Comparison of Early Results of Limited Thoracotomy Versus Complete Sternotomy in Atrial Septal Defect Closure

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Abstract

Background- Atrial septal defect (ASD) closure by surgery is a standard method with low mortality and complication rate. In recent years, there is increasing use of minimally invasive methods including interventional and limited thoracotomy. The aim of this study is comparison of post-surgical results in two groups who underwent ASD surgery by sternotomy and thoracotomy methods.

Method- This retrospective study was performed in Shahid Madani Heart Hospital from 1998-2003 in 73 patients who underwent ASD surgery. Collecting data has been performed through filling a questionnaire. The statistical analysis is based on the SPSS software and has been done through descriptive statistical method.

Result- Group I (thoracotomy) included 38 patients with mean age of 23.84±3.2 years and group II (complete sternotomy) included 35 patients with mean age of 21.82±2.3 years. The results were nearly the same in both groups except for longer operation time (P=0.01) and shorter hospitalization period (P=0.01) in group I.

Conclusion- Regarding lower injury by surgery and better cosmetic results, ASD repair by thoracotomy can be a suitable method. In this study, the obtained results with respect to available equipment in hospital were acceptable ***(Iranian Heart Journal 2006; 7 (2):19-24)***.

Key words: atrial septal defect ■ thoracotomy ■ sternotom

Atrial septal defects (ASD) are classified according to their position on the inter-atrial septum. Ostium secundum is located in region of the fossa ovalis, ostium primum in the inferior portion of the inter- atrial septum and sinus septum, and sinus venosus type in the superior portion of the septum near the junction of superior vena cava and right atrium.

Ostium primum is seen often with other developmental defects of endocardial cushion such as mitral valve cleft or interventricular septal defect.

Sinus venosus defect also is associated with partially abnormal pulmonary venous connection.

In this abnormality, a pulmonary vein enters the right atrium or vena cava instead of left atrium, causing increase in right to left shunt.

In most inter-atrial defects, the pressures in the two atria are equal; and the severity of shunt depends on the relative compliance of the right ventricle and pulmonary arteries in comparison with the left ventricle and systemic arteries, rather than the pressure difference between the atria.

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Pulmonary vascular resistance and pulmonary arterial pressure cause pulmonary hypertension and right-to-left shunt (Eisenmenger's syndrome).

Atrial septal defect may be missed in childhood because of absence or paucity of clinical symptoms, and an ejection murmur due to increase in blood flow across pulmonary valve may be considered as a functional murmur. It is expected that these persons reach adolescence, however their life span is shorter than normal patients. Their death is usually due to heart failure and some of them have pulmonary hypertension at a juvenile age. Overall, atrial tachycardia is frequent in patients older than 40 years old, in addition to findings related to congestive heart failure. This defect should be repaired in all patients surgically.[1]

Nearly all patients tend to have surgery with smaller incisions so that there is no disadvantage regarding operation quality and safety. Although operation time in sternotomy group was less than that in patients underwent limited thoracotomy, it should be considered that we may spend further time for non-invasive or less invasive procedures but, in turn, the better results with less operative trauma to patient leads to earlier discharge and recovery, to resume her/his daily activities. It must be mentioned that currently ASD closure by surgery is safe and more effective than non-surgical (interventional) modalities.[1] Median sternotomy is the standard method in surgery of intracardiac congenital lesions, but it leaves a bad scar at the incision site and its probable complications may cause problems for the patient. Cosmetically, thoracotomy incision in females is preferred.

Currently closures of interatrial defect (ASD) is performed also by endoscopy and videoscopy and extracorporeal blood circulation through femur and femur to right atrium.[2]

The advantages of minimally invasive surgical methods include less pain, minimal skin incision, acceleration of recovery and resumption of activities and shortening of hospitalization period and stay in ICU.[2] The aim of this study is comparison of postoperative results in two groups of patients who underwent ASD closure surgery by two methods of sternotomy or thoracotomy in our department.

Methods

This is a retrospective study in which the records of 73 patients who underwent surgery for closure of ASD by two methods of sternotomy and thoracotomy from 1998 to 2003, were assessed. The information was collected by questionnaire including pre, post and perioperative data and was analyzed by statistical tests of fisher and Mann-Whitney and P values less than 0.05 were considered significant. In this study, the patients were classified as group I (thoracotomy) and group II (sternotomy). There were neither urgent operations nor aortic lesions and coronary vascular disease. The patients having atrial septal defect, partial or complete anomalous connection of pulmonary veins, partial or complete atrioventricular canal, and mitral, tricuspid or pulmonary lesions, were evaluated in this study. The excluded patients included patients with ASD associated with cardiac lesions requiring other urgent surgery in addition to ASD surgery, and patients having aortic valve and coronary artery diseases. The surgery method was selected by surgeon suggestion and patient consent, especially in females.

Results

In this study the records of 73 patients were assessed. Table I shows preoperative diagnosis of patients according to the echocardiography and angiography.

Table I. Frequency of ASD and associated lesions in two groups of patients.

Variable	Thoracotomy group	Sternotomy group
ASD (Ostium primum)	1	0
ASD(Ostium primum) and MR and TR	0	1
ASD (Ostium secundum)	30	26
ASD(Ostium secundum) and MR	0	1
ASD (Ostium secundum) and MS	0	1
ASD (Ostium secundum)and partial Abnormality of pulmonary vein attachment	2	0
ASD (Ostium secundum) and PDA	0	2
ASD(Ostium secundum) and PS	1	0
ASD (Sinus venosus)	1	2
ASD with total anomalous pulmonary venous connection	0	1
Complete atrioventricular canal	3	0
Partial atrioventricular canal	0	1
Summation	38	35

ASD: Atrial Septal Defect; **MR:** Mitral regurgitation, **TR:** Tricuspid regurgitation, **MS:** Mitral stenosis,
PDA: Patent ductus arteriosus, **PS:** Pulmonary stenosis.

Table II shows the performed surgery methods. The most frequent repaired lesions were ostium secundum and patent ductus arteriosus.

The average blood transfused in group I and group II patients was 323.63 ml and 342.85 ml, respectively (P=0.32). The average time of stay in ICU was 2.28 days and 2.48 days in group I and group II patients, respectively (P=0.136).

Table II. Frequency of surgery methods performed in patients.

Method	Thoracotomy group	Sternotomy group
ASD repair with valved perforated patch	0	1
ASD repair with pulmonary commissurotomy	0	2
ASD repair and pulmonary commissurotomy and partial venous anomaly (PAPVC)	0	1
ASD (Ostium secundum repair)	34	28
ASD repair, Mitral repair	0	1
ASD repair, Mitral repair , Tricuspid repair	2	1
ASD repair, Mitral annulus repair	1	0
ASD repair, PAPVC repair	0	1
ASD repair, Mitral annulus repair with ring	1	0
Summation	38	35

There was no significant difference regarding need for transfusion, mortality, need for reoperation and complications between the two groups. Hospitalization time was 10.8 days in group I and 12.79 days in group II, with a significant difference (P=0.01).

The duration of surgery was 4.33 hours and 3.43 hours in group I and group II, respectively (P=0.000). The duration of mechanical ventilation was 9.14 hrs in group I and 12.06 hrs in group II (P=0.12). There was no significant difference regarding the amount of bleeding between the two groups. Table III shows the results of the operation in both groups.

Table III. Results ASD repair and associated lesions in thoracotomy (group I) and sternotomy (group II).

Variable	Number		Average		Standard deviation		Error deviation (average)		P value
	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II	
Age (Year)	38	35	32.84	21.82	12.28	16.39	1.99	2.77	0.359
Body surface (m2)	-	-	1.41	1.22	0.35	0.47	0.05	0.08	0.075
EF (%)	-	-	59.78	61.07	10.94	9.49	1.77	1.6	0.684
Operation time (hrs)	-	-	4.33	3.43	0.88	1.18	0.14	0.19	0.000
Aorta clamping time (min)	34	35	32.35	35.88	20.44	30.17	3.50	5.09	0.414
EC (Pump)(min)	38	35	65.68	69.48	27.66	48.21	4.48	8.14	0.279
Mechanical Ventilation (hrs)	37	34	9.14	12.06	10.30	10.69	1.69	1.83	0.128
Staying in ICU (day)	37	34	2.28	2.48	1.42	1.07	0.23	0.18	0.136
Hospitalization time (day)	36	34	10.08	12.79	4.19	6.36	0.69	1.09	0.01
Blood transfusion (ml)	22	21	323.63	342.85	142.78	266.12	30.44	58.7	0.380
Plasma transfusion(ml)	27	36	527.77	604.23	384.89	526.52	74.07	103.25	0.572
First postoperative day drainage (ml)	36	34	264.72	325	230.21	298.88	38.36	51.25	0.557
Second postoperative day drainage (ml)	36	34	205.13	123.67	267.44	127.49	61.24	21.86	0.427
Total postoperative drainage (ml)	36	34	469.86	448.67	437.2	379.83	72.86	65.14	0.791
Mortality (number)	38	35	2	1	-	-	-	-	0.531
Reoperation	38	35	1	-	-	-	-	-	0.732
Complications	38	35	9	10	-	-	-	-	0.417

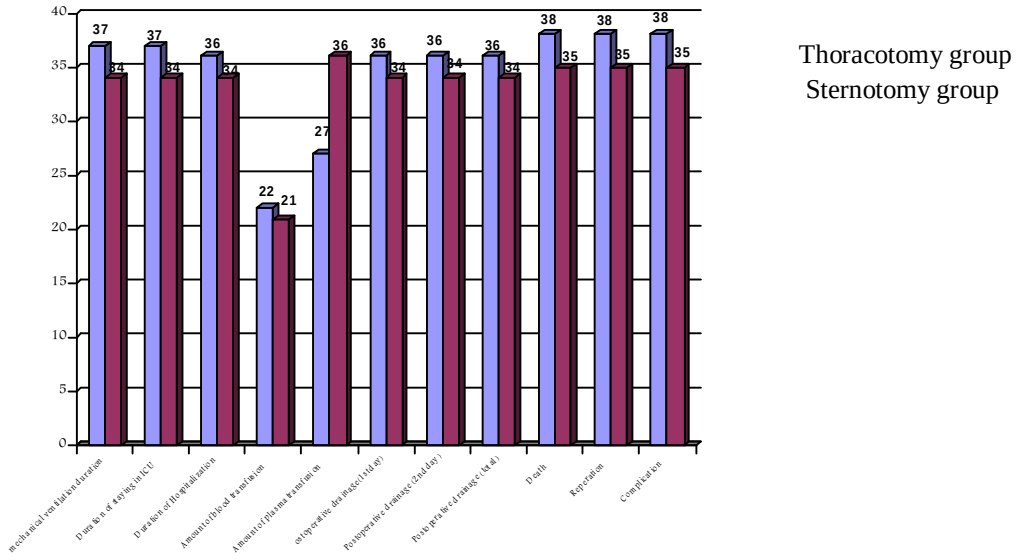

Fig. 1. Post-operative findings in both groups of patients with ASD operated by limited thoracotomy and median sternotomy.

Discussion

Although median sternotomy is the gold standard incision for repair of congenital heart lesions, large incisions, postoperative pain, disadvantages due to cosmetic reasons and possibility of complications resulting from sternotomy such as sternal dehiscence, osteomyelitis and mediastinitis implicate that this procedure may be substituted with less invasive procedures such as minimally invasive thoracotomy with videoscopy or moderate or more extended thoracotomies with direct access and surgical repair with direct sutures.[2]

The major advantage of less invasive procedures is avoidance of complete sternotomy, resulting to less postoperative infection such as mediastinitis and postoperative pain due to less musculoskeletal injury and less manipulation.

Prior experiences of surgeons suggest also that less invasive surgeries of thorax and heart are safe with minimal postoperative pain, earlier return to activity, excellent results obtained from repair regarding cosmetic aspects, less hospitalization period and consequently less costs for patients.[2]

Regarding the number of operated patients, there were low rates of complications, including 2 deaths in the less invasive group and 1 case in the median sternotomy group, and also reoperation with repeat repair by prosthetic ring, but overall there was no significant difference in mortality and morbidity between the two groups; the cause of death in the mentioned cases was not the surgery method but was often low cardiac output and intolerance of discontinuance of extracorporeal circulation.

In less invasive surgeries, in order to prevent reoperation, we can routinely use transesophageal echocardiography (TEE), leading to a decrease in this complication.

Although in less invasive surgeries for congenital heart disease, we can use femoral artery and vein cannulation, in surgeries for ASD by less invasive methods, cannulation of the aorta and superior and inferior vena cava is not easily possible, especially with young children with low weight (less than 15 kg) who may have femoral artery and vein with unsuitable diameters for cannulation.[2] The repair surgeries for ASD by smaller and limited incisions have had acceptable results. These incisions have been made in median and /or inferior part(s) of sternum with skin incision even smaller than sternal incision; and it is possible to extend the sternal incision through release of subcutaneous tissue.

In this method it is also possible to cannulate the superior and inferior vena cava via the right atrium.[3] Although sufficient myocardial protection has been achieved by continuous cardiac perfusion without clamping of the ascending aorta in some studies, stopping the heart by cold cardioplegia is the standard protection protocol for the myocardium.[2] In nearly all of our studied patients, the choice method for protection of the myocardium was clamping of the ascending aorta and injection of a cardioplegic agent into the aortic root. In less invasive cardiac operations such as ASD repair, prevention from air embolism is one of the most important problems that should be considered during operation, especially in discontinuation of the pump. Initially, the air must be emptied completely from cardiac chambers and even before initiation of heart beat, the absence of air in cardiac cavities can be documented by transesophageal echocardiography.

In conclusion, repair of ASD and associated lesions such as ostium primum and sinus venosus defects may be performed by less invasive methods, but it is necessary to place defibrillator pads in a suitable location before preparing the patient and to place the TEE probe for transesophageal echocardiography during operation for assessment of valvular function, adequacy of repair and residual air within cardiac chambers.

Various minimally invasive methods are present for rapid access to operation site in ASD repair surgery that are used depending on ASD type and associated lesions, patient's

tendency, surgeon's experience and accessibility of equipment. However, regardless of interventional methods with their specific criteria, it seems that right limited anterior thoracotomy is a suitable alternative method.[4] Although there was no apparent advantage of the less invasive method in our patients, with regard to the available equipments in this center we obtained acceptable results in comparison with conventional methods. Other surgeons encountered less mortality and morbidity and acceptable cosmetic results in their experiences with this method.[5]

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