

Extended Vertical Transseptal Approach versus Transseptal Approach for Mitral Valve Operation

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ABSTRACT

Background: Adequate exposure of the mitral valve is a critical factor of success for either replacement or repair of the mitral valve. In the present study, we evaluated the merits of the extended vertical transseptal approach in comparison with the transseptal approach for mitral valve operations.

Methods: A total of 72 consecutive patients operated on for mitral procedures were allocated to either group A (those operated on through an extended vertical transseptal approach [n = 38]) or group B (whose mitral valve exposure was achieved through a right atrium transseptal approach [n = 34]). The operation time, aortic cross-clamp time, first 24-hour drainage volume after the operation, and the rhythms pre- and postsurgery were compared between the 2 groups.

Results: The mean operation time and mean cross-clamp time in group A were longer than that in group B and the drainage volume was greater in the first 24 hours, but the differences were not statistically significant. There was no surgical reexploration for bleeding in either group. For the 13 patients who had normal sinus rhythm preoperatively in group A, 2 (15.4%) developed episodes of atrial fibrillation and 1 (7.7%) developed temporary sinus bradycardia requiring temporary pacing in the immediate and early postoperative period. In group B, 2(15.4%) of patients with normal sinus rhythm before surgery developed atrial fibrillation that continued until 1 week after surgery.

Conclusion: The extended vertical transseptal approach not only affords excellent exposure of the mitral valve, but also is safe for maintaining sinus node function compared with the transseptal approach.

INTRODUCTION

Adequate exposure of the mitral valve is a critical factor of success for both replacement and repair. There are various approaches to expose the mitral valve apparatus, including the classic vertical interatrial groove approach, the transseptal approach, and the left atrium roof approach [Dubost 1966; Brawley 1980; Balasundaram 1990; Nienaber 2006].

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Currently, the most widely used approach in our institution is the transseptal incision through a median sternotomy. It can be applied in most cases [Santibáñez Escobar 1997], but achieving adequate exposure can be very difficult, especially in cases with a small left atrium or reoperation.

At the beginning of the 1990s, a new approach to obtain better exposure of the mitral valve in difficult situations was described [Guiraudon 1991]. It involves extending the vertical transseptal approach onto the superior dome of the left atrium. Research has demonstrated that the new approach provides the best field of view for mitral valve surgery, but concern exists regarding extended procedure time (including total operation time and aortic cross-clamp time), the possibility of bleeding due to the long incision, and the possible adverse effects on cardiac rhythm [Dubost 1966; Brawley 1980].

To address some of the concerns raised in the literature regarding the new approach, we present outcome data from a single institution's experience utilizing either the transseptal approach or the extended vertical transseptal approach.

SUBJECTS AND METHODS

Subjects

Seventy-two consecutive mitral valve procedures were performed from January 2006 to October 2008. Patient age ranged from 20 to 68 years, including 46 female and 26 male patients. Preoperatively, 48 patients had atrial fibrillation and 24 had sinus rhythm.

The patients were divided into 2 groups (group A and group B). The extending vertical transseptal approach was applied in group A, and the transseptal approach was applied in group B. Patient demographics are listed in Table 1. The following information was collected from all patients: operation time, aortic cross-clamp time, 24-hour postoperative drainage volume, and cardiac rhythms pre- and postsurgery. This study was conducted in accordance with the Declaration of Helsinki and with approval from the Ethics Committee of the Fourth Affiliated Hospital of Guangxi Medical University. Written informed consent was obtained from all participants.

Surgical Techniques

All operations were performed with cardiopulmonary bypass, using conventional aortic cannulation and double venous cannulation. Myocardial protection was achieved with antegrade cold blood cardioplegia.

Table 1. Preoperative Patient Profile in the 2 Study Groups*

Variable	Group A	Group B	P
No. of patients	38	34	NS
Age, years			
Mean	41.2	40.8	NS
Range	25-68	20-66	NS
Sex, n			
Male	18	8	NS
Female	20	26	NS
Mean functional class (New York Heart Association)	2.4 ± 0.8	2.6 ± 0.7	NS
Rhythm, n			
Sinus	13	13	NS
Atrial fibrillation	25	21	NS

*NS, not significant.

For group A, the atrial septum was incised vertically through the fossa ovale. The atrial septal incision terminated inferiorly at the inferior pole of the fossa; it was prolonged superiorly by 1 to 2 cm into the atrial septum. The right atriotomy was prolonged superiorly into the right coronary fossa between the right atrial appendage and the atrioventricular (AV) sulcus to join the superior end of the septal incision. From where the 2 incisions met, the roof of the left atrium was incised. The left atriotomy was extended to the left over 3 to 5 cm, at a distance from the aortic root. The procedure of the mitral valve was then finished. Finally, the left atrium was closed with 2 running 4-0 polypropylene sutures. The first suture started at the roof of the left atrium; the second one started at the fossa ovalis. The 2 sutures met at the superior aspect of the atrial septum and then went on their own tracks to close the right atrium.

For group B, after access to the right atrium was gained through a vertical incision parallel to the AV groove, a longitudinal incision was made into the fossa ovale, with extension superiorly toward the superior vena cava, and inferiorly to the area just behind the coronary sinus, and then the mitral valve was exposed. After the completion of the procedure, the interatrial septum and the right atrium were closed with a running 4-0 polypropylene suture.

STATISTICAL ANALYSIS

Data were analyzed with SPSS17.0. Continuous data are expressed as the mean ± standard deviation. Comparisons were performed using the paired and unpaired Student's t-test. Statistical significance was assumed at $P < 0.05$ ($P = 0.000$ means $P < 0.001$).

RESULTS

Surgical Data

Exposure in all 72 patients was judged to be either excellent or good. No complications directly related to the incision

Table 2. Operative Data in the 2 Study Groups*

Variable	Group A	Group B	P
Operation time, h	4.5 ± 2.1	4.0 ± 2.4	NS
Cross-clamp time, min	45 ± 13	43 ± 12	NS
Drainage volume, mL	652 ± 45	546 ± 58	NS

*NS, not significant.

occurred. There were no atrial septal defects or unsatisfactory prosthetic valve implantations.

The average operation time was 4.5 ± 2.1 hours and the mean aortic cross-clamp time was 45 ± 13 minutes in group A and 4.0 ± 2.4 hours and 43 ± 12 minutes in group B. No significant differences between groups were observed. The first postoperative 24-hour drainage volume was significantly more in group A (652 ± 45 mL versus 546 ± 58 mL), but the difference was not statistically significant (Table 2). Also, the number of reexplorations required in the 2 patient groups did not differ significantly and none were related to the technique used.

Cardiac Rhythm

Among the 25 patients who had atrial fibrillation preoperatively in group A, 23 continued to have atrial fibrillation after the operation and 2 converted to sinus rhythm immediately after the operation but reverted to their preoperative rhythm in 72 hours. Of the 13 patients who had normal sinus rhythm preoperatively, 10 maintained their rhythm after the operation. Atrial fibrillation developed in 2 (15.4%) patients in the first 48 hours postoperation, but both returned to normal rhythm after intravenous administration of amiodarone for 24 hours. One (7.7%) patient developed sinus bradycardia requiring temporary pacing in the immediate and early postoperative period but reverted to sinus rhythm by the time of discharge. In contrast, of the 21 patients who had atrial fibrillation preoperatively in group B, only 1 converted to sinus rhythm postoperatively and maintained this rhythm for more than 48 hours. Of the 13 patients with normal sinus rhythm preoperatively, 11 maintained the same rhythm after the operation. Two (15.4%) patients developed atrial fibrillation and maintained it until 1 week after surgery. In both groups no patients developed AV heart block postoperatively (Table 3).

Table 3. Postoperative Profile in the 2 Study Groups*

Variable	Group A	Group B	P
Sinus rhythm	10	11	NS
Atrial fibrillation	2	2	NS
Sinus bradycardia	1	0	NS

*NS, not significant.

DISCUSSION

The success of any surgical procedure is heavily influenced by the exposure of the part in need of surgery. This is especially true in mitral valve procedures. At present, most of the surgical access to the mitral valve is through the left atrium, but the currently preferred approach in our institution is the transseptal incision through the right atrium because of its convenience. This can be the first-line approach in tricuspid mitral valve disease, in which a tricuspid valve procedure is anticipated. Similarly to our experience, Aykut et al. [Aykut 1991] concluded that use of the transseptal approach for mitral valve operations is simple and safe in patients who require a right atriotomy for concomitant procedures. However, although a good exposure can be made through this approach, some difficult situations, such as small left atrium or redo operations, require a new approach to achieve a better exposure. At the beginning of the 1990s, Guiraudon and colleagues [Guiraudon 1991] described a new approach, which obtained exposure by extending the transseptal incision onto the superior dome of the left atrium. Many studies [Misawa 1999; Tenpaku 2000; Kunitomo 2001; Salerno 2009] have demonstrated that this new approach, which uses a semicircular incision over the superior half of the mitral annulus, provides better exposure than the left atrium approach and facilitates the performance of most types of mitral valve procedures, especially in cases with a small left atrium. Also, the technique permits less tension to be applied to the atrial walls, thus preserving the atrial tissues and preventing damage to the surrounding cardiac structures. Moreover, testing of valve competence during conservative procedures is more accurate, because there is no distortion caused by undue traction [Kumar 1995]. To our knowledge, however, there have been no reports comparing the new approach with the transseptal approach.

The present study was designed to assess whether the new approach was as safe and effective as the transseptal approach. Our results showed that there were no surgery-related deaths in both groups. In group A, the operation time and the cross-clamp time were longer owing to the longer incision, which required a longer reconstruction time than in group B. In the meantime, no significant differences were found between the 2 groups with respect to the first postoperative 24-hour drainage volume or reexploration for bleeding related to the techniques used in the 2 groups.

Although the new approach provides a better field of view for mitral valve surgery, theoretical detrimental effects related to this approach must be addressed, including the possibility of postoperative sinus node dysfunction. The blood supply for the sinus node artery is usually derived from a major coronary artery branch [Busquet 1984; Kyriakidis 1988; Okmen 2009], and many studies have shown differing results with regard to sinus node function after sinus node artery ligation, showing nonuniform blood supply for the sinus node [Caetano 1995; Ozturk 2011]. Lukac and colleagues [Lukac 2007] demonstrated that the new approach has a higher risk of clinically significant sinus node dysfunction than the left atrial approach, and that it is an independent risk factor for pacemaker implantation. In a series of 128 patients, García-Villarreal and González-Oviedo [García-Villarreal 2003]

also showed 2 cases of complete AV block requiring definitive pacemaker implantation, and Kumar et al. [Kumar 1995] reported junctional rhythm in 38% of 65 patients who underwent surgery using this access. In contrast, in a series of 34 patients, Guiraudon et al. [Guiraudon 1991] showed no cases of atrial arrhythmia, whereas Takeshita and colleagues [Takeshita 1997] reported that with the new approach the sinus node function was relatively well maintained for more than 1 year after the operation and the influence during the midterm postoperative period was apparently mild, but monitoring was required.

In the present series of 38 patients in whom the new approach was applied, no junctional rhythm or AV block occurred. But 2 patients developed atrial fibrillation and 1 patient developed sinus bradycardia; therefore, the rate of loss of sinus rhythm was only 3 out of 13 (23.08%). In group B, there were 2 out of 13 (15.38%) patients who lost their sinus rhythm and developed atrial fibrillation. But no significant differences were found between the 2 groups.

CONCLUSION

The extending vertical transseptal approach affords excellent exposure of the mitral valve. Although the longer incision leads to longer operation time and more postoperative drainage volume, no statistically significant differences were found compared with the transseptal approach. Also, this approach is safe for maintaining sinus node function.

REFERENCES

- Aykut K, Celik B, Acikel U. 2011. The transseptal approach to the mitral valve during multivalvular surgery. *J Card Surg* 26:472-4.
- Balasundaram SG, Duran C. 1990. Surgical approaches to the mitral valve. *J Card Surg* 5:163-9.
- Brawley RK. 1980. Improved exposure of the mitral valve in patients with a small left atrium. *Ann Thorac Surg* 29:179-81.
- Busquet J, Fontan F, Anderson RH, Ho SY, Davies MJ. 1984. The surgical significance of the atrial branches of the coronary arteries. *Int J Cardiol* 6:223-36.
- Caetano AG, Lopes AC, DiDio LJ, Prates JC. 1995. Critical analysis of the clinical and surgical importance of the variations in the origin of the sinoatrial node artery of the human heart. [in Portuguese] *Rev Assoc Med Bras* 41:94-102.
- Dubost C, Guilmet D, Parades B, Pedferri G. 1966. New technic of opening of the left auricle in open-heart surgery: the transseptal bi-auricular approach. [in French] *Presse Med* 74:1607-8.
- García-Villarreal OA, González-Oviedo R, Rodríguez-González H, Martínez-Chapa HD. 2003. Superior septal approach for mitral valve surgery: a word of caution. *Eur J Cardiothorac Surg* 24:862-7.
- Guiraudon GM, Ofiesh JG, Kaushik R. 1991. Extended vertical transatrial septal approach to the mitral valve. *Ann Thorac Surg* 52:1058-60.
- Kumar N, Saad E, Prabhakar G, De Vol E, Duran CM. 1995. Extended transseptal versus conventional left atriotomy: early postoperative study. *Ann Thorac Surg* 60:426-30.
- Kunitomo R, Okamoto K, Utoh J, et al. 2001. Evaluation of superior

transseptal approach for the removal of left atrial myxoma. [in Japanese] *Kyobu Geka* 54:211-4.

Kyriakidis M, Vyssoulis G, Barbesetas J, Toutouzas P. 1988. A clinical angiographic study of the arterial blood supply to the sinus node. *Chest* 94:1054-7.

Lukac P, Hjortdal VE, Pedersen AK, Mortensen PT, Jensen HK, Hansen PS. 2007. Superior transseptal approach to mitral valve is associated with a higher need for pacemaker implantation than the left atrial approach. *Ann Thorac Surg* 83:77-82.

Misawa Y, Fuse K, Kawahito K, Saito T, Konishi H. 1999. Conduction disturbances after superior septal approach for mitral valve repair. *Ann Thorac Surg* 68:1262-4.

Nienaber JJ, Glower DD. 2006. Minitransseptal versus left atrial approach to the mitral valve: a comparison of outcomes. *Ann Thorac Surg* 82:834-9.

Okmen AS, Okmen E. 2009. Sinoatrial node artery arising from postero-lateral branch of right coronary artery: definition by screening consecutive

1500 coronary angiographies. *Anadolu Kardiyol Derg* 9:481-5.

Ozturk E, Saglam M, Bozlar U, et.al. 2011. Arterial supply of the sino-atrial node: a CT coronary angiographic study. *Int J Cardiovasc Imaging* 27:619-27.

Salerno TA, Suarez M, Panos AL, et al. 2009. Results of beating heart mitral valve surgery via the transseptal approach. *Rev Bras Cir Cardio-vasc* 24:4-10.

Santibáñez Escobar F, Serrano Gallardo G, Ramirez Marroquin S, Lopez Soriano F, Barragán García R. 1997. The transseptal approach for mitral valve replacement revisited. *Tex Heart Inst J* 24:209-14.

Takeshita M, Furuse A, Kotsuka Y, Kubota H. 1997. Sinus node function after mitral valve surgery via the transseptal superior approach. *Eur J Cardiothorac Surg* 12:341-4.

Tenpaku H, Wariishi S, Kanemitsu N, Okabe M, Nakamura T. 2000. Combined superior-transseptal approach versus conventional approach for mitral valve surgery. *Jpn J Thorac Cardiovasc Surg* 48:688-92.