原 著

Minimally Invasive Valve Surgery with Single Access in 10 Patients

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Abstract

Ten patients (8 males and 2 females, mean age of 58 ±10 years) of valvular disease (4 mitral and 6 aortic) underwent surgery by using minimally invasive cardiac surgery. Two mitral valve repairs, 2 mitral valve replacements and 6 aortic valve replacements were performed via partial sternotomy or parasternotomy. Cannulation of the heart for cardiopulmonary bypass was carried out in the same surgical field, placing a cannula directly into the superior vena cava and a second cannula in the inferior vena cava via the right atrium. Arterial return was through the ascending aorta. There were no intraoperative complications. All patients survived and could be discharged home with satisfaction. A mean size of skin incision was 9.5±1.0 cm, hospital stay was 19.6 ± 7.6 (11-34) days, and aortic cross clamping time, cardio-pulmonary bypass time and total operating time was 97.5±17.7 (70-122) min, 135.8 ±17.5 (111-158) min, and 287 ± 58 (230-400) min, respectively.

Key words : Minimally invasive valve surgery, Single access, Mitral and aortic valve disease

Minimally invasive cardiac surgery (MICS) for valvular disease started in our department at July 1997. The operative indication of MICS in our department is that a patient is 1) isolated valvular disease, and 2) regular sinus rhythm on electro-cardiogram. As an approach to the heart, instead of conventional surgery, partial sternotomy (not full sternotomy) or parasternotomy[1] was selected with skin incision of no more than 10 cm length. Cannulation of the heart for cardiopulmonary bypass is carried out in the same surgical field[2].

We used the conventional technique of cardiopulmonary bypass cannulation, and medical instruments under the present circumstances instead of new technique like a port access or video assisted surgery[3~5].

Patients and methods

Ten consecutive valvular diseases performed in our department from July to October 1997, 2 women and 8 men with a mean age of 58 years, a mean body weight of 57.5 kg and a mean body surface area of 1.62 m^2, were the subject of this procedure (Table 1). We performed two mitral valve repairs (posterior leaflet quadrangular resection), two mitral valve replacements (one re-do surgery) and 6 aortic valve replacements with St Jude Medical prosthesis via a minithoracotomy.

Surgical method

Patients were given total endovenous anesthesia (Fentanyl : 10 μg/kg, Diazepam : 0.1 mg/kg and Propfol : 1 mg/kg) and were ventilated via a single lumen endotracheal tube. Skin incision of no more than 10 cm length were made. In nine patients, partial

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Table 1 patients characteristics

variable	No.	Mean±SD	range
patients	10		
male/female	8/2		
age (years)		57.7±10	42−68
MR	3		
AR	4		
AS	2		
MS	1		
COLD	1		
Previous operation	1		

MR : mitral regurgitation AR : aortic regurgitaion
AS : aortic stenosis MS : mitral stenosis
COLD : chronic obstructive lung desease

sternotomies (8 upper and 1 lower) were made. In one patient, parasternal incision was made because he had undergone esophagus surgery with stomach-role reconstruction beneath the sternum. Cannulation of the heart for cardio-pulmonary bypass is carried out in the same surgical field, placing a venous drainage cannula directly into the superior vena cava (24Fr, Medtronic DLP Inc., Grand Rapids, MI), and a second cannula in the inferior vena cava via the right atrium, and arterial return cannula was through the ascending aorta (7.0 mm, Sarns 3M Health Care, MI) through double pursestrings sutures. In aortic valve surgery performed under partial cardiopulmonary bypass, a 12F vent cannula was inserted into the left ventricle via the right superior pulmonary vein. Cardiopulmonary bypass was conducted under moderate general hypothermia (33 ℃ rectal temperature), and then aorta was cross-clamped. We could inserte easily a retrograde cardioplegic cannula into the coronary sinus in mitral valve procedure, and administered cardioplegia following normograde cardioplegia, but could not blindly inserte the cannula into the coronary sinus via the right atrium in aortic valve surgery except one patient. The composition of our cold (15 ℃) blood (oxigenated blood : crystalloid solution =4 : 1) cardioplegic solution is potassium-rich (8 meq/l) solution. We utilized terminal warm cardioplegia before aortic unclamping. On unsuccessful cases of the cannulation into the coronary sinus in aortic valve surgery, the cardioplegia was administered either directly into the coronary ostia with two rigid cannulas (DLP Inc., Grand Rapids, MI) in valve incompetence, or into the aortic root in stenosis. In all aortic valve cases, the aorta was opened and aortic valve was resected and replaced with St Jude Medical prosthesis by interrupted mattress suture technique. In three patients of mitral valve disease, the left atrium was opened via septal-superior approach through the right atriotomy. In one patients of mitral re-stenosis who had undergone open mitral commissurotomy for 7 years ago, the left atrium was opened through the right side of left atrium near the pulmonary vein. Distribution of the prosthesis size was as follows: one 21, three 23, two 25 in aortic procedure; 25, 27 in mitral procedure. The aortic and mitral wall were closed with two continuous layers of 3-0 monofilament polypropylene. A temporary epicardial pace-maker wire was placed either on the right ventricular out-flow tract in cases of upper partial sternotomy, or on the right ventricular posterior wall in cases of lower partial sternotomy and parasternal thoracotomy. The left ventricle was deaired through both a left ventricular vent and a continuously aspirating cannula on the aortic root. Before the aortic clamp was removed, the heart was rewarmed by giving a warm blood cardioplegia either into the aortic root or into the coronary sinus. A pair of disposable paddle for electrical defibrillation was placed on the patient's back and chest before the start of surgery, but there was only one case defibrillated in this series. A second single temporary pace-maker wire was inserted on the right atrium. The chest drainage tube was inserted separately into the pericardial and chest cavity. The pericardium was closed with interrupted sutures. The sternum was closed with interrupted titanium wires. The wound was closed layers. Trans-esophageal echocardiography (TEE) was used as an intraoperative monitoring in all cases.

Results

There were no intraoperative complications. The heart began beating spontaneously by recirculation of coronary flow in nine patients. In one case, the heart fibrillated, and it was elecrically defibrillated. Cardiopulmonary bypass time, aortic cross clamp time,

and total operation time are listed in Table 2 . Nine of ten patients were extubated in the intensive care unit at an average of 13±6 (SD) hours (range, 4 to 21) after the end of surgery, and they could eat and drink at an average of 35 ±9 (SD) hours (range, 22 to 45). One patient with severe chronic obstructive lung disease had to be supported with a ventilator for 10 days. Intraoperative bleeding was 498±442 (SD) ml (range, 100 to 1600). The preserued whole blood (heterogeneous) was transfosed to two patients (1000 ml and 1600 ml), since no their auto-blood was preoperatively saved becaused of their anemia. In eight patients, only their auto-blood (800 to 1200 ml) was med for transfusion and no heterogeneous blood was transfused even in postoperative course. All patients survived and their hospital stay was an average of 19.6 ±7.6 (SD) days (range, 11 to 34).

Table 2 operative data

variable	MICS (n=10)	conv AVR (n=7)	
TOT (min)	287±58	255±29	ns
CPB (min)	135.8±17.5	125.3±29.4	ns
ACC (min)	97.5±17.8	92.1±25.1	ns
Bleeding (ml)	498±442	567±190	ns

MICS : minimally invasive cardiac surgery
conv AVR : conventional aortic valve replacement
(6 male, 1 female; 63.5 ± 5 y-o; 6 aortic regurgitation, 1 aortic strenosis; randomized, in 1996)
TOT : total operation time
CPB : cardiopulmonary bypass time
ACC : aortic cross clamping time

Discussion

Minimally invasive valve surgery has been suggested to be suitable for the majority of patients with isolated heart valvular disease[6,7]. The technical improvement has made this approach simpler and safer. An appropriate vent of the left ventricle is very important to keep blood-free surgical field. Intraoperative monitoring with TEE is also important, because we can not directly investigate the deairing and ventricular function, perioperatively. We investigated MICS by comparing with the conventional valve surgery (randomized 7 cases of aortic valve surgery in our department in 1996). On the point of total operation time (255 ±28 min), cardio pulmonary bypass time (125.3 ±29 min), aortic cross clamping time (92.2±25.1 min), intraoperative bleeding amount (567 ±3 ml) and hospital stay (20.0 ± 3.7 days), we could not point out the statistical differences between the two method (Table 2). However the minimal surgical trauma with small incision in the chest wall, without further incision of the groin provides a good cosmetic result and an advantage of avoiding the healing problems observed after operations in the groin. We could not investigate the complaint of the chest pain between the two method, because a sense of pain was very independent. For patients with relatively small body surface areas, two small venous cannulas are very adequate for the surgery. In Conclusion, single access for minimally invasive valve surgery seemed to be an excellent operation for most patients with isolated valvular disease. The rehabilitation of the patients are earlier without fear of serious healing problems.

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