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Minimally Invasive Port Access Surgery Reduces Operative Morbidity for Valve Replacement in the Elderly

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ABSTRACT

Background: Although minimally invasive techniques for valvular surgery have rapidly come into widespread use, whether such an approach can be safely applied to elderly patients remains an open question. To help resolve this issue, we reviewed our experience with minimally invasive port access (MIPA) valve surgery in elderly patients and compared it to the results obtained with the standard sternotomy (STD) approach in the same age group.

Methods: From January 1994 through December 1998, 370 consecutive patients at least 70 years of age underwent isolated aortic or mitral valve surgery at our institution. The standard sternotomy operative approach was used in 259 patients (mean age 77.5 years) and the minimally invasive port access approach was used in 111 patients (mean age 76.0; p=.006). A mitral valve procedure was performed more often in the MIPA patients than in the STD patients (49.5% vs. 35.9%; p<.001).

Results: Hospital mortality was comparable in the two groups, 9.7% (25/259) in the STD group and 7.2% (8/111) in the MIPA group (p=.50), as was the incidence of many perioperative complications. The MIPA group, however, had a significantly lower incidence of sepsis or wound complications (1.8% vs 7.7%; p=.027), required less fresh frozen plasma transfusion (median 1.0 unit vs 2.0 units; p =.04), and had a shorter length of hospital stay (11.6 days vs 17.6 days; p=.001).

Conclusions: These results indicate that with appropriate surgical techniques the MIPA approach for isolated valve surgery can be safely applied to the elderly patient population with excellent results. In our initial experience the MIPA approach is associated with significantly less plasma transfusion, fewer postoperative complications, and shorter length of hospital stay.

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INTRODUCTION

Although there are a number of studies in the surgical literature on valve surgery in the elderly [Antunes 1989, Jamieson 1989, Holper 1995, Pupello 1995, Kobayashi 1997], few studies have examined the results of valve surgery in the elderly using a minimally invasive approach. Those few early studies which have addressed this issue have, of necessity, examined only relatively small numbers of patients [Mohr 1998].

Among the expected advantages offered by minimally invasive port access (MIPA) valve surgery are a less traumatic operation with less blood loss, less postoperative pain, and more rapid recovery. Such advantages would be particularly welcome for elderly patients whose inherent fragility renders them more vulnerable to operative death and complications after cardiac surgery [Maharajh 1998]. On the other hand, some aspects of the MIPA may pose special dangers for elderly patients. This study was designed to compare hospital outcomes for our institution's early experience with MIPA valve surgery in comparison with outcomes for a similar group of patients who underwent valve surgery by standard sternotomy (STD) techniques.

MATERIALS AND METHODS

We studied 370 consecutive patients, 70 years of age or older, who underwent isolated aortic or mitral valve surgery at our institution between January 1994 and

Table 1. Comparison of the standard sternotomy (STD) and minimally invasive port access (MIPA) groups' preoperative characteristics

	STD (n=259)	MIPA (n=111)	*p*
Age (mean±SD)	77.5±5.1	76.0±4.7	0.006
Sex			
Male	46.7%(121)	49.5%(55)	0.617
Female	53.3%(138)	50.5%(56)	
Previous cardiac surgery	36.3%(94)	22.5%(25)	0.009
NYHA class III or IV	44.7%(116)	53.0%(59)	0.171
Emergent	4.2%(11)	0%(0)	0.040
Hemodynamics			
Unstable	4.6%(12)	1.8%(2)	0.191
Shock	0.8%(2)	0.9%(1)	0.899
Operative procedure			
AV replacement	64.1%(166)	50.4%(56)	<0.001
MV replacement	26.2%(68)	19.8%(22)	
MV repair	9.7%(25)	29.7%(33)	
Ejection fraction (mean±SD)	43.3%±19.0	53.0±10.4	<0.001
CHF this admission	42.1%(109)	33.3%(37)	0.114
Renal failure (creatine >2.5 or dialysis)	9.6%(25)	4.5%(5)	0.100
Cardiomegaly (>50% C-T ratio)	49.4%(128)	42.3%(47)	0.211
>1 Previous MI	5.4%(14)	5.4%(6)	1.00
Stroke	6.2%(16)	6.3%(7)	0.963
Hypertensive	45.6%(118)	66.7%(74)	<0.001
Endocarditis (active)	4.2%(11)	3.6%(4)	0.774
IV Nitro within 24 hrs. preop	0.8%(2)	2.7%(3)	0.141
LV hypertrophy	52.9%(137)	48.6%(54)	0.454
Aorto-iliac disease	8.5%(22)	8.1%(9)	0.902
Femoral-popliteal disease	10.0%(26)	7.2%(8)	0.388
Malignant ventricular arrhythmia	2.7%(7)	2.7%(3)	1.00
COPD	12.0%(31)	18.9%(21)	0.078
Extensively calcified ascending aorta	14.7%(38)	22.5%(25)	0.066
Diabetes mellitus requiring medication	9.3%(24)	9.0%(10)	0.937

December 1998. There were 222 (60.0%) isolated aortic valve procedures and 148 (40.0%) isolated mitral valve procedures. During this period, 259 (70.0%) of these patients were operated upon using the STD approach and 111 patients (30.0%) were operated upon using the MIPA approach. Most of the STD approach cases were performed prior to October 1996. Fresh frozen plasma transfusion data is based on a total of 130 patients operated upon between May 1996 and October 1997, the first year during which the MIPA approach was used at our institution. A comparison of the study groups' preoperative characteristics is shown in Table 1 (◎). The definitions used to determine the presence of preoperative risk factors and perioperative complications were those delineated by the New York State Cardiac Surgery Reporting System in January 1998.

The port access techniques for valve surgery have been described in detail elsewhere [Colvin 1998]. Briefly, for the port access minimally invasive approach to mitral valve surgery, the cardiopulmonary bypass cannulae are placed peripherally. The Endoclamp™ endoaortic balloon clamp (Heartport, Inc., Redwood City, CA) is placed in the ascending aorta using transesophageal echocardiography (TEE) guidance [Schultze 1999]. A small right inframammary thoracotomy is performed, and the mitral valve is exposed via a standard posterior atriotomy incision. With this approach, a mitral repair, ring annuloplasty, or mitral valve replacement can be performed with equal facility, and the exposure is comparable to or better than that obtained with the sternotomy approach.

For minimally invasive aortic valve replacement, a 5-cm transverse incision is made in the third right interspace. The aorta is cannulated either centrally or peripherally, and a long venous cannula is placed into the right atrium via the femoral vein. We used retrograde cardioplegia with the Endocoronary Sinus™ catheter (Heartport, Inc., Redwood City, CA) placed by the anesthesiologist in the majority of cases. Standard aortic valve replacement techniques were employed. It is not necessary to visualize the entire heart because of the good valvular exposure provided by just these limited access incisions.

Statistical analysis was performed using the statistical software SPSS. Continuous variables were analyzed by the Student's T-test and categorical variables by the Chi-square test. Non-parametric testing was performed with

Table 2. Comparison of the standard sternotomy (STD) and minimally invasive port access (MIPA) groups' operative variables, hospital mortality, and perioperative complications

	STD (n=259)	MIPA (n=111)	*p*
Hospital mortality	9.7%(25)	7.2%(8)	0.449
Length of stay, days, mean±SD (median)	17.6±17.2 (12.0)	11.6±11.8 (7.0)	0.001
Cardiopulmonary bypass time (min.)	118±43	124±35	0.204
Aortic clamp time (min.)	82.6±31.5	82.6±31.2	0.819
Plasma transfusion (median) (units)	2.0	1.0	0.040
Sepsis or wound complication	7.7% (20)	1.8% (2)	0.027
Stroke	3.5% (9)	3.6% (4)	>0.05
Renal failure, dialysis	4.2% (11)	2.7% (3)	0.476
Respiratory failure	11.2% (29)	13.5% (15)	0.528
MI	0.4% (1)	0% (0)	0.647
Bleeding requiring reoperation	3.1% (8)	6.3% (7)	0.150
Heart Block, permanent pacemaker	6.3% (15)	0% (0)	0.069

the Mann-Whitney test. A p value of .05 or less was considered significant.

RESULTS

As can be seen in Table 1 (◎), the STD and MIPA patient groups were quite comparable in most respects. The MIPA patients were slightly younger than the STD patients (76.0 vs 77.5, p=.006) and had a significantly lower incidence of previous open heart surgical procedures (22.5% vs 36.1%; p=.009). The MIPA group also had a slightly better estimated ejection fraction (53.0% vs. 43.3%; p<.001). A significantly higher percentage of STD patients underwent emergent or urgent surgery (4.2% vs 0%; p =.040), but a significantly greater number of MIPA patients were hypertensive (66.7% vs 45.6%; p<.001) and underwent mitral as opposed to aortic valve procedures (49.5% vs 35.9%; p<.001). There were no significant differences between the groups with respect to cardiomegaly, renal failure, or any of the other risk factors examined. No perioperative aortic dissections occurred in either patient group.

The hospital mortality in the MIPA group (7.2%) was similar to that in the STD group (9.7%; p=.449) (Table 2 ◎). The cardiopulmonary bypass time, aortic clamping time, and the incidence of most major operative complications were similar in the two groups. The MIPA patients, however, suffered a significantly lower incidence of postoperative sepsis or wound complications (1.8% vs 7.7%; p=.027) and required significantly less fresh frozen plasma transfusion (median = 1.0 vs 2.0 units; p=.04). In addition, the MIPA patients had a significantly shorter hospital length of stay than the STD patients (11.6 days vs 17.6 days; p=.001).

DISCUSSION

The two groups of patients compared in this study were similar in most respects. A recent study of 436 patients, 75 years of age or older, undergoing cardiac operations via conventional sternotomy identified three factors which determined hospital survival: 1) cardiomegaly, 2) renal failure, and 3) emergency procedures [Maharajh 1998]. In other studies of cardiac surgery in the elderly, the presence of congestive heart failure has been found to be a predictor of early death [Ennabli 1986, Edwards 1991, Peterson 1995]. In our study there were no significant differences in any of these preoperative indicators between the STD and MIPA groups except for a higher incidence of emergency procedures in the STD group.

The overall hospital mortality did not differ significantly between the STD and MIPA groups in our experience. The MIPA group, however, did enjoy significantly better freedom from sepsis or wound complications, undoubtedly related to the small size of the lateral incisions used and the avoidance of sternotomy in the MIPA group. The significantly lower requirement for blood plasma transfusion in the MIPA group also seems related to the size and location of the incisions used in the MIPA approach. Finally, the significantly reduced length of hospital stay in the MIPA group is probably also a direct effect of avoiding the pain and immobility associated with sternotomy. It is important to note that these advantages were obtained in the MIPA group without lengthening the cardiopulmonary bypass or aortic clamping times.

Limitations of this study are primarily due to the retrospective nature of the operative series. There do exist some differences in the patient groups, (i.e., a 14% differential in the incidence of prior cardiac surgery in the STD group and a 14% higher incidence of mitral valve disease in the MIPA group). The increased incidence of prior surgery would militate against the STD patient outcome, while the differential in the incidence of mitral disease would negatively impact the MIPA patients. Such methodological issues will only be solved in the future when greater patient numbers are available to allow a case-matched and multivariate analysis to be performed. The strength of this study is that it is a single institution, consecutive patient series, which allows the reader to gauge the impact of this new surgical approach on clinical outcomes in the geriatric patient population.

The results of this study demonstrate that when comparable groups of patients 70 years of age or older undergo

isolated aortic or mitral valve surgery, the MIPA approach offers definite advantages in terms of morbidity. Lowering the need for plasma transfusion and the incidence of sepsis or wound complications would be expected to shorten the average length of stay for elderly patients, and this was found to be the case. These data suggest that the MIPA approach for isolated valve surgery in the elderly is not only as safe and effective as the STD approach, but also may offer significant advantages in terms of lower morbidity and shorter length of hospital stay.

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