and direct reattachment are not feasible, such as in patients undergoing reoperation and those with extremely large aneurysms[8]. In all cases, we use surgical adhesive to secure the suture lines. Each of the recent modifications are relatively easy to perform and can be accomplished within a few minutes. Whether the resulting subjective improvement in hemostasis will translate into improved outcomes and fewer late pseudoaneurysms remains to be seen.

References

1. David TE, Feindel CM, Bos J. Repair of the aortic valve in patients with aortic insufficiency and aortic root aneurysm. J Thorac Cardiovasc Surg 1995;109:345-52.
2. Bentall HH, DeBono A. A technique for complete replacement of the ascending aorta. Thorax 1968;23:338-9.
3. Cabrol C, Pavie A, Gandjbakhch I, et al. Complete replacement of the ascending aorta with reimplantation of the coronary arteries: new surgical approach. J Thorac Cardiovasc Surg 1981;81:309-15.
4. Kouchoukos NT, Marshall WG, Wedige-Stecher TA. Eleven-year experience with composite graft replacement of the ascending aorta and aortic valve. J Thorac Cardiovasc Surg 1986;92:691-705.
5. Gott VL, Cameron DE, Alejo DE, et al. Aortic root replacement in 271 Marfan patients: a 24-year experience. Ann Thorac Surg 2002;73:438-43.
6. LeMaire SA, DiBardino DJ, Köksoy C, Coselli JS. Proximal aortic reoperations in patients with composite valve grafts. Ann Thorac Surg 2002;74:S1777-80.
7. Miller DC, Mitchell RS. Composite aortic valve replacement and graft replacement of the ascending aorta plus coronary ostial reimplantation: how I do it. Semin Thorac Cardiovasc Surg 1993;5:74-83.
8. Copeland JG 3rd, Rosado LJ, Snyder SL. New technique for improving hemostasis in aortic root replacement with composite graft. Ann Thorac Surg 1993;55:1027-9.
9. Bayfield MS, Kron IL. Reducing bleeding after replacement of the aortic root: how I do it. Ann Thorac Surg 1995;60:1130-1.
10. Gott VL, Greene PS, Alejo DE, et al. Replacement of the aortic root in patients with Marfan's syndrome. N Engl J Med 1999;340:1307-13.
11. Dossche KM, Schepens MA, Morshius W, Knaepen P, Brutel de la Riviere A, Vermeulen FE. A 23-year experience with composite valve graft replacement of the aortic root. Ann Thorac Surg 1999;67:1070-7.
12. Ehrlich MP, Ergin MA, McCullough JN, et al. Favorable outcome after composite valve-graft replacement in patients older than 65 years. Ann Thorac Surg 2001;71:1454-9.
13. Passage J, Jalali H, Tam RK, Harrocks S, O'Brien MF. BioGlue surgical adhesive - an appraisal of its indications in cardiac surgery. Ann Thorac Surg 2002;74:432-7.

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