

Thoracic Aortic Graft Salvage after Sternal Wound Infection with Antibiotic Beads and Flap Coverage

Samuel H. Cole, BS*

Ryan D. Wagner, MD*

Angela S. Volk, MD*

Michelle K. Nemecek, PA-C†

Ourlania A. Preventza, MD‡

Kim De La Cruz, MD‡

Joseph S. Coselli, MD‡

Shayan A. Izaddoost, MD, PhD†

Summary: Infections involving thoracic aortic grafts are difficult to treat and have devastating consequences. The traditional approaches to surgical management include aggressive debridement with graft explantation and replacement. Despite treatment, the reported morbidity and mortality rates are high. The purpose of this study was to present our experience with an innovative approach to aortic graft salvage in the setting of sternal wound infection using antibiotic impregnated polymethylmethacrylate beads followed by definitive wound closure with flap coverage. A retrospective review identified patients with surgical wounds after aortic graft or cardiac valve placement over a 7-year period at a single institution. Patients were treated using an algorithm consisting of repeated surgical debridement and placement of antibiotic beads followed by flap coverage after suppression of the infection. A total of 20 patients were treated for surgical wounds, including 19 sternal and one thoracotomy wound. Culture positive surgical site infections were documented in 16 patients. One patient required a bead exchange before definitive closure. There were no in-hospital mortalities. All but two patients achieved successful infection suppression and wound closure with flap coverage. The use of antibiotic beads with serial debridement and flap closure may offer a valid option for aortic graft salvage in the setting of infected sternal wounds in the appropriate patient population. The proposed algorithm showed that patients may be successfully treated, and their infection suppressed without the need for graft removal. Mortality rates were lower from those previously reported in the literature. (*Plast Reconstr Surg Glob Open* 2022;10:e4371; doi: [10.1097/GOX.0000000000004371](https://doi.org/10.1097/GOX.0000000000004371); Published online 10 June 2022.)

INTRODUCTION

Aortic prosthetic graft and cardiac implant infections are infrequent but can have devastating consequences with historically high morbidity and mortality rates. Reported rates of these infections are between 1% and 15%, with an associated mortality rate of 25%–75%.^{1–3} Furthermore,

traditional treatment paradigms are complex, morbid, and associated with unique risks.

The conventional approach to management of vascular graft and cardiac implant infection requires graft explantation with replacement or extra-anatomical bypass, followed by long-term antibiotic therapy.^{2,4,5} Emphasis is placed on prophylactic measures, sterile technique, and meticulous wound care in the postoperative period to prevent thoracic infections; however, a more effective treatment algorithm is needed. Recently, new practices have been implemented, including graft replacement with homografts or rifampin coated grafts, using antibiotic beads, and myocutaneous flap coverage. Here, we present the first case series in the English literature of aortic graft infections treated with antibiotic impregnated polymethylmethacrylate beads followed by definitive wound closure with flap coverage.

From the *Division of Plastic Surgery, Department of Surgery, Baylor College of Medicine, Houston, Tex.; †Department of Plastic Surgery, Kelsey-Seybold Clinic, Houston Tex.; and ‡Division of Cardiothoracic Surgery, Department of Surgery, Baylor College of Medicine, Houston, Tex.

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METHODS

Institutional review board approval was obtained for a retrospective chart review on all patients treated by the senior author for thoracic wound infections. All patients received a graft or implant during an initial cardiothoracic operation and were treated for an infection between December 2012 and July 2019 at a single institution. Patients received systemic antibiotic therapy, which was tailored to culture results when available. In conjunction with the cardiothoracic team, patients were treated with the same algorithm in an attempt to salvage the graft (Fig. 1).

Patients initially underwent aggressive surgical debridement. If the wound was superficial, sternal wires were left in place, intraoperative cultures were obtained, and antibiotic impregnated polymethylmethacrylate beads were placed above the sternum with temporary complex closure if skin could be approximated without excess tension. If this was not possible, a wound vac was placed. After infection clearance, the beads and wires were removed followed by definitive flap coverage. In these patients, the sternum was allowed to undergo routine bony healing before wire removal. If the mediastinum or aortic graft was involved, the sternal wires were removed during initial debridement, and antibiotic beads were placed on top of an aortic graft with bovine pericardium for graft protection when needed (Fig. 2). Infections were determined to be cleared when there were no signs of infection on intraoperative evaluation, and cultures were negative. Drains were placed in all cases.

Antibiotic beads were created using one package of nonabsorbable polymethylmethacrylate impregnated with 1g of tobramycin (Simplex P with tobramycin; Stryker,

Takeaways

Question: Can aortic grafts be salvaged by using antibiotic beads in the setting of sternal wound infections?

Findings: Twenty patients with surgical wounds following thoracic aortic graft placement were treated with repeated debridements and placement of antibiotic beads followed by flap coverage after clearance of the infection. Eighteen patients achieved long-term infection suppression, and only one patient required aortic graft replacement.

Meaning: The use of antibiotic beads with serial debridement and flap closure offers a valid option for aortic graft salvage in the setting of infected sternal wounds.

Kalamazoo, Mich.) with an additional 1.2g of tobramycin (X-GEN Pharmaceuticals, Big Flats, N.Y.) and 2–4g of vancomycin hydrochloride (Pfizer, New York, N.Y.). All beads were assembled and strung onto a 2-0 Prolene (Ethicon, Inc., Somerville, N.J.) suture, and cured before implantation.

RESULTS

During our 7-year review, 20 patients were treated with antibiotic beads for implant-associated cardiothoracic wound infections by the senior author, according to our surgical algorithm. There were 14 deep infections and six superficial infections. Nineteen patients presented with sternal wound infections, and one with a thoracotomy site infection. (See table, Supplemental Digital Content 1, which shows patient demographics and comorbidities. <http://links.lww.com/PRSGO/C52>.)

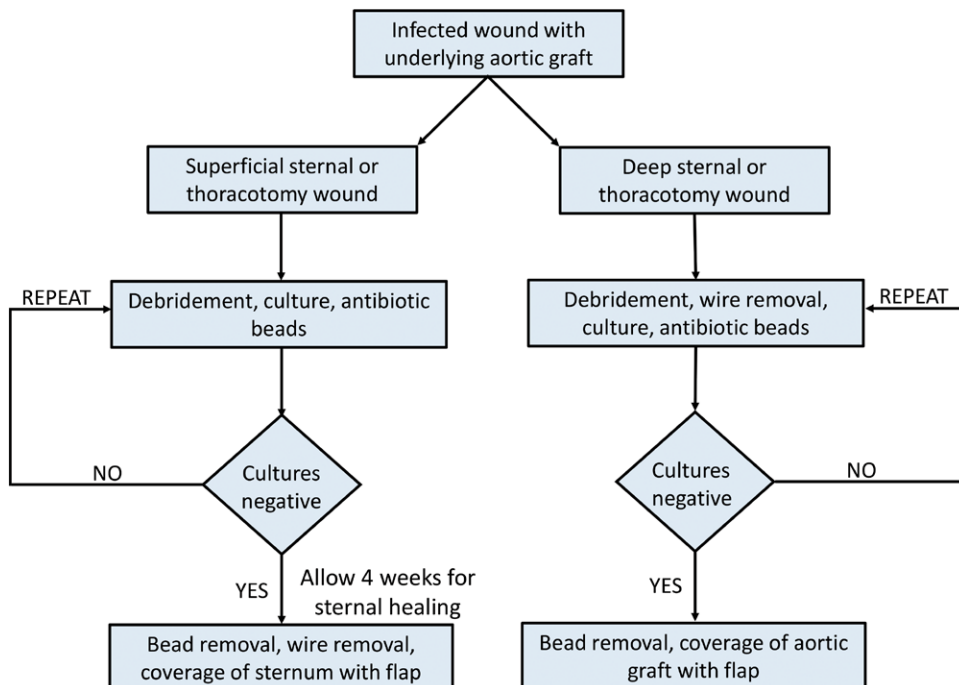


Fig. 1. Salvage algorithm for the treatment of infected thoracic grafts.

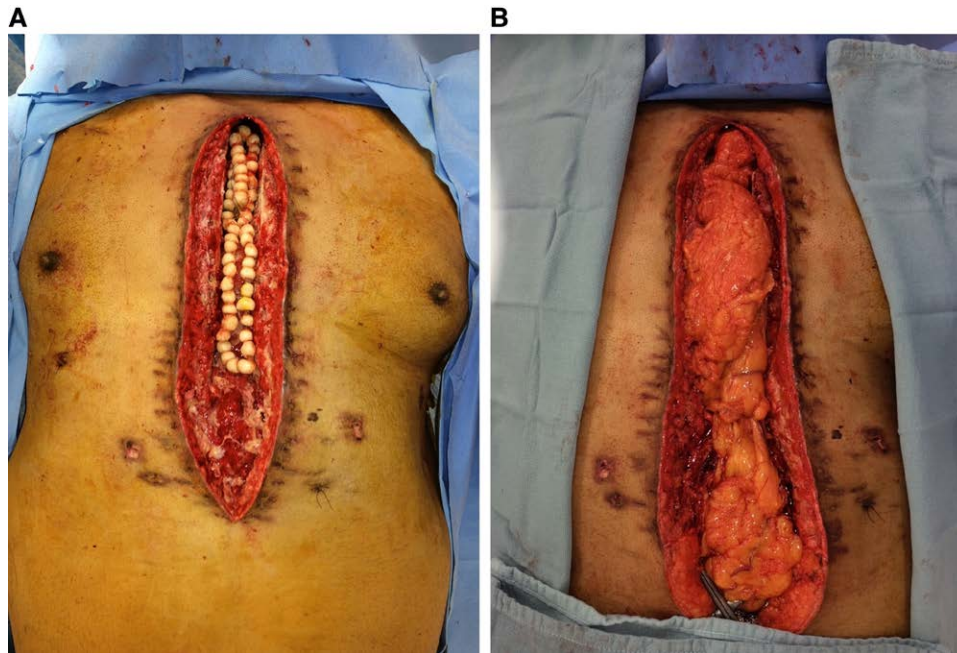


Fig. 2. A patient undergoing salvage of an infected thoracic aortic graft. A, Placement of antibiotic impregnated polymethylmethacrylate beads in the sternal defect after debridement of devitalized tissue. B, Coverage of the sternal defect with omental flap after infection clearance.

The average time from the initial cardiothoracic procedure until infection presentation was 150 days (range 9–939 days), with an average length of initial hospital stay of 20.5 days (Table 1). Cultures taken at the time of debridement and antibiotic bead placement yielded positive results in 16 patients (80%) (Table 1). Twelve patients remained in-house after antibiotic bead placement. Eight were discharged after initial bead placement and returned for elective bead removal and flap coverage. Fasciocutaneous, pectoralis major advancement, pectoralis major turnover, and/or omental flaps were used for sternal wound coverage (Table 1). The average time from infection presentation until flap coverage was 25.2 days (range 8–60 days). No in-hospital mortalities occurred during the initial admission for infection or the subsequent admissions for bead removal and coverage. Eighteen patients with sternal wounds subsequently achieved long-term infection suppression. Two patients developed persistent or recurrent infection, and one patient required thoracic aortic graft replacement.

DISCUSSION

Aortic prosthetic graft and cardiac implant infections are devastating complications with challenging management.⁶ Coselli et al reported on the use of Dacron tube grafts to treat aortic infections with successful outcomes.² Alternatively, cryopreserved aortic homografts have shown better antibiotic diffusion and resistance to recurrent infections; however, graft deterioration is possible.⁴ A common theme to these alternatives is the need for

multiple subsequent operations and prolonged operative time, with high morbidity.

An alternative method of treatment is the use of antibiotic beads. Polymethylmethacrylate forms a construct with heat-stable antibiotics and allows for the controlled elution directly to the site of infection.⁷ Several reports have detailed using antibiotic beads for treating cardiothoracic surgical site infections.^{5,8,9} Healy et al demonstrated the treatment of a patient with recurrent sepsis, using antibiotic beads following ascending aortic aneurysm repair.⁸ Fakhro et al proposed an algorithm with repeated debridement and antibiotic beads to salvage cardiac implantable electronic devices.¹⁰ Additionally, infections of left ventricular assist devices have been treated using antibiotic beads.⁹

In this review, 20 patients with complex cardiothoracic infections were treated via debridement and placement of antibiotic beads followed by definitive wound closure with flap coverage. This treatment algorithm demonstrated successful salvage in patients with sternal wound infections with only one patient requiring graft removal because of infection. The average time from infection presentation until definitive closure was just over 3 weeks. No inpatient mortalities were observed during the initial admission for infection or subsequent admissions for bead removal and closure.

Although the clinical outcomes were impressive, the results were limited by the small sample size at a single institution and the retrospective study design. Additionally, this study lacked a control group and did not compare outcomes of patients receiving antibiotic beads to those receiving traditional treatment regimens.

Table 1. Infectious and Operative Course

Patient	Time to Infection (d)	Cultures	Complications	Time to Closure (d)	Final Reconstruction	Reoperation after Flap Coverage	LOS (d)	Readmission	Infection Cleared	Mortality
1	9	<i>Klebsiella pneumoniae</i>	N	17	Omental flap, b/1 fasciocutaneous flaps	N	26	N	Y	N
2	385	<i>Mycobacterium avium</i> complex	Nonhealing wound	18	Latissimus dorsi flap	Y	23	Y—non-healing wound	N	N
3	37	MSSA, Corynebacterium	Hematoma x3, periaortic collection, graft injury, graft infection	30	R pec turnover flap, L pec adv. flap	Y	9	Y—hematoma evacuation, graft infection	N	N
4	33	Negative	N	32	B/1 pec adv. flaps	N	4	N	Y	N
5	628	MRSA	Pneumonia; graft injury after bead removal	56	B/1 pec adv. flaps	N	67	N	Y	N
6	60	CoNS	N	17	B/1 pec adv. flaps	N	24	N	Y	N
7	327	Negative	N	16	Split pec turnover flap	N	9	N	Y	N
8	25	<i>Enterobacter cloacae</i> , <i>Hafnia alvei</i> , CoNS	Pleural effusion	13	Omental flap, L fasciocutaneous flap	N	21	N	Y	N
9	92	MRSA, <i>Astorgillus fumigatus</i>	N	11	B/1 pec adv. flaps	N	14	Y—NSTEMI, endocarditis, pericardial effusion, ARF	Y	N
10	87	<i>Mycobacterium chelonae</i>	Respiratory failure, pleural effusion	18	B/1 fasciocutaneous flaps	N	30	N	Y	N
11	18	Negative	N	17	B/1 fasciocutaneous flaps	N	21	Y—syncopal episodes	Y	N
12	11	<i>Klebsiella pneumoniae</i>	N	60	B/1 pec adv. flaps	N	7	N	Y	N
13	11	<i>Propionibacterium acnes</i> , CoNS	N	24	B/1 pec adv. flaps	N	23	Y—afib	Y	N
14	939	CoNS	N	8	R pec turnover flap	N	13	N	Y	N
15	94	MRSA, pseudomonas	Pleural effusion	21	B/1 pec adv. flaps	N	28	N	Y	N
16	34	MSSA	Respiratory failure, pleural effusion, pneumonia, afib	12	B/1 pec adv. flaps	N	33	N	Y	N
17	77	CoNS	N	27	B/1 pec adv. flaps	N	4	N	Y	N
18	52	MRSA	N	16	B/1 pec myocutaneous flaps	N	22	N	Y	N
19	25	Negative	N	35	B/1 pec adv. flaps	N	11	N	Y	N
20	46	CoNS	N	14	B/1 pec adv. flaps	N	20	Y—functional decline	Y	N

Adv., advancement; afib, atrial fibrillation; b/1, bilateral; CoNS, coagulase-negative Staphylococci; IR, interventional radiology; L, left; LOS, length of stay; MRSA, Methicillin-Resistant *Staphylococcus aureus*; MSSA, Methicillin-Sensitive *Staphylococcus aureus*; N, No; NSTEMI, non-ST-elevation myocardial infarction; pec, pectoralis major muscle; R, right; SOB, shortness of breath; UTI, urinary tract infection; Y, Yes.

CONCLUSIONS

This review adds credibility to the preexisting literature on antibiotic beads and provides a new application for use in thoracic graft associated sternal wound infections. The salvage approach resulted in successful infection suppression and wound closure with limited complications.

Shayan A. Izaddoost, MD, PhD
Department of Plastic Surgery
Kelsey Seybold Clinic
Houston, TX
E-mail: shayanizaddoost@gmail.com

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