

Complications Associated With Femoral Cannulation During Minimally Invasive Cardiac Surgery

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Background. Different types of cannulation techniques are available for minimally invasive cardiac surgery. At our institution, we favor a femoral platform for most minimally invasive cardiac procedures. Here, we review our results utilizing this cannulation approach.

Methods. We retrospectively reviewed all minimally invasive valve surgeries that were performed at our institution between January 2009 and January 2015. Operative times, lengths of stay, postoperative complications, and mortality were analyzed.

Results. We identified 2,645 consecutive patients. The mean age was 69.7 ± 12.77 years, and 1,412 patients (53.4%) were male. Three hundred fifty-eight patients (13.5%) had a history of cerebrovascular accident, 422 (16%) had previous heart surgery, and 276 (10.4%) had a history of peripheral vascular disease. The procedures performed were isolated aortic valve replacements (42.1%), isolated mitral valve operations (40.6%), tricuspid valve repairs (0.57%), double valve surgery (15%), triple valve surgery

(0.3%), and ascending aortic aneurysm resection with and without circulatory arrest (5%). Femoral cannulation and central cannulation were utilized in 2,400 patients (90.7%) and 244 patients (9.3%), respectively. The median aortic cross-clamp time and cardiopulmonary bypass time were 81 minutes (interquartile range, 65 to 105) and 113 minutes (interquartile range, 92 to 142), respectively. The median postoperative hospital length of stay was 6 days (interquartile range, 5 to 9). There were 31 cerebrovascular accidents (1.17%), no aortic dissections, two compartment syndromes, two femoral arterial pseudoaneurysms, and 174 (6.65%) groin wound seromas. The overall 30-day mortality was 57 patients (2.15%).

Conclusions. Minimally invasive cardiac surgical procedures utilizing femoral cannulation techniques have a low risk of complications.

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Cannulation methods for minimally invasive cardiac surgical techniques related to cardiopulmonary bypass have evolved over the past decade. These have ranged from femoral cannulation techniques with endoaortic clamping during the early port access and robotic times to direct aortic cannulation and cross-clamping through the thoracotomy incision [1–5]. As minimally invasive surgeons begin to perform more complex procedures, growing concerns over complications associated with femoral cannulation have increased. These complications include aortic dissection, stroke, femoral arterial injury, groin seromas, and wound infections [6]. We performed a retrospective review of minimally invasive cardiac operations that were performed at our institution to evaluate the incidence of postoperative complications related to femoral cannulation.

Patients and Methods

After obtaining approval from the Mount Sinai Medical Center Institutional Review Board, we retrospectively

evaluated all consecutive minimally invasive cardiac operations that were performed at our institution between January 2009 and January 2015. Postoperative complications were identified.

All patients had their cardiac workup documented by diagnostic catheterization and echocardiography, and all operative reports and intraoperative transesophageal echocardiograms (TEE) were reviewed. The surgical technique time was compared on the basis of aortic cross-clamp and cardiopulmonary bypass times. Definitions and variables were selected based on The Society of Thoracic Surgery Database definitions.

Surgical Techniques

Our techniques for minimally invasive valve surgery and minimally invasive ascending aortic surgery have been previously described [7, 8]. Briefly, all patients were placed in a supine position, and the appropriate monitoring lines were placed. Transesophageal echocardiography was performed in all cases. In patients with a history of

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previous cardiac surgery, transvenous pacing wires were placed with fluoroscopic assistance before the start of the procedure. At our institution, the femoral platform is the preferred method for establishing cardiopulmonary bypass. Preoperative computed tomography angiography or ultrasonography was not routinely performed to detect peripheral vascular disease and aortic pathology. Central (direct) aortic cannulation and axillary artery cannulation were performed for the aortic valves and mitral valves, respectively, if the following occurred: (1) significant peripheral vascular disease was suspected through history or physical examination; (2) peripheral vascular disease was present at the time of femoral cannulation; or (3) severe descending aortic atherosclerosis was evident by TEE. The grading system by TEE ranged from I to IV depending on the thickness and mobility of the plaque. Positioning on the table depended on the procedure performed (Table 1).

A vertical incision was made in either the left or right groin to expose the femoral vessels for cannulation. Care was taken not to disrupt the lymphatics located between the vessels. Utilizing a modified Seldinger technique, the femoral artery was cannulated with a 15F to 19F arterial cannula (Medtronic, Minneapolis, MN). The size of cannula utilized depended on the patient body surface area. In patients with known aortoiliac or femoral artery disease or with difficult femoral access, axillary artery cannulation was performed under fluoroscopic guidance. In these cases, proximal and distal control of the axillary artery was obtained, and an arteriotomy was performed for direct insertion of the cannula. Lower or upper extremity perfusion monitoring was not performed. The femoral vein was cannulated with a 25F venous cannula (Biomedicus, Medtronic), and TEE was utilized to aid placement in the superior vena cava.

The incision was also dependent on the planned surgery (Table 1). A soft tissue retractor and rib spreader are utilized to enhance exposure. The pericardium is opened and pericardial retraction sutures are placed. Dissection between the aorta and pulmonary artery was not performed. A left ventricular vent was placed through the right superior pulmonary vein in patients undergoing any aortic valve procedure. That is not necessary in isolated mitral or double valve surgery. A Cygnet (Vitalitec, Plymouth, MA) cross-clamp is placed directly through the incision. In patients undergoing mitral valve surgery with prior cardiac surgery or a calcified aorta, the procedure was performed with a fibrillating heart and cardioplegia was avoided. These patients were cooled until fibrillation occurred. In all other procedures, antegrade cardioplegia was delivered through a 14G angiocatheter that was inserted into the aortic root. A single dose of extended-effect antegrade cardioplegia was given to arrest the heart. Retrograde cardioplegia cannulation was utilized in our early series but was no longer needed with our new cardioplegia strategy. We have resorted to using a modified del Nido solution with 4 parts blood and 1 part cardioplegia to allow for at least 90 minutes of safe arrest time.

Table 1. Summary of Minimally Invasive Surgical Techniques

Procedure	MVR	Redo MVR	AVR	Redo AVR	TVR	AVR/MVR	MVR/TVR	AVR/MVR/TVR	Ascending Aorta ± AVR
Position									
Supine	M	M	M/F	M/F	M	...	M	...	M/F
Right arm up	F	F	...	...	F	M/F	M/F	M/F	M/F
Incision	Lateral, ICS	Lateral, 4th ICS	Medial, 2nd or 3rd ICS	Medial, 2nd or 3rd ICS	Lateral, 4th or 5th ICS	Lateral, 4th ICS	Lateral, 4th or 5th ICS	Lateral, 4th ICS	Lateral, 2nd or 3rd ICS
Cannulation									
Femoral	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Central	No	No	Yes	Yes	No	No	No	No	No
Axillary	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Direct LV vent	No	No	Yes	Yes	No	No	No	No	Yes ^b
Direct cross-clamp	Yes	No, fibrillating	Yes	Yes	Fibrillating	Yes	Yes	Yes	Yes ^b
Cardioplegia	...	No	...	...	No	...	...	...	...
Antegrade ^a	Yes	...	Yes	Yes	...	Yes	Yes	Yes	Yes
Retrograde	Yes	...	Yes	Yes	...	Yes	Yes	Yes	Yes

^a Direct coronary injection if moderate or severe aortic insufficiency.

^b Clamp placed on graft after termination of circulatory arrest.

AVR = aortic valve repair or replacement; F = female; ICS = intercostal space; LV = left ventricular; M = male; MVR = mitral valve repair or replacement; TVR = tricuspid valve repair.

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