

Research Article

Right thoracotomy approach for open heart surgery

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ABSTRACT

Background: Median sternotomy approach provides excellent exposure of all the chambers of heart for performing open heart surgery, but this approach is the most invasive used for any surgical procedure. Besides an ugly scar, median sternotomy not only increases the morbidity but at times mortality also. To have an acceptable postoperative scar and to avoid the morbidity and mortality associated with median sternotomy, the present study was conducted to find an alternative to median sternotomy in patients with atrial septal defect, mitral and tricuspid valve disease.

Methods: Patients were positioned with right side elevated 30-45 degree, and heart was approached by right anterior thoracotomy, through 4th intercostals space. Pericardium was opened anterior to phrenic nerve, and upper end pericardial stay sutures given to get aorta more anterior. Aortic and bicaval cannulation was done and intracardiac procedures were performed as are done after standard median sternotomy.

Results: Difficult aortic cannulation and fracture to costochondral junction was the problem observed in some patients. Repair of atrial septal defect was the most common operation performed. Sternotomy, rib resection and peripheral cannulation was not needed in any of these patients. Post-operative period was uneventful in majority.

Conclusions: In all patients above 4 years of age, with normal aortic valve, without active lung disease / previous right thoracotomy, having isolated atrial septal defects, mitral and tricuspid valve disease the heart should be approached through right anterior thoracotomy.

Keywords: Right thoracotomy, ASD repair

INTRODUCTION

Though most cardiac operations are performed through median sternotomy because of its versatility and familiarity to surgeons, the fact is sternotomy is not without complications, and the problems of post sternotomy pain, dehiscence, mediastinitis, osteomyelitis and unstable sternum increases morbidity and mortality in these patients. Median sternotomy may also leave a bad scar which patients don't prefer. Alternative to median sternotomy are gaining popularity in cardiac surgery. As an alternative to median sternotomy, the heart may be approached by (i) right parasternal mini-incision,

aortic and central venous cannulation, (ii) right submammary mini-incision, femoral arterial cannulation and central venous cannulation, (iii) right submammary mini-incision, femoral arterial cannulation, right atrial cannulation and percutaneous jugular vein cannulation, (iv) parasternal incisions, the (v) hemisternotomy, the (vi) minithoracotomy, (vii) upper half sternotomy and or (viii) lower half sternotomy, (ix) lower small midline skin incision with minimal sternotomy approach, (x) transxiphoid approach without sternotomy. At times horizontal submammary skin incisions are used to split sternum to get the best post-operative results. The concept of alternative approaches for cardiac surgery started only when safety of open heart surgery was

beyond any doubt. It is a fact now that besides simple cardiac operations even complex intra cardiac surgeries are performed after approaching heart by thoracotomy. Thoracotomy approach to cardiac surgery should not hinder the definitive surgical procedure, the access to all chambers should be good, peripheral cannulation should not be needed and median sternotomy should be avoided. Right submammary anterior thoracotomy provides excellent access to both atria and right ventricle. Right anterolateral thoracotomy has been used with acceptable results for patients undergoing intra cardiac operations.

METHODS

The study was conducted over a period of more than 2 years. A detailed history thorough general and systemic examination was contemplated. Echocardiographic evidence of intra cardiac pathology was reported in all. Patients below 4 years of age, functional class IV, previous right thoracotomy, active chest infections and patients with abnormal aortic valve were not included in the study.

All the patients were explained the chances of peripheral cannulation, conversion to median sternotomy or extension of incision to either side to get adequate exposure. After endotracheal intubation, placement of invasive monitoring lines / probes and indwelling catheterization, patients were positioned with right side elevated 30-45 degree, left leg flexed at knee at about 75 degree angle and right leg flexed at about 30 degree angle. A curved submammary incision was given starting from the lateral border of sternum towards anterior axillary line over 5th intercostal space; the dissection was carried down to the chest wall, dividing separating the pectoralis major, minor and at times the latissimus dorsi muscle. The pleural space was entered through 4th intercostal space after dividing the intercostal muscles along the upper border of 5th rib. Depending on the exposure the thoracotomy was limited to small 7-10 cm anterior thoracotomy, anterior thoracotomy and anterolateral thoracotomy. Right thoracotomy as an acceptable alternative to median sternotomy has also been reported by others,^{1, 2} that the incision should be given over 5th intercostals space and chest entered through 4th intercostals space is well known.^{3, 4} Pleural cavity was inspected for any concomitant pathology. As reported by others, pericardium was opened anterior to phrenic nerve thymus was separated and the pericardiotomy extended up to left innominate vein superiorly and diaphragm inferiorly.^{3,5,6} Pericardial stay sutures were given to isolate the field, to facilitate dissection between aorta and pulmonary artery and to get aorta more anteriorly for easy aortic cannulation, and is as per the recommendations from other centres.^{4,7-9} After applying purse string sutures, systematic cannulation, putting patient on bypass, and giving cardioplegia, cardiomy and intracardiac procedures were done as are performed after a standard median sternotomy. Left ventricular venting was done directly, or through right

superior pulmonary vein, tapes around inferior vena cava (IVC) were placed before or after starting cardiopulmonary bypass.

The intra cardiac operations were performed as per the indications, cardiomy incisions were closed meticulously, patients were weaned of bypass gradually, and decannulation was done systematically. Complete haemostasis was achieved, pacing wires placed, chest tubes placed in position and incisions closed back. Patients were shifted to intensive care unit, post-operative period monitored, morbidity and mortality recorded, and after discharge patients were followed up in outpatient department.

RESULTS

Table 1: New York heart association (NYHA) functional class, in 50 patients.

NYHA functional class	No. of patients	Percentage
I	1	2
II	20	40
III	29	58

Table 2: Open heart surgical procedures performed*.

Surgical procedure Performed	No. of patients	Percentage
Direct repair of ASD	29	58
Mitral valve replacement	16	32
Tricuspid valve repair	04	08
Patch repair of ASD	03	06
Mitral valve repair	03	06
Pulmonary valvotomy	01	02
Excision of myxoma	01	02
Patch repair septum primum defect	01	02

*More than one procedure were performed in some patients

A total of 50 patients, in the age group of 4 to 46 years, with a male-female ratio of 2:3 were operated. 58% were in functional class III (Table 1). Heart was approached through right anterior thoracotomy incision in all. 8% of the patients developed hemothorax while inserting central venous catheter and needed suction of blood and evacuation of clot. After pericardiotomy, right atrium (RA), superior vena cava (SVC), and aorta were nicely seen, systematic purse string sutures for cannulation were

placed without difficulty and cannulation was straight forward (Figure 1), except in 8% of the patients in whom aortic cannulation could not be done in first attempt. Cardiotomy was under vision and easy, even after cardiotomy aortic, SVC, IVC, and cardioplegic cannulas, right atriotomy, right atrium, and ASD are appreciated nicely (Figure 2). All the procedures were performed under cardiopulmonary bypass using hyperkalemic blood cardioplegia at a temperature of 25-32 degree centigrade. ASD was the most common indication for surgery in 62% of patients, followed by mitral regurgitation in 32%, mitral stenosis in 14%, tricuspid regurgitation in 8%, besides a case each of tricuspid stenosis, septum primum defect and atrial myxoma. More than one defect/pathology was observed in some patients. Direct suture closure of ASD was the most common operation performed (Table 2), patch repair of ASD was done in 6% (Figure 3). Even grossly diseased and perforated mitral leaflets (Figure 4) were excised without any difficulty and mitral valve replaced without compromise in field of vision or space (Figure 5). Length of thoracotomy incision varied from 7 to 20 cm with a mean of 10.58 cm. Heart was approached within 10- 40 minutes with a mean of 15.4 minutes. Cardiopulmonary bypass time was less than 60 minutes in 68% of the patients, and 60% of the patients had Cross clamp time of less than 30 minutes. Left ventricle was vented through right superior pulmonary vein in 40% of patients. De-airing was done systematically, and there was no difficulty in weaning patients off bypass, decannulation, achieving haemostasis and placing pacing wires. Thoracotomy wound was closed within 10-50 minutes with a mean time of 20.12 minutes. 90% of the patients had post-operative drainage of less than 300 ml with a mean of 150 ml. Intra operative fractures to costochondral junction was observed in 28%, and injury to internal mammary artery in 16% of patients. Post-operative complications were wound infection in 14.58%, consolidation in 8.33%, wound dehiscence in 4.16% and pyothorax in 2.08%. Post-operative hospital stay was up to 25 days with a mean of 10.6 days (Table 3). 4% of the patients died in post-operative period. All the survivors were satisfied with early ambulation, less pain, early discharge and excellent cosmetic results (Figure 6).

Table 3: Post-operative hospital stay (48 patients)*.

Hospital stay in days	No. of patients	Percentage
05-10	27	56.25
11-15	14	29.16
16-20	05	10.41
21-25	02	04.16

*2 Patients died in postoperative period

DISCUSSION

Cardiac operations irrespective of their indications are most often forgotten or repressed especially by young people. Therefore, the skin scar is quiet often the only

long-lasting reminder of a cardiac operation. Consequently we feel obliged to pay the utmost attention to the scar. This is particularly true when the patient is a woman since the scar can be unsightly and detract from her physical appearance. Principally for cosmetic reasons alternative operative approaches have been developed with better aesthetic results. A thoracotomy was used for open heart surgery in 1940s, 1950s, and 1960s, for both open and closed heart operations. Median sternotomy became the incision of choice in late 1960s. But of late alternative to median sternotomy are gaining popularity not only for minimal internal fiddling at the time of surgery, but also for quick recovery, less pain, decreased morbidity, shorter hospital stay, early return to work and better cosmetic results.

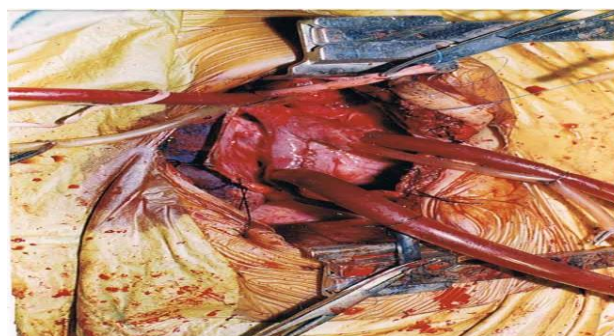


Figure 1: Aortic, SVC, IVC cannula and closed atriotomy suture line.



Figure 2: Showing Aortic, SVC/IVC and cardioplegic cannula, right atriotomy, right atrial cavity and ASD.



Figure 3: Patch repair of ASD.

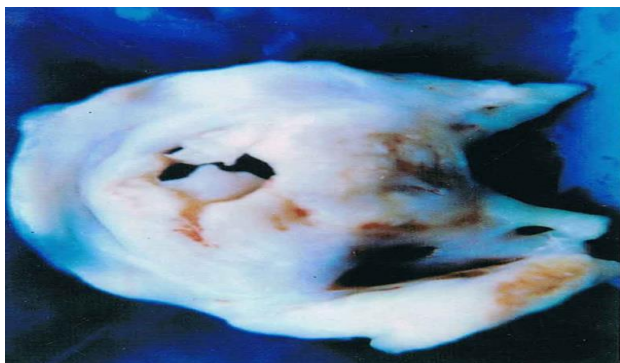


Figure 4: Diseased and perforated mitral valve leaflet.



Figure 5: Replaced prosthetic mitral valve.



Figure 6: Post-operative scar.

Majority of the patients having ASD and presenting in 3rd to 4th decade of life is well known.³ Atrial septal defects and mitral valve disease being more in females is reported by others also.⁵ The results of this study are in contrast to study of Praeger PI et al who operated only functional class IV patients, but is in similarity as for as excellent exposure of left atrium, and difficult aortic cannulation is concerned.¹⁰ Right thoracotomy as an acceptable alternative to median sternotomy is in accordance to other studies.¹⁻⁴ That the incision should be given lower down on the 5th intercostals space and the chest entered through 4th intercostals space is reported by other authors also, these observations differ from those of Praeger PI et al, who used 4th space for incision and chest entry.^{3-6,10} Srinivasan Muralidharan et al gave incision below 5th intercostals space and entered chest through 4th

intercostals space.⁷ Anterolateral thoracotomy with entry through 3rd space is also reported. That the pericardiotomy should be made 3 cm above phrenic nerve is well documented, however, some have preferred pericardiotomy just 1 to 2 cm above phrenic nerve.^{3-6,9} Upper end aortic sutures help in getting aorta more anterior and similar observations have been made in other studies.^{3,4,7-9} Aortic and bicaval cannulation in thoracotomy approach has also been reported by others, but some had only patients with ASD in their study.^{3,4,7,8} The observations of the present study are not in accordance to Masetti M et al, who used peripheral cannulation in 12 patients and proposed that for cosmetic reasons only isolated ASD with completely developed breast is an indication for anterolateral thoracotomy approach.⁴ Over results are in consistency to Rosengart TK et al, who operated 54 patients using small anterolateral thoracotomy entering pleural cavity through 4th space and observed closure of ASD with this approach which offers good exposure, is safe, quick, efficacious and cosmetic results are superior to that of median sternotomy.⁸ The findings of the present study are similar to those of Chitwood WR et al, who also reported mitral valve repair through a limited 6 cm thoracic incision, but differs from their study because to avoid rib spreading they resected part of 5th rib, and used peripheral extracorporeal perfusion.¹¹ ASD repair, mitral and tricuspid valve surgeries can be comfortably done by anterior thoracotomy in mild to moderate hypothermia.^{5,6,8,9} Early post-operative recovery and shorter hospital stay in minimally invasive approach is well known, Grossi EA et al, compared the results of minimally invasive (small anterior thoracotomy) and sternotomy approach and observed, residual mitral insufficiency was similar in both the groups, cumulative freedom from reoperation was not significantly different but the follow up New York Heart Association functional class was significantly better in the patients undergoing minimally invasive approach and recommended this approach should be widely adopted.¹²

The results of the present study are at variance to that of Laks H et al, where to improve the cosmetic results transverse submammary skin incision have been used, skin flap raised and then the sternum splitted vertically, even with this the morbidity was less.¹³ To overcome the problem of unsightly scar with sternotomy, Brutel de La et al used horizontal submammary skin incisions for median sternotomy in patients undergoing open heart surgery, with excellent results.¹⁴ The present study is also in contrast to the results of Bedard P et al, who used bilateral submammary horizontal skin incisions, raised flaps to perform sternotomy to decrease morbidity.¹⁵ Though none of our patients were in redo group, still the findings of the present study are in accordance to the results of Cohn LH et al, who observed that to decrease postoperative blood loss and get better exposure of left atrium, thoracotomy as an alternative to median sternotomy is preferred, especially in patients with previous mediastinitis, severe right ventricular

hypertension, with multiple previous sternotomies, intact coronary artery bypass graft, or previous aortic valve replacement.⁶ In none of the patients in present study was internal mammary artery ligated deliberately, nor was costal cartilage resected intentionally, and these findings vary from that of Navia JL et al, who reported mitral valve surgery through thoracotomy approach by sacrificing internal mammary artery, resecting 3rd and 4th costal cartilages to reduce cost, accelerate patient recovery, and decrease total hospital stay.¹⁶ Fracture rib during thoracotomy is well known, but fracture to costochondral junctions being more in our results could be because we had performed complete procedure through thoracotomy approach only, these fractures occur while opening chest wall retractors to get wider exposure.³ The results of this study are not in similarity to Mohr FW, who reported high morbidity and mortality in patients undergoing mitral valve surgery performed through a right lateral minithoracotomy and under video scope guidance, the difference could be because they had used lateral thoracotomy in all their patients which does not provide good exposure.¹⁷ That the thoracotomy approach should be used even in young girls is at variance to the observation made by Richard A, infact they advised anterolateral approach should not be used in prepubescent girls due to the risk of damage to the breast buds, the disagreement could be because as reported in so many other and our study the chest incision should be lower down over 5th intercostals space, also we have not seen any case of decrease in breast volume/nipple sensitivity and anaesthesia in lower part of the breast, but the follow up data is yet to be provided.¹⁸ The observations of this study are almost in accordance to the results achieved by Muralidharan et al, except that, they had used anterolateral thoracotomy in all and had patients for ASD repair only.⁷ The incision length in present study is at variance to Loulmet et al, who used only 6-7 cm sub mammary skin incision for mitral valve surgery, but they had used peripheral cannulation to maintain cardiopulmonary bypass.¹⁹ Submammary skin incision are highly accepted and similar observations have been made by Cremer et al, who used three approaches for closure of ASD.²⁰ Even right posterolateral thoracotomy incisions have been offered by Ramsankar et al, as a cosmetic alternative for ASD closure.²¹ Uneventful postoperative period and less hospital stay after thoracotomy is well documented.^{4,7,22} Post-operative deaths after minimally invasive cardiac surgery are known, but as observed in our study also none was related to the thoracotomy procedure.^{6,10} Shivaprakasha et al, stressed that the alternative to median sternotomy for cardiac surgery is considered only when safety of open heart surgery is beyond any doubt.²³

CONCLUSION

Right anterior thoracotomy is easy to perform, entry to pericardium is quick so is closure of wound, access to right/left atria, mitral and tricuspid valve is excellent, cannulation is easy but aortic can be inconvenient,

cardiotomy is under vision, intraoperative field is good, intra and post-operative blood loss is less, recovery is quick, pain is less, morbidity is reduced, hospital stay is shortened, return to work is earlier, and cosmetic results are excellent. In all patients with ASD, mitral and tricuspid valve disease, who are above 4 years of age, without aortic valve disease/previous right thoracotomy/active chest infections, the heart should be approached through right anterior thoracotomy.

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REFERENCES

1. Barrat Boyes BG. Right anterolateral thoracotomy for cardiopulmonary bypass. In: Kirklin JW, Barrat Boyes BG, Eds. *Cardiac Surgery Is ted*. New York: Churchill Livingstone. 1988: 29-92.
2. Lancastar LL, Mavroudis C, Rees AH, Slater AD, Gansel BL, Gray LA. Surgical approach to atrial septal defect in the female: Right Thoracotomy versus sternotomy. *Ann Surgery*. 1990;56:218-21.
3. Dietl CA, Torres AR, Favaloro RG. Right submammary thoracotomy in females patients with atrial septal defects and anomalous pulmonary venous connections. Comparison between the transpectoral and sub pectoral approaches. *J Thorac Cardiovasc Surg*. 1992;104:723-27.
4. Massetti M, Babatasi G, Rossi A, Neri E, Bhojroo S, Zitouni S et al. Operation for atrial septal defect through a right anterolateral thoracotomy, current outcome. *Ann Thorac Surg*. 1996;62:1100-3.
5. Grinda JM, Folliguet TA, Dervanian P, Mace L, Legault B, Neveux JY. Right anterolateral thoracotomy for repair of atrial septal defect. *Ann Thorac Surg*. 1996;62:175-8.
6. Cohn LH, Peigh PS, Sell J, Disesa VJ. Right thoracotomy, femoro femoral bypass and deep hypothermia for re-replacement of mitral valve. *Ann Thorac Surg*. 1989;48:69-71.
7. Muralidharan S, Krishnan WA, Verma SK, Nagarajan M. Atrial septal defect closure in young females by an anterolateral thoracotomy. *IJTCVS*. 2004;20:129-31.
8. Rosengart TK, Stark JF. Repair of atrial septal defect through right thoracotomy. *Ann Thorac Surg*. 1993;55:1138-40.
9. Molavipour A, Dastani M, Abdollahi A, Karamroudi A. Repair of atrial septal defect through a right anterolateral thoracotomy: A cosmetic and safe approach. *J Cardiovasc Thorac Res*. 2009;1(2):29-31.
10. Praeger PI, Pooly RW, Moggio RA, Somberg ED, Sarabu M, and Reed GE. Simplified method for reoperation on mitral valve. *Ann Thorac Surg*. 1989;48:825-7.

11. Chitwood WR, Elbeery JR, Moran JF. Minimally invasive mitral valve repair using transthoracic aortic occlusion. *Ann Thorac Surg.* 1997;63:1477-9.
12. Grossi EA, Lapietra A, Ribakove GH, Delianides J, Esposito R, Culliford AT, et al. Minimally invasive versus sternotomy approaches for mitral reconstruction: comparison of intermediate term results. *J Thorac Cardiovasc Surg.* 2001;121:708-13.
13. Laks H, Hammond GL. A cosmetically acceptable incision for the median sternotomy. *J Thorac Cardiovasc Surg.* 1980;79:146-9.
14. Brutel de La Riviere A, Brom GHM, Brom AG. Horizontal submammary skin incision for median sternotomy. *Ann Thorac Surg.* 1981;32:101-4.
15. Bedard P, Keon WJ, Brais M, Goldstein W. Submammary skin incision as a cosmetic approach to median sternotomy. *The Annals of Thoracic Surgery.* 1986;41(3):339-41.
16. Navia JL, Cosgrove DM. Minimally invasive mitral valve operations. *Ann Thorac Surg.* 1996;62:1542-4.
17. Mohr FW, Falk V, Diegeler A, Walther T, Van Son JA, Autschbach R. Minimally invasive port-access mitral valve surgery. *J Thorac Cardiovasc Surg.* 1998;115:567-76.
18. Richard A Hopkins, Arthur A, Bryan Buchholz, Kathleen Guarino, and Merry Meyers. Surgical patch closure of ASD defect. *Ann Thoracic Surgery.* 2004;77:2144-50.
19. Loulmet DE, Carpentier A, Cho PW, Berribi A, d'Attellis N, Austin CB, et al. Less invasive techniques for mitral valve surgery. *J Thorac Cardiovasc Surg.* 1998;115:772-9.
20. Cremer JT, Boning A, Ansaar MB, Kim PY, Pethig K, Harringer W, et al. Different approaches for minimally invasive closure of atrial septal defects. *Ann Thorac Surg.* 1999;67:1648-52.
21. Ramsankar P, Sadanandan R, Abdul Rashid MH, Nampooththiri MNY, Dinakaran KG, Nair PB. Right postero-lateral thoracotomy for atrial septal defect closure; a comparative analysis with median sternotomy. *IJTCVS.* 2005;21:24-8.
22. Tribble CG, Nolan SP, Kron IL. Anterolateral thoracotomy as an alternative to repeat median sternotomy for replacement of mitral valve. *Ann Thorac Surg.* 1995;59:255-6.
23. Shivaprakasha K, Murthy KS, Coelho R, Agarwal R, Rao SG, Planche C, et al. Role of limited posterior thoracotomy for open heart surgery in current era. *Ann Thoracic Surg.* 1999;68:2310-3.

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