Salvage periaortic pericardial baffle equalizes mortality in bleeding patients undergoing aortic surgery

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Objective: Bleeding is a potentially serious complication of aortic surgery. We report our experience with the use of a periaortic bovine pericardial baffle to control intractable intraoperative bleeding.

Methods: All patients who underwent aortic root, ascending, or arch replacements between January 2002 and April 2013 were reviewed. A bovine pericardial periaortic baffle was created to shunt shed blood into the right atrium. The transverse sinus was sutured closed in patients undergoing primary sternotomy. Baffle recipients were compared with the remaining patients undergoing aortic surgery. The Fisher exact test was used to determine statistical significance for categoric variables. Continuous variables were compared using the nonparametric Wilcoxon rank-sum test. All factors with a P value less than .2 were considered for multivariate logistic regression to determine independent associations with baffle use.

Results: A total of 413 patients were identified, of whom 23 received a baffle. Operative mortality for patients receiving a baffle was 4% (1/23) compared with 6% (25/390) ($P = 1$) for the remaining patients. Prolonged ventilation was more common in the baffle recipients ($P < .0005$); otherwise, there were no differences in postoperative morbidity. Multivariate analysis of all patients undergoing aortic surgery revealed infectious endocarditis ($P < .0005$; odds ratio, 15.1; 95% confidence interval, 4.8-47.2), redo sternotomy ($P < .0005$; odds ratio, 11.9; 95% confidence interval, 4.1-34.1), and male gender ($P = .04$; odds ratio, 4.6; 95% confidence interval, 1.1-19.3) to be predictive of baffle placement.

Conclusions: Patients requiring salvage periaortic pericardial baffle for intractable intraoperative hemorrhage experienced an operative mortality similar to that in the remaining patients undergoing aortic surgery. Infectious endocarditis requiring root replacement or reoperative aortic surgery should alert the surgeon to the potential need for baffle placement, including prophylactic transverse sinus closure. (J Thorac Cardiovasc Surg 2014;148:151-5)

Bleeding can be a serious and life-threatening complication of aortic surgery. Mortality for aortic surgery complicated by significant bleeding has been reported to be as high as 22%.[1,2] For specific management problems, such as active prosthetic endocarditis, mortality rates as high as 22% to 57%[3-5] have been reported. Procedures complicated by bleeding lead to prolonged ventilation, intensive care unit length of stay, overall length of stay, and increased hospital costs.[6-8] In addition, increased blood and blood product use associated with resuscitating these patients has been shown to increase the incidence of postoperative infection and the short- and long-term risk of death.[9-11]

To this end, numerous strategies have been developed and significant resources invested to combat perioperative coagulopathy and bleeding. A few examples include intravenous antifibrinolytic agents[12]; topical procoagulants, glues, and sealants[13-15]; and off-label use of recombinant activated factor VII.[16,17] These measures are variably effective at stopping coagulopathic or minor surgical bleeding, and significant negative side effects have been reported for most of these strategies.[18-20] In contrast to coagulopathic bleeding, aortic surgery presents a relatively unique situation in which major surgical bleeding may not be reachable without physiologically unrealistic measures. Further coagulopathy and myocardial ischemia may make reinstitution of cardiopulmonary bypass, cardioplegic arrest, and revision of an aortic repair unreasonable.

In 1978, Cabrol and colleagues[21] described aortic root replacement using an inclusion technique and routine anastomosis of the reapproximated aortic aneurysm sac to the right atrial appendage to control bleeding. Since then, there have been several modifications of the Cabrol shunt.[22-26] The widespread adoption of aortic resection,[27] as opposed to graft inclusion, has resulted in the lack of an aneurysm sac to create the Cabrol shunt should major hemorrhage occur. A more recent technique described by Posacioglu and colleagues[24] in 2002 has revitalized the shunt option by creating a baffle over the ascending aorta using bovine pericardium that decompresses arterial bleeding through creation of a shunt to the right atrium. The purpose of this

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Abbreviations and Acronyms
CI = confidence interval
CT = computed tomography
OR = odds ratio

article is to review a decade of experience with the pericardial baffle procedure and to identify risk factors for severe bleeding potentially requiring its use.

MATERIALS AND METHODS

We retrospectively reviewed all aortic root, ascending, and arch replacements from January 2002 to April 2013. This study was approved by the institutional review board of the Medical University of South Carolina, and the need for individual consent was waived. Data were obtained from review of the patient's medical records and the institutional Society of Thoracic Surgeons Adult Cardiac database.

Conventional methods were used to attempt to obtain hemostasis in all patients. For those patients who had clear surgical bleeding that was not accessible and for whom resumption of cardiopulmonary bypass was thought to be contraindicated, an appropriately trimmed sheet of bovine pericardium was used to create a baffle over the ascending aorta, sutured to surrounding structures, and decompressed into the right atrium (Figure 1). It is important to note that the floor of this space includes the opening of the transverse sinus between the dome of the left atrium and the right pulmonary artery. To obtain hemostasis, this communication with the free pericardial space must be closed in primary sternotomy patients. Closure of the transverse sinus is most easily accomplished before aortic reconstruction in cases in which the baffle may be anticipated.

Patients receiving a baffle were compared with those who did not. The decision to place a baffle was at the discretion of the attending surgeon and was made on the basis of the amount and location of bleeding after adequate patient rewarming, separation from bypass, reversal of heparin, and correction of coagulation deficiencies.

Categoric variables are reported as percentages, and the median is reported for each continuous variable. Fisher exact test was used to determine the statistical significance for categoric variables. Continuous variables were compared using the nonparametric Wilcoxon rank-sum test. All factors with a univariate P value less than .2 were considered for multivariate logistic regression to determine independent multivariate associations with placement of a baffle.

RESULTS

Between January 2002 and April 2013, 413 patients underwent aortic root, ascending, or arch replacement. Preoperative demographics are listed in Table 1. Baffle recipients had a higher incidence of previous sternotomy, infectious endocarditis, and renal failure. Operative variables and outcomes are listed in Table 2. Operative variables, including the use of a homograft, bypass time, and crossclamp time, were all significantly higher in the baffle group. Circulatory arrest was less common in baffle recipients, and circulatory arrest times were not statistically different. Postoperative variables and outcomes, including open chest, prolonged ventilation, and atrial fibrillation, were more common in the baffle group. Of these 413 patients, 23 required a baffle to control bleeding. There was 1 intraoperative death (4%) among the baffle recipients, which was similar to the 25 (6%) in the remaining aortic surgery cohort ($P = 1.0$). The incidence of reoperation for bleeding, mediastinitis, permanent stroke, renal failure, and death was similar between the 2 groups.

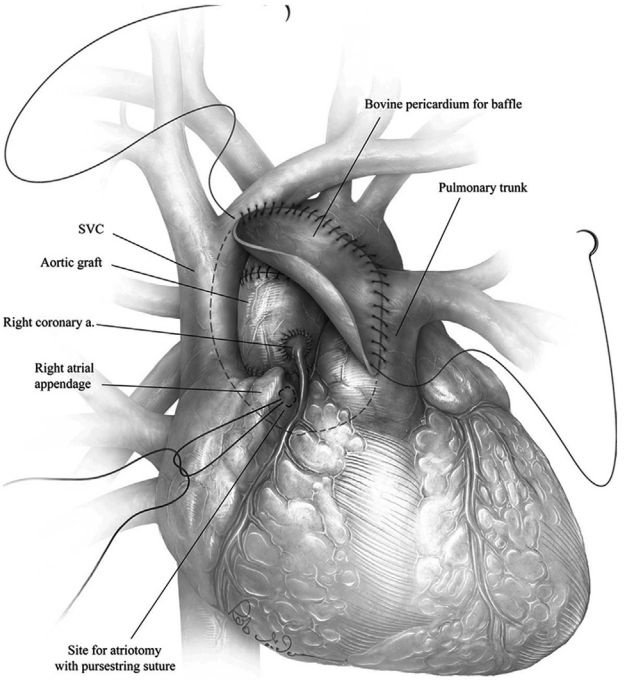

FIGURE 1. Pericardial baffle procedure. *SVC*, Superior vena cava. Adapted with permission from Ikonomidis JS. Surgery for aortic valve endocarditis. *Op Tech Thorac Cardiovasc Surg*. 2011;16:226-41.

On multivariate analysis of the entire aortic surgery cohort, preoperative predictors of baffle placement included infectious endocarditis ($P < .0005$; odds ratio [OR], 15.1; 95% confidence interval [CI], 4.8-47.2), redo operation ($P < .0005$; OR, 11.9; 95% CI, 4.1-34.1), and male gender ($P = .04$; OR, 4.6; 95% CI, 1.1-19.3). The receiver operating curve for this analysis yielded a C statistic of 0.87 (95% CI, 0.80-0.95).

Of the 22 baffle survivors, postoperative imaging was available for 20 patients. Fifteen patients underwent computed tomography (CT), and 5 patients underwent transthoracic echocardiography. Six patients were found to have persistent flow within the baffle. Of these, 5 patients had undergone homograft root replacement for prosthetic endocarditis and 1 patient underwent redo sternotomy for Stanford type A aortic dissection with aortic root, ascending, and hemiarch replacement using a bioprosthetic valved conduit. One patient required reintervention, and the remainder were asymptomatic.

DISCUSSION

Aside from the efforts of Cabrol and colleagues,[21] subsequent reports of shunts in this setting have been limited to