Redo Mitral Surgery Using the Estech Endoclamp

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ABSTRACT

Background: Redo-CABG surgery remains extremely hazardous in the presence of open bypass grafts. In our patients with mitral valve pathology with open and well-functioning bypass grafts, we explored alternative approaches in order to avoid damage to the grafts by extensive dissection and direct clamping of the ascending aorta. The "Estech procedure," which uses the Estech remote access perfusion (RAP) endoclamp catheter (Estech Inc., Danville, CA), was selected for these patients.

Methods: From January 1998 to January 2000, 10 patients underwent an Estech procedure for redo mitral surgery. All patients had previous cardiac operations such as coronary artery bypass grafting (CABG) and/or mitral valve procedures. The Estech procedure consisted of an anterior left thoracotomy and peripheral cannulation at femoral site using the Estech endovascular balloon technique. The series was comprised of seven mitral valve replacements, two valve reconstructions, and one closure of a paravalvular leak. One procedure had to be converted to a standard re-sternotomy due to extreme arteriosclerosis of the descending aorta with plaque dislocation at the time of catheter insertion. However, no damage was inflicted to the open bypass grafts.

Results: The follow-up period ranged from six to 30 months and was 100% complete. We encountered one hospital death in our group, which was due to a late post-operative intestinal infarction and multiple organ failure (MOF), and was not procedure related. As expected, morbidity was high in this compromised cohort, but no late death has occurred prior to submission of this article. All survivors progressed to an acceptable NYHA functional class.

Conclusion: The excellent results in this complex patient group inspired us to use the Estech procedure as a standard approach for redo mitral surgery.

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INTRODUCTION

Retrospective analysis of our results in redo-CABG through standard re-sternotomy revealed a high incidence of complications. Avoidance of damage to the open bypass grafts (particularly the left internal mammary graft, or LIMA) seems to be the key issue as reported by Gillinov et al. [Gillinov 1999]. Therefore, we looked for alternative approaches to standard re-sternotomy for redo-CABG. Because of the availability of the Estech aortic endoclamp catheter (Estech Inc., Danville, CA), we chose to use the "Estech procedure" and selected 10 patients for redo mitral surgery to be operated upon without reopening the sternum.

PATIENTS AND METHODS

Patients

All patients (10) underwent valve surgery for major mitral valve pathology. Mean age at operation was 63.6 years. The group was comprised of male patients, 70% of whom had a body surface area (BSA) over 1.78 m^2. Most patients were severely disabled by their disease. The average pre-operative NYHA functional class was 3.2. Eight of the patients had undergone previous CABG (average time after CABG of 3.6 years), two patients required mitral valve reconstruction (MVR), and one patient presented a paravalvular leakage post-MVR. The redo-CABG patients had an average of 3.75 distal anastomoses, all with IMA

graft, and all open at the time of operation. Venous grafts presented a patency of 87%. All patients (except one with a major paravalvular leak after mitral valve replacement) presented major mitral valve regurgitation (4/4 on echocardiograph). The implanting surgeon chose the procedure after consulting with the patient and obtaining the patient's verbal informed consent.

Operative Technique

Left anterior thoracotomy was performed in the fourth intercostal space (length = 12 to 22 cm). The left atrium was opened in the inter-atrial groove posterior to the phrenic nerve. Meanwhile, peripheral cardiopulmonary bypass was installed at the left inguinal level in all cases. The Estech femoral 21 Fr aortic balloon catheter was guided into the ascending aorta under echocardiographic control and placed within approximately 2.5 cm of the aortic valve. Adequate venous drainage was obtained by means of a 32 or 36 Fr femoral cannula in addition to a 28 or 32 Fr direct atrial cannulation through the thoracotomy. Myocardial protection was accomplished with moderate systemic hypothermia (25° to 28°C), and anterograde crystalloid modified St. Thomas cardioplegia was delivered at the tip of the catheter after complete inflation of the endoclamp. Echocardiography by a multiplane Sonos 2500 (Hewlett-Packard Inc., Andover, MA) transesophageal probe and direct pressure monitoring controlled the procedure. The same group of surgeons using identical operative techniques performed all operations. For mitral valve replacement, the interrupted insertion technique was used, with preservation of the native valve apparatus where possible. Visualization of the mitral valve was assisted by endoscopy [Chitwood 1997].

Procedures

We performed seven mitral valve replacements (six mechanical and one biological prosthesis), two radical mitral valve reconstructions (MVPs) and one closure of a partial dehiscence of the prosthesis for paravalvular leakage. Associated procedures in the MVP group included mitral valve annuloplasty (two patients). Endoclamping was performed by introduction of 25 to 37 cc of saline solution into the balloon. Cardiac arrest was obtained by means of 1000 cc modified St. Thomas cardioplegia delivered at the tip of the catheter. However, because the LIMA graft was not clamped, cardiac activity restarted prematurely. Thus, further myocardial protection was provided at moderate hypothermia of 25°C by additional doses of cardioplegia every 15 minutes. Mean aortic clamp-time was 52.6 min. (standard 46.6 min., p = ns) for MVR and 74.8 min. (standard 66.1 min.) for MVP. De-airing remained a major problem because of inaccessibility of the ventricles and could only be achieved by suction at the tip of the endoclamp. Mean ECC-time of 96.7 min. (standard 77 min., p = 0.001) for MVR was prolonged due to longer reperfusion times before obtaining stable hemodynamics. However, only one patient was in need of postoperative inotropic support.

RESULTS

Mortality and Morbidity

One hospital death, which was non-procedure related, occurred. The death took place after late postoperative intestinal infarction (61 days post-op) and subsequent multiple organ failure (MOF). No late deaths have occurred prior to submission of this article.

One arteriosclerotic patient had to be converted to a standard re-sternotomy due to the dislocation of a plaque in an extremely calcified descending aorta while positioning the endoclamp (see Figure 1, ◉). One patient required intra-aortic balloon pumping for post-operative low cardiac output, and was successfully weaned six days following initial operation. One patient experienced a postoperative non-Q-wave myocardial infarction, although all bypass grafts were patent on angiographic control. One patient with significant vascular history experienced cardiovascular accident (CVA) in the early postoperative course but had complete neurological recuperation. Another patient was reoperated for bleeding.

Follow-up

Follow-up ranged from six to 30 months and was 100% complete, yielding 16 patient/years. All hospital survivors, even some who were severely disabled pre-operatively, progressed to NYHA functional class 1 or 2 (average 1.2). Seventy percent of the patients were followed entirely at our institution. Patients were questioned at seven weeks, six months, and each year following discharge. Questions were presented by staff members before clinical examination and addressed general health, medication, and complications. The remaining 30% of patients were followed by their referring cardiologist and/or physician, who submitted information by mail, fax or telephone. No episodes of endocarditis, hemolysis, or paravalvular leakage have occurred as of this date. During follow-up, echocardiographic control was provided in-house or by outside cardiologists for the first week and every six months thereafter, confirming the absence of mitral valve regurgitation with full recovery of the left ventricular function.

DISCUSSION

The early results of this difficult redo mitral valve group, even for patients who were severely disabled preoperatively, are better than the results we have obtained by standard re-operation techniques in our institution since 1990. Avoidance of damage to the open bypass grafts during re-sternotomy seems crucial, as reported by other authors [Gillinov 1999]. Although not a thorough port-access operation as the operation described by Mohr et al., an alternative approach was explored by the authors for mitral valve surgery post-CABG [Mohr 1998]. The Estech procedure with the aortic endoclamp, allowed us to operate successfully on 10 mitral patients without reopening the sternum. Our group was comprised of male patients, a

striking 70% of whom had a BSA over 1.78 m^2. This size feature is due to the technique requiring larger femoral arteries (and thus larger patients) for easy cannulation. Although the procedure is feasible in arteriosclerotic patients, one patient had to be converted to a standard resternotomy due to a plaque dislocation in an extremely calcified descending aorta. Precise positioning of the catheter is critical. Once the balloon was positioned at the correct level in the ascending aorta, endoclamping was easily performed by introducing saline solution into the balloon. As previously described, cardiac arrest was obtained by means of anterograde cardioplegia delivered at the tip of the catheter. However, because the LIMA graft was not clamped, myocardial protection was sub-optimal, necessitating additional doses of cardioplegia and deeper cooling. A direct balloon endoclamping of the subclavian or internal mammary artery could be useful in this respect.

CONCLUSION

The mean aortic clamp-times for the Estech procedure were comparable to those of standard procedures. However, de-airing remained a major problem because of inaccessibility of the ventricles and could only be obtained by suction at the tip of the catheter. Mean ECC-time was probably prolonged due to initial hemodynamic instability during reperfusion. Despite this, only one patient was in need of postoperative inotropic support. Left ventricular function was fully recovered, with a significant reduction of the postoperative left ventricular end-diastolic diameter over time. Moreover, all survivors progressed considerably in NYHA functional class, but further follow-up is needed. The excellent results in this complex patient group inspired us to use the Estech procedure, despite its technical difficulties, as a standard for redo mitral surgery post-CABG.

REFERENCES

1. Gillinov AM, Casselman FP, Lyttle BW, et al. Injury to a patent left internal thoracic artery graft at coronary reoperation. Ann Thorac Surg 67(2):382–6, 1999.
2. Chitwood WR, Elbeery JR, Chapmann WHH, et al. Video-assisted minimally invasive mitral valve surgery: the "Micro-Mitral" operation. J Thorac Cardiovasc Surg 113:413–14, 1997.
3. Mohr FW, Falk V, Diegereler A, et al. Minimally invasive port-access mitral valve surgery. J Thorac Cardovasc Surg 115:567–74, 1998.