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Right Anterolateral Minithoracotomy Versus Median Sternotomy in Atrial Septal Defects Closure

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ABSTRACT

Background: Over the years, surgeons have used a midline sternotomy to repair atrial septal defects (ASD) with good long-term outcomes but unsatisfactory cosmosis.Because of this, less intrusive surgical procedures are employed to lessen surgical trauma and improve the final cosmetic outcome.

Aim of the study: to assess ASDs repair using right-anterolateral minithoracotomy (RALT) versus median sternotomy in terms of surgical outcomes.

Patients and Methods: Our study was prospective, comparative, non-randomized ,non-blinded study that carried out at our institution between June 2016 and October 2018. It included forty surgical candidates who had isolated ostium secondum ASDs; patients were allocated to either group I (RALT group) (n=20),or group II (conventional sternotomy) (n=20).

Results: before surgeries, demographic and echocardiographic data were comparable in both groups except for more female patients(80%) in group I(p-value=0.022) and more patients with low body surface area in group II(p-value=0.002).Group II had considerably shorter total bypass time than group I(p-value=0.004).After surgeries, data were identical in both groups regarding ICU and total hospital stay, chest tube drainage,and amount of blood transfusion.However,group I had significantly shorter mechanical ventilation time(p-value=0.002) and smaller length of wound (p <0.001).Wound infection rate was substantially higher in sternotomy group(p-value=0.035).Patient satisfaction was higher in minithoracotomy group(90%) than in sternotomy group(60%).No cases required conversion to sternotomy in group I. Neither residual defects nor mortality were encountered in both groups.

Conclusion: Right anterolateral minithoracotomy approach is safe, effective,cosmetic, less traumatic, and saving resources.

Keywords: *ASD; Atrial septal defects; RALT;Median sternotomy .*

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INTRODUCTION

ASD is a prevalent congenital heart condition which comprise approximately 35% of all adult congenital cardiac disorders; it impacts one out of every 1500 births.[1] Even if there are no symptoms, repairing moderate to large ASDs is advised. These suggestions are meant to reduce the risk of adult onset pulmonary vascular obstructive disease, supraventricular arrhythmias, and aging-related symptoms.[2] Repairing secundum ASDs can be performed surgically or using percutaneous devices. However, surgical repair is the only option for sinus venosus,coronary sinus,and primum ASDs.[3] Although midline sternotomy has been employed efficiently in repairing ASD for years, it has been associated with poor cosmetic image.[4] Minimally invasive surgical techniques as RALT with sub mammary incision have been developed for ASDs repair to minimize surgical trauma and for better cosmetic outcome.[5] These new techniques have the advantages of better cosmesis, reduced post-surgical pain, hospital stay, and sooner return to regular activities.[6] This study to assess ASDs repair using RALT versus median sternotomy in terms of surgical outcomes.

PATIENTS AND METHODS

This study was prospective, non-randomized, comparative, on-blinded study.It was carried out in Alhussien University Hospital after getting approval of the Ethics Board of Al-Azhar University between June 2016 and October 2018.It included forty patients diagnosed with isolated ostium secondum ASDs who were candidates for surgical correction. We allocated participants into two groups:Group I (n = 20) had RALT whereas group II (n = 20) had standard sternotomy.Prior to surgery, each patient (or guardian) signed an informed consent form after being fully briefed about the two options. Only candidates with isolated ostium secondum ASD met the inclusion criteria. Patients with coronary artery disease, valvular heart disease, complex CHDs, abnormalities in systemic venous drainage, and anomalous pulmonary venous drainage were exempted from the study.In addition,obese patients and children with low body surface area (age< 2 years & body weight <6 Kg)were excluded in RALT group.All our patients were fully assessed by history taking, clinical examination, laboratory work up,chest X ray,electrocardiography,and echocardiography describing detailed cardiac anatomy and pathology in addition to coronary angiography for patients above the age of 40. Intraoperative variables were assessed including total operation time,total bypass time,cross clamp time and intraoperative complications. Postoperative data were collected which comprised mechanical ventilation time, blood transfusion amount,wound length, ICU stay,chest tube drainage, average hospital stay,and post-surgical complications that comprise hemorrhage,re-exploration,death,shunt remnants(echocardiographical follow-up before discharge and after one month), local infection, chest wall or breast deformity and right shoulder mobility restriction in groupI,and patient satisfaction about cosmotic image.

Operative procedure;

In group I, after full anesthetic state was obtained with a standard cuffed single lumen endotracheal tube, all patients were put in a 45° right-side up supine posture, with arms alongside the trunk. Following draping, incising the sub-mammary area was estimated with eight to ten cm in length. Then, both breast and pectoralis majorwere dissected from the chest wall. A fourth intercostal space was used to access the right hemi-thorax after transient lung deflation. We considered preservation of internal thoracic vessels and rib periosteum in all participants. The right lung was preserved using wet laparotomy cushion. The thymic tissues were then dissected, retaining the phrenic nerve. The pericardium was opened and harvested in part; traction sutures were utilised to secure it on the chest wall. During cardiopulmonary bypass (CPB), heparin (300 U/Kg) was administered to keep the activated clotting time (ACT) above 400 seconds. Aortic root shown after displacement of right atrial appendage. The aortic root, superior and inferior vena cava were cannulated with purse string 4-0 polyprolene sutures. After establishing the CPB circuit, we halted mechanical breathing, snared both caval cannulas with nilon tape, and lowered the temperature to 35-36 degrees. After opening the right atrium, the ASD, four pulmonary veins, tricuspid and mitral valves, and coronary sinus were inspected for any concurrent abnormalities. To repair all ASDs in group I, autologous untreated pericardial patch by continuous (4-0 polypropylene) sutures were used. This was done on a fibrillating heart without a cross clamp. During the surgery, blood was retained in the left atrium. The fibrillator's electrodes were located on the epicardium. After de-airing the heart and removing the fibrillator, all participants spontaneously restored sinus rhythm.On minimal doses of vasopressors without intropic support, gradual weaning of CPB was achieved with sustained hemodynamics. Decannulation followed by heparin inhibition by protamine sulphate (1mg/100 IU heparin), good hemostasis, application of pacemaker wire ,and thoracotomy wound closure over one pleural chest tube was done.

In group II,median sternotomy approach was used for ASD repair with use of aortic cross clamping and antegrade cold crystalloid cardioplegia.All cases were repaired using autologous untreated pericardial patch by continuous (4-0 polypropylene) sutures.

Statistical analysis:

IBM Statistical Package for the Social Sciences (SPSS) software (SPSS Inc., Chicago, IL, USA) was employed to analyze statistics.Analysis of categorical variables was done using Chi-square test and/or Fisher exact test; on the other hand,analysis of continuous ones was achieved using non-paired t-test presented as mean ± SD (standard deviation). The 95% CI was utilized. A statistically significant P-value was<0.05percent.

RESULTS

According to demographic data, differences of gender and body surface area were statistically significant between both groups with p-value 0.022 , 0.002 respectively while no significant difference regarding age with p-value 0.151(Table 1).

In terms of findings in echocardiography, the two groups showed no significant difference.These findings included defect size,pulmonary artery pressure(PAP),degree of tricuspid regurgitation(TR),and ejection fraction(EF)(p-value 0.718,0.113,0.598,0.292respectively) (Table 2).

Intraoperative data indicated that group II had a 31.00 minutes mean aortic cross clamp time and group I had a 35.00 minutes mean fibrillatory time.Total bypass time was statistically different between the two groups (p-value 0.004), while total operation time was not (p-value 0.320). (Table 3).

Regarding postoperative data, the statistical analysis showed that mechanical ventilation time and wound length differed significantly between both groups with p-value 0.002,<0.001 respectively while no significant difference was observed regarding total chest tube drainage,transfusion of the blood,total ICU stay,and total hospitalization period with p-value 0.271,0.649,0.574,0.754 respectively (Table 4).

Wound infection rate differed considerably between both groups (p-value 0.035) while there was no marked difference regarding bleeding with p-value 0. 311. No patients required re-exploration in both groups. No mortality was encountered in any of both groups. Echocardiography, conducted for follow-up, on discharge and a month later showed no residual shunts in both groups. Furthermore, patient satisfaction in RALT group was greater than in sternotomy group (Table 5).

	group I (n=20)	group II (n=20)	P-value
Age Mean ±SD (year)	25.25±8.67	19.55±18.01	0.151
Gender male(%) Female(%)	 4 (20%) 16 (80%)	 11 (55%) 9 (45%)	 0.022
Body weight Mean ±SD (kg)	66.45 ±13.53	45.60±36.05	0.020
Body surface area Mean ±SD (m²)	1.7±0.17	1.2±0.61	0.002

Table 1: Comparison between the demographic data in both groups.

	group I (n=20)	group II (n=20)	P-value
Defect size mean ±SD (cm)	2.09±0.640	2.08± 0.435	0.718
PAP mean ±SD (mmgh)	37.75±6.17	34.45±6.668	0.113
TR Mild Mild to moderate Moderate	 19 (95%) 1 (5%) 0 (0%)	 18 (90%) 1 (5%) 1 (5%)	 0.598
EF mean ±SD (%)	60.50± 3.59 %	62.25± 6.38 %	0.292

Table 2: Comparison between the echocardiographic data in both groups.

	group I (n=20)	group II (n=20)	P-value
Fibrillatory time(min) Mean±SD	35.00±5.90		
Aortic cross clamp time (min) Mean±SD		31.00±5.03	
Total bypass time (min) Mean±SD	57.25±6.97	48.50±10.77	0.004
Total operation time(hour) Mean±SD	3.30±0.30	3.43±0.47	0.320

Table 3: Comparison between the operative data in both groups.

	group I (n=20)	group II (n=20)	P-value
Mechanical ventilation time mean ±SD (hour)	4.85±2.03	6.85±1.76	0.002
Total chest tube drainage mean ±SD (ml)	297.5±573.65	152.5±92.44	0.271
Amount of blood transfusion mean ±SD (ml)	1075±244.68	1027.5±393.86	0.649
Total ICU stay mean ±SD (day)	2.05±0.22	2.00± 0.32	0.574
Total hospital stay mean ±SD (day)	6.80±2.48	7.00±1.38	0.754
Wound length mean ±SD (cm)	9.2±1.005	19.3±3.74	<0.001

Table 4: Comparison between the post-operative data in both groups.

	group I (n=20)	group II (n=20)	P-value
Bleeding	1 (5%)	0 (0%)	0.311
Re-exploration	0 (0%)	0 (0%)	-
Wound infection	0 (0%)	4 (20%)	0.035
Mortality	0 (0%)	0 (0%)	-
Residual shunt	0 (0%)	0 (0%)	-
Chest wall deformity in group I	0 (0%)	-	-
patient satisfaction	18(90%)satisfied 2(10%)unsatisfied	12(60%)satisfied 8(40%) unsatisfied	-

Table 5: Comparison between the post-operative complications in both groups.

DISCUSSION

ASD is a prevalent congenital heart condition.Because most individuals with this heart problem are ineligible for percutaneous ASD closure, surgery is advised.[7] For decades, midline sternotomy has been used to repair ASDs with minimal perioperative complications and great long-term results.[4]

To lessen surgical trauma and improve cosmetics, minimally invasive surgical approaches such as RALT have been used to repair ASD.[8] These new approaches have the advantages of better cosmosis ,less pain postoperatively,shorter hospitalization and sooner return to regular activities.[6] The right anterolateral thoracotomy has a small incision, less operational trauma, and less retro-sternal adhesion which aid for future surgical interventions. It also preserves the thoracic cage's stability and integrity despite of the reduced consumption of resources and overall expenditures. [5]

Our study included 40 patients with isolated ASDs,who underwent surgical closure, divided into the following groups:group I (n = 20) had RALT, whereas group II (n = 20) got conventional sternotomy.

In our study, the two groups showed no significant difference in terms of age with p-value (0.151) which is in the same line with other study[6] while other investigators[5&9] reported significant difference between both groups.

This study showed that more allocated females in group I (80%)which came in the same line with other studies.[9,10,11&12]

Also, both groups exhibited a statistically significant difference regarding body weight and body surface area with p-value 0.020,0.002 respectively while other investigators[5,6&10]revealed no remarkable difference between both groups.

All of the patients in our work had isolated ostium secondum ASD, and no considerable differences were detected between groups I and II regarding echocardiographic data including defect size, PAP, TR and EF with p-value 0.718, 0.113, 0.598, 0.292 respectively which in the same line with other studies.[5,6&13]

Mechanical ventilation using single lumen endotracheal tube was done in RALT group to prevent potential damage or stretch of lung, or pleural impairment as reported by other researchers.[14,15&16]On contrary,Ding et al.[17]reported that single-lung ventilation was performed using double- lumen endotracheal tube to offer better surgical field exposure.

In our study, incising in the sub-mammary area estimated with eight to ten cm in length was made through which central (Aortobicaval) cannnulation was performed that offered better field exposure and avoiding femoral cannulation and its potential problems which is in the same line with other studies.[6,10&18]On contrary,other investigators[5,11,13&17]used smaller incisions with peripheral cannulation for CPB to operate comfortably when they used small cannulas and found no major issues.

The procedure was implemented on a fibrillating heart in RALT group without the use of an aortic cross clamp maintaining continuous cardiac perfusion sufficient for myocardial protection which is in the same line with other studies[5,11&18]while in group II, myocardial protection was done through aortic cross clamping and crystalloid cardioplegic solution was infused into the root of aorta.On contrary,other investigators[6,10&17]reported that myocardial protection via aortic cross clamping and crystalloid antegrade cardioplegic solution was used in all RALT cases.

In our study, no group I patients needed modification to sternotomy incision which is in the same line with other investigators[5,9,10,11,12,13&19] while Gil-Jaurena et al.[20] reported conversion to sternotomy in one patient due to difficult defect closure via a submammary incision. Furthermore, other investigators[21&22]reported conversion to sternotomy due to difficult arterial cannulation in some cases and major bleeding in others.

Autologous untreated pericardial patch (100%) was used to close the defect in all cases of both groups for a secure ASD closure as supported by other investigators[9,10,11,18&23].However, other studies[5,6,13,19&24]reported that both direct and patch closure techniques were utilized.

Statistical data showed that cardiopulmonary bypass differed significantly between RALT and sternotomy groups with p-value 0.004, with longer time in group I which in the same line with other studies[5,6,9&17]but on contrary to Palma et al.[10].However,the total operation time did not vary significantly between both groups(p0.320) which is in the same line with Doll et al.[5] while other studies[6&9]showed significant difference between both groups.

Our investigation revealed that both groups were free of intra-operative complications or mortality, which agreed with other studies[5,9,12,13&24]while other investigators[23&25]reported that the most frequent perioperative complication was atrial fibrillation in addition to two patients developed cerebral infarction.

Mechanical ventilation time was substantially smaller in group I with p-value 0.002 which is in the same line with other studies[5,10&17]but Jung&Kim study[9] showed no significant difference between both groups with p-value 0.566.

In addition, no substantial difference was detected regarding total chest tube drainage and amount of blood transfusion between both groups with p-value 0.271 , 0.649 which is in agreement with Doll et al.[5]

Similarly, the ICU stay did not exhibit significant difference with p-value 0.574 which is in the same line with Jung&Kim study[9] while other studies[5&17] reported significantly shorter ICU stay in the RALT group.

Regarding hospital length of stay, no significant difference was encountered with p-value 0.754 in the same line with Jung&Kim study[9] while other investigators[5,6,10&17]reported significantly shorter stay in RALT group.

Our investigation found a difference of statistical importance in wound length (p-value<0.001) with much shorter skin incision in the RALT group.

None of our patients in both groups required re-exploration which in the same line with other studies[6,9&24]while other investigators[12&13]reported re-exploration in some patients due to bleeding.

In our study, the data showed a statistical significant difference in terms of wound infection with p-value 0.035 between the two groups, where 4 (20%) cases in the sternotomy group had got superficial wound infection while no cases encountered in the RALT group which is in the same line with other studies[5,9,18&24]while other studies[6,13&19] reported that no wound problems were observed.

No postoperative mortality cases were encountered in any of both groups which is in the same line with other investigators.[6,11,12,13&24]However,other studies[5,9&10] reported that postoperative mortality was encountered in sternotomy group either due to sepsis or ischemic colitis.

In our work, no residual defects were reported in any case in the two groups in the postoperative and follow-up echocardiographies.This is in the same line with other studies[9,11,12,13,18,19&25]while other studies reported that some patients required reintervention due to residual defect after direct closure of the ASD[5] or due to patch dehiscence.[6] In addition,other investigators[10&24] reported non significant residual shunts in some cases in postoperative follow up.

In our study, none of our patients complained of chest wall or breast deformity or any considerable right shoulder movement restriction with overall good satisfaction regarding cosmotic results in the RALT group where most of the cases are females compared to less patient satisfaction in adult patients in the sternotomy group which in the same line with other investigators.[5,10,11,13,18&24]However, Dabritz et al.[12]found that three (4.8%) adult patients had breast asymmetry, whereas two (2.5%) had shoulder mobility limitation due to pain.

CONCLUSION

RALT technique for ASDs repair is safe , effective , offering better cosmosis, less traumatic, fewer wound infection rates , and offering fast recovery. It is advisable whenever possible to get better esthetic result and to save resources.

Conflict of interest : none

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