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Off-pump apicoaortic conduit insertion for high-risk patients with aortic stenosis[☆]

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Abstract

Objectives: Recently, we implanted an apicoaortic conduit off-pump in three high-risk patients with severe aortic stenosis. **Methods:** A muscle-coring device was utilized to create the apical outflow tract followed by insertion of a rigid apical connector. A valved conduit was then connected to the descending thoracic aorta and to the apical connector graft. **Results:** A stentless porcine bioprosthesis was implanted in two patients and a stented valve in one. The left ventricular (LV)-aortic gradients were reduced from a mean of 66 to 28 mmHg. **Conclusions:** With modification of an existing technique, apicoaortic conduit insertion can be performed safely off-pump. This technique can be applied to complex forms of LV outflow obstruction and high-risk patients.

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Keywords: Aorta; Heart valve prosthesis

1. Introduction

Construction of an apicoaortic conduit (AAC) to treat aortic stenosis was first conceived by Carrel in 1910 [1] and first performed clinically by Sarnoff, Templeton and Al-Naaman between 1955 and 1963 [2,3]. A limited number of investigators have described successful results of AAC insertion for the treatment of pediatric patients with complex left ventricular (LV) outflow tract obstruction [4,5] as well as for adult patients with aortic stenosis with complicated situations, such as previously complicated aortic valve replacement [6]. The purpose of this study was to examine the feasibility of an off-pump technique of AAC insertion for the treatment of adult patients with aortic stenosis with a prohibitive operative risk.

2. Materials and methods

After informed consent, three patients underwent off-pump AAC insertion for pure aortic stenosis with functional class IV and a prohibitive predicted mortality for direct replacement therapy. Patient 1 was an 83-year-old woman

with chronic renal insufficiency (creatinine of 2.8), inoperable carotid artery disease, a previous history of stroke and a previous CABG procedure with a patent sub-sternal left internal mammary artery (LIMA) graft. Patient 2 was a 75-year-old man with a LV ejection fraction of 18%, and a previous CABG with a patent LIMA graft. The patient had also had a sternectomy for a postoperative infection. Patient 3 was a 76-year-old man with a LV ejection fraction of 22%, interstitial lung disease and porcelain, ascending aorta. Preoperative risk scores predicted an operative mortality of greater than 30% [7].

Anesthetic management consisted of placement of a double-lumen endotracheal tube for single-lung ventilation. Echocardiography verified the absence of LV thrombus and circumferential calcification of the descending aorta. The left pleural cavity was entered through a sixth intercostal space incision centered along the mid-axillary line. The inferior pulmonary ligament was divided and the lung retracted cephalad exposing the cardiac apex and the descending thoracic aorta. The patients were fully heparinized and the left femoral artery and vein were exposed in the event that cardiopulmonary bypass (CPB) was necessary. The distal limb of the AAC was performed first in two patients and last in one patient. In two patients, a 20 mm Hemashield graft (Meadox, Hemashield, Boston Scientific, Boston, MA) was sewed end-to-side using a partial occluding clamp and a running 3-0 non-absorbable suture

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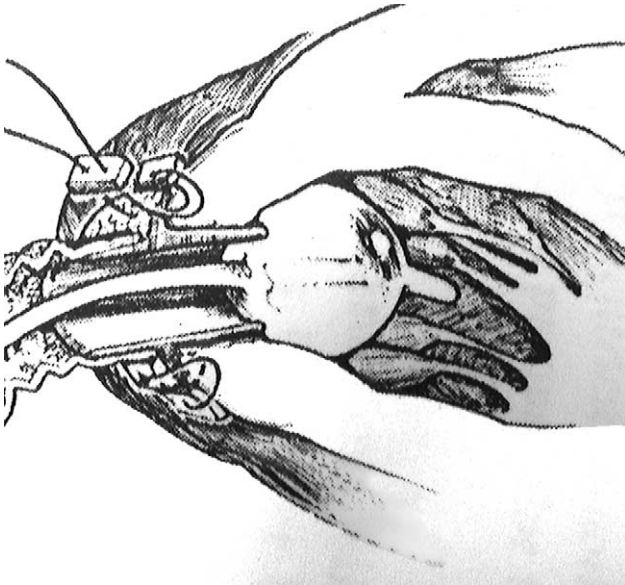


Fig. 1. Apicoaortic connector insertion off-pump.

technique. These tube grafts were then connected end-to-end to a 19 mm stainless porcine valve (Freestyle aortic root bioprosthesis, Medtronic, Minneapolis, MN) as an intact root with a continuous 4-0 non-absorbable suture. In one patient a Hemashield graft with a 19 mm stented, porcine, valved conduit (Hancock MO II bioprosthesis, Medtronic, MN) was sewed end-to-side directly to the aorta. The pericardium was then opened anterior to the phrenic nerve and the apex was exposed. In the two patients with previous coronary artery bypass, it was necessary to divide the pericardial adhesions for 2–3 cm from the center of the apex. An 18-gauge needle was passed through the apex and into the left ventricle along the longitudinal axis. A guide wire and a series of dilators were then used before placing a 14 Fr occlusion balloon over the wire. The ventricular coring device (Medtronic, Minneapolis, MN) was then threaded in-line over the catheter, thereby removing a core of ventricular muscle at the apex. The balloon occluded the 18–20 mm circular opening in the ventricle while the connector was slid into place. The occlusion balloon was left in place while eight interrupted pledgeted 2-0 non-absorbable sutures were sewed from the ventricular muscle around the opening in the apex to the external cuff of the connector

(Fig. 1). The coring device and rigid connector (Medtronic, Minneapolis, MN) are available in 8–22 mm and 26 mm. The distal end of the apical connector was then sewed to the valved conduit with a running 3-0 non-absorbable suture. Before removing the distal clamp, the graft was de-aired through an 18-gauge needle on low continuous suction. A biologic glue (Bioglue, Cryolife Inc., Atlanta, GA) was then applied to all suture lines. One patient also had a bypass placed from the conduit to the main circumflex in the atrio-ventricular groove. None of the patients required the use of CPB. The course of the AAC was fixed in the mediastinum so as not to be affected by the movements of the lung and diaphragm. Postoperatively, the three patients were kept anti-coagulated with warfarin sodium for 90 days and then switched to aspirin.

3. Results

The mean operative time was 248 min (range 245–278 min) and the mean operative blood loss was 850 cc (range 650–1100 cc). There were no hospital deaths. Patient 1 was readmitted to the hospital 3 months later and expired from a pulmonary embolism on postoperative day 94. At autopsy, this 83-year-old female had extensive femoro-popliteal venous thrombosis and a saddle embolism at the bifurcation of the left and right pulmonary arteries. The AAC was intact and unobstructed. The two remaining patients are alive and well at 4.2 and 6.2 months postoperatively. The hemodynamic data are provided in Table 1. Both patients improved from a functional class IV to II–III and II, respectively.

4. Discussion

Creating a double-outlet LV has been successfully employed to treat a variety of complex congenital LV outflow obstructions as well as adult-onset aortic stenosis in patients with complicating preoperative conditions [8]. However, the AAC insertion procedure was largely abandoned because of early failures using first-generation bioprosthesis coupled with the success of direct LVOTO repair or replacement. Despite an aging population, the unadjusted mortality for isolated aortic valve operations in the United States in 2001 remained under 4% [9].

Table 1
Hemodynamic data

Variable	Patient 1		Patient 2		Patient 3		Mean (range)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Functional class (I–IV)	IV	NA	IV	II–III	IV	II	IV	II–III
LVOT area (cm ²)	0.40	1.60	0.50	1.80	0.40	1.60	0.43 (0.4–0.5)	1.7 (1.6–1.8)
LV-Ao gradient (mmHg)	93	27	47	38	58	19	66 (47–93)	28 (19–38)
LVEF (%)	35	25	18	35	22	25	26.7 (18–35)	31.7 (25–35)
LVEDP (mmHg)	22	15	25	18	24	14	23.7 (22–25)	15.7 (14–18)
CI (l/min per m ²)	1.90	2.80	1.70	2.20	1.70	3.10	1.8 (1.7–1.9)	2.7 (2.2–3.1)

Further, the AAC insertion operation, with or without CPB, is not as technically straightforward as direct aortic valve replacement. Nonetheless, several series have demonstrated that AAC insertion successfully lessens the LV-aortic pressure gradient, preserves or improves ventricular function and maintains normally distributed blood flow through the systemic and coronary circulation [10–12]. While there have been several techniques described, the most commonly employed method is the lateral thoracotomy approach with placement of the AAC to the descending aorta. The current techniques and technology available to perform AAC insertion were originally designed to be performed on-pump either in the arrested or fibrillating heart. While off-pump cases have been described, they can be technically difficult. If significant modifications of the technique and the addition of enabling technology simplify inserting a graft into the beating cardiac apex, then the approach as a whole might be more attractive. By creating a second outflow tract off-pump, the detrimental effects of both CPB and global cardiac ischemia are avoided. Additionally, the conduction system is avoided as are the native coronary arteries and patent grafts from previous surgical revascularization. A small size valve (≤ 21 mm) for typical adult body surface areas is usually adequate as the effective postoperative orifice is the sum of the native and prosthetic aortic valves. Further, valved conduit failure is far less likely with the availability of newer generation biologic valves.

In summary, these data support previous reports that off-pump AAC insertion is a feasible alternative to direct repair or replacement of LVOTO. Our encouraging, but limited, early clinical experience has motivated us to redesign the tools and techniques of AAC insertion to perform the procedure on the beating heart without CPB. One can also envision the extension of this technique to a minimally invasive, endoscopically assisted approach.

References

- [1] Carrel A. On the experimental surgery of the thoracic aorta and heart. *Ann Surg* 1910;52:83–95.
- [2] Sarnoff SJ, Donovan TJ, Case RB. The surgical relief of aortic stenosis by means of apical-aortic valvular anastomosis. *Circulation* 1955;11:564–574.
- [3] Al-Naaman YD. Bypass procedure for aortic stenosis simplified. *Med Tribune* 1963;4:27.
- [4] Sweeney MS, Walker WE, Cooley DA, Reul GJ. Apicoaortic conduits for complex left ventricular outflow obstruction: 10-year experience. *Ann Thorac Surg* 1986;42:609–611.
- [5] Kanna SK, Anstadt MP, Bhimji S, Bannan MM, Mawulawde K, Zumbro GL, Moore HV. Apico-aortic conduits in children with severe left ventricular outflow tract obstruction. *Ann Thorac Surg* 2002;73:81–87.
- [6] Cooley DA, Lopez RM, Absi TS. Apicoaortic conduit for left ventricular outflow tract obstruction: revisited. *Ann Thorac Surg* 2000;69:1511–1514.
- [7] Higgins TL, Estafanous FG, Loop FD, Beck GJ, Blum JM, Paranandi L. Stratification of morbidity and mortality outcome by preoperative risk factors in coronary artery bypass patients. A clinical severity score. *J Am Med Assoc* 1992;267:2344–2348.
- [8] Brown JW, Girod DA, Hurwitz RA, Caldwell RL, Rocchini AP, Behrendt DM, Kirsh MM. Apicoaortic valved conduits for complex left ventricular outflow obstruction: technical considerations and current status. *Ann Thorac Surg* 1984;38:162–168.
- [9] Society of Thoracic Surgery National Database. Adult cardiac surgery section. Spring 2001 executive summary: 8.
- [10] Nihill MR, Cooley DA, Norman JC, Hallman GL, McNamara DG. Hemodynamic observations in patients with left ventricle to aorta conduit. *Am J Cardiol* 1980;45:573–582.
- [11] Fogel MA, Rychik J, Chin AJ, Hubbard A, Weinberg PM. Evaluation and follow-up of patients with left ventricular apical to aortic conduits with 2D and 3D magnetic resonance imaging and Doppler echocardiography: a new look at an old operation. *Am Heart J* 2001;141:630–636.
- [12] Renzulli A, Gregorio R, De Feo M, Ismeno G, Covino FE, Cotrufo M. Long-term results of apico-aortic valved conduit. *Texas Heart J* 2000;27:24–28.

Appendix A. Conference discussion

Dr O. Alfieri (Milan, Italy): You have reported an intraoperative blood loss of 800 cc in one case and very little blood loss in another. Did you have technical difficulties?

Dr Vassiliades: Yes. There is definitely a learning curve from one patient to the next, and, as I have mentioned, the equipment is not particularly designed well to perform off-pump, and I think that some modifications that we have some ideas for need to be done to make it much easier.

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