Atrial Septal Defect Ostium Secundum: A Comparative Study Between Surgical and Transcatheter Management

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ABSTRACT

Background: Atrial septal defect is one of the more commonly recognized congenital cardiac anomalies presenting in adulthood. Atrial septal defect is characterized by a defect in the interatrial septum allowing pulmonary venous return from the left atrium to pass directly to the right atrium .Atrial septal defects can be closed either by surgical or transcatheter closure.

Objectives: To provide a comparison between the surgical and transcatheter closure of atrial septal defects and study accuracy of transesophageal echocardiography in demonstrating atrial septal defect size and morphology.

Methods: Sixty patients their age ranged from one years to 46 years, median age was 25.33 years, 30 patients underwent surgical repair of atrial septal defects and 30 patients underwent transcatheter closure of atrial septal defects. Their data were collected and retrospective studied from 1/6/2013 to 1/6/2014 at Ibn- Alnafees teaching hospital for cardiothoracic surgery in Baghdad, Iraq. A comparison create between two groups according to age, sex, pre closure pulmonary hypertension, size of atrial septal defects, present of multiple atrial septal defects, procedure time, hospital stay time and post closure morbidity and mortality. Transesophageal echocardiograph findings were evaluated in relation of operative observations.

Results: There was no death in two groups, mortality was 0% in both groups. Residual shunt was not observed in any group. Failure rate of closure was much higher in transcatheter group than surgical group, 13.33% versus 0%. Cardiac tamponade was seen in one patient in transcatheter group 3.33% versus 0% in surgical group.

Conclusions: Surgical closure is the standard option for management of atrial septal defects. Transcatheter closure is limited to isolated atrial septal defects secundum with size less than 20 mm and a rim of 5 mm and over, there is no role of transcatheter closure in ostium primum and sinus venosus defects.

Keywords: Atrial septal defect, Surgical correction, Transcatheter Management, Transesophageal echocardiography, Fluoroscopy.

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Atrial septal defect (ASD) is one of the more commonly recognized congenital cardiac anomalies presenting in adulthood[(1)]. ASD is characterized by a defect in the interatrial septum allowing pulmonary venous return from the left atrium to pass directly to the right atrium[(2)].

Depending on the size of the defect, size of the shunt, and associated anomalies, this can result in a spectrum of disease ranging from no significant cardiac sequel to right-sided volume overload, pulmonary arterial hypertension, and even atrial arrhythmias[(3)]. These defects were among the first congenital cardiac anomalies to be corrected by surgical treatment, the treatment of these defects was made much easier with advent of cardio pulmonary bypass machine[(4)]. Transcatheter device closure has become the treatment of choice for

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patients with amenable ostium secundum ASD anatomy providing similar efficacy[5]. Factors that decide suitability for transcatheter closure include size of the defect and presence of adequate tissue rims around the defect. Transcatheter closure is limited to isolated atrial septal defects secundum with size less than 20 mm and a margin >5 mm[6]. Transesophageal echocardiography (TEE) provide accurate imaging of the anatomic features of the ASD which critical for case selection[7]. Transcatheter device closure significantly less invasive, it allows to avoid problems associated with open heart surgery (anesthesia ,sternotomy and cardiopulmonary bypass) and is also associated with fewer complications and shorter hospital stay, especially in older adults[8]. Nevertheless, transcatheter device closure is associated with specific complications. Device embolization is the most common complication (prevalence 0.55-0.62%), often requiring urgent surgical retrieval[9]. Another rare, but potentially fatal complication is erosion or cardiac perforation[9]. More rarely, device infection[9]. The aims of this study to provide a comparison between the surgical and transcatheter closure of atrial septal defects, to assess the accuracy of transesophageal echocardiography in demonstrating ASD size and morphology and to evaluate the experience at Ibn-Alnafees teaching hospital for cardiothoracic surgery regarding this subject in comparison with worldwide experience.

Methods

Sixty patients their age range from one years to 46 years, median age was 25.33 years, 30 patients underwent surgical repair of ASD and 30 patients underwent transcatheter closure of ASD. Their data were collected and retrospective studied from 1/6/2013 to 1/6/2014 at Ibn-Alnafees teaching hospital for cardiothoracic surgery in Baghdad, Iraq. All cases were referred from pediatric cardiology unit to cardiac surgery unit and all evaluated by pediatric cardiology preoperative and postoperative. Electrocardiography, chest x-ray and transthoracic echocardiography (TTE) applied to all patients. TEE was applied for all patients of surgical group 100% and for 14 patients in transcatheter group 46.67%. Coronary angiography was needed in one patient in surgical group to exclude coronary heart disease were him age above 40 years. The inclusion criteria for both groups consisted of the presence of an isolated secundum ASD. Excluded from the study were those who had other types of ASD (ostium primum or sinus venosus) or the presence of an additional cardiac malformation amenable only by surgical repair. Additional exclusion criteria for the percutaneous closure group were patients with multiple defects that were unsuitable by device closure or a defect too close to the superior vena cava, atrioventricular valve, coronary sinus or pulmonary veins predictable failure of interventional procedure.

All surgical procedures were done using median sternotomy, total cardiopulmonary bypass and antegrade cardioplegic. The closure of the defects was performed through right atriotomy, the method used to close the defect depended on its size and anatomical type, in 25 patients 83.34% were closed by autologous pericardial patch with prolene 4-0 suture while the rest 5 patients 16.66% underwent direct suture closure. Intraoperative TEE was not employed in any patient. Transcatheter closure was done under general anesthesia, under guide of TEE and fluoroscopy in 14 patients 46.67%, while in16 patients 53.33% was done under local anesthesia and under guide of TTE and fluoroscopy. The right femoral vein was accessed using a 7-8 Fr short sheath. Right heart catheterization was performed to ensure the presence of normal pulmonary vascular resistance. Amplatzer septal occluder system was applied to all patients in transcatheter group. All cases assessed postoperative by TTE in early post closure period and

before discharge. ASDs were categorized into three groups: small (≤ 10), medium (10-20 mm), and large (> 20 mm). A comparison create between two groups according to age, sex, pre closure pulmonary hypertension, size of ASDs, present of multiple ASDs, procedure time, hospital stay time and post closure morbidity and mortality. TEE findings were evaluated in relation of operative observations .The statistical package for social science (SPSS) program version 22 was used for authentic examination .The results were imparted by mean and standard deviation for tenacious components or with repeat and rate for total variables. Pearson's Chi square test was used for relationship and assessing association. P-values under 0.05 were idea to be quantifiably immense.

——————————Results

One to ten years was common age group in transcatheter group 36.67% versus 21-30 years which common age group in surgical group 40%, (Table 1).

All patients were symptomatic and common symptom was fatigue in transcatheter group 73.33% versus exertion dyspnea in surgical group 50%, (Table 2). Common cause of ASDs shift to surgery closure was small or no rim 43.33%. Failure trials of transcatheter closure represented 20% of causes of shift ASDs to the surgery.

TEE findings were not correlated with surgical observations in 11 patients of surgical group 36.67% most common error in TEE findings was in detect multiple ASDs 75% versus 53.85% in detect small or no rim (Table 3). Inferior rim was common deficient rim 61.53% and its detection was common TEE error in rim detection 62.5%, (Table 4).

Common cause of failure trial was attempt of transcatheter closure for large size defects 50%, (Table 5).

The common size of ASD defects which were closed by Amplatzer septal device was 10-20 mm (moderate defect size) 63.33%.Trans-catheteric closure was done under local anesthesia in 16 patients 53.33% versus it was done under general anesthesia in 14 patients 46.67%.The surgical options for ASD defects closure were direct closure in five patients 16.66% versus patches usage in 25 patients 83.33%, autologous pericardial patch was used in all patients. Common cause for usage of patches in closure of ASD defects was large ASD size 80%, (Table 6).

There was no death in the two groups, mortality was 0% in both groups. Residual shunt was not observed in any group. Failure rate of closure was much higher in transcatheter group than surgical group, 13.33% versus 0%. Cardiac tamponade was seen in one patient in transcatheter group 3.33% versus 0% in surgical group. Incidence of post closure wound infection, respiratory tract infection and tachyarrhythmia were higher in surgical group than transcatheter group 23.33% versus 0%, 13.33% versus 0% and 10% versus 6.66%, respectively. Groin hematoma was noted in 6patients in transcatheter group 20% versus 0% in surgical group. Procedure time and hospital stay time was much shorter in transcatheter group than surgical group 1.5 days versus 6.3 days and 0.98 hours versus 3.5 hours respectively. Mean ASDs size was much larger in surgical group than transcatheter group 23.33 mm versus 17.66 mm. Multiple ASDs was seen in four patients in surgical group 13.33% versus 0% in transcatheter group. Pre-closure pulmonary hypertension was founded in four patients in surgical group 13.33% versus 0% in transcatheter group. Mean age was lower in transcatheter group than surgical group 21.33 years versus 29.33 years. Female: male ratio was much higher in transcatheter group than surgical group 2.72 versus 1.72, (Table 7).

Table 1: Age and sex of patients.

Variable	transcatheter group	surgery group	Total	%	P-value
Age (years)					
1-10	11(36.67%)	1(3.33%)	12	20	0.0012
11-20	8(26.67%)	9(30%)	17	28.33	0.7718
21-30	7(23.33%)	12(40%)	19	31.67	0.1645
31-40	4(13.33%)	7(23.34%)	11	18.33	0.3173
41-50	0(0%)	1(3.33%)	1	1.67	0.3125
Total	30(100%)	30(100%)	60	100	
Gender					
Female	22(73.33%)	19(63.33%)	41	68.33	0.4065
Male	8(26.67%)	11(36.67%)	19	31.67	0.4065
Total	30(100%)	30(100%)	60	100	

Table 2: Clinical presentation in both groups.

Variable	Transcatheter group	Surgery group	Total	%	p-value
Fatigue	22(73.33%)	9(30%)	31	51.7	0.0007
Exertion dyspnea	5(16.67%)	15(50%)	20	33.3	0.0061
Tachyarrhythmia	1(3.33%)	5(16.67%)	6	10	0.0854
Repeated chest infection	2(6.67%)	1(3.33%)	3	5	0.5552
Total	30(100%)	30(100%)	60	100	

Table 3: Causes for ASDs shift to the surgery and correlation of TEE findings with surgical observations.

Causes	No.	%	TEE findings correlated with surgical observations	TEE findings not correlated with surgical observations
Small or no rim	13	43.33	6(46.15%)	7(53.85%)
Large ASD	3	10	2(66.67%)	1(33.33%)
Multiple ASDs	4	13.33	1(25%)	3(75%)
Failure trials of transcatheter closure	6	20	6 (100%)	0 (0%)
Pulmonary hypertension	4	13.33	4(100%)	0(0%)
Total	30	100	19(63.33%)	11(36.67%)

Table 4: TEE findings in correlation with surgical observations in ASDs shift to surgery as had small or no rims.

Rim type	No.	%	TEE findings correlated with surgical observations	TEE findings not correlated with surgical observations
Inferior rim	8	61.53	3(37.5%)	5(62.5%)
Superior rim	3	23.08	2(66.67%)	1(33.34%)
Posterior rim	2	15.39	1(50%)	1(50%)
Total	13	100	6(46.15%)	7(53.85%)

Table 5: Sizes and morphologies of ASDs shift to surgery as failure trials in transcatheter closure and their TEE findings in relation of surgical observations.

ASDs size and morphology	No.	%	TEE findings correlated with surgical observations	TEE findings not correlated with surgical observations
Large size ASD	3	50	3(100%)	0(0%)
Moderate size no inferior rim	2	33.33	2(100%)	0(0%)
Small no inferior rim	1	16.67	1(100%)	0(0%)
Total	6	100	6(100%)	0(0%)

Table 6: Causes of patch usage in surgical group and defects size in transcatheter group.

Size of defect in transcatheter group	No.	%
20-30mm	2	6.67
10-20mm	19	63.33
>10mm	9	30
Total	30	100
Causes of patch usage		
Large ASD size	20	80
No or small inferior rim	4	16
No or small superior rim	1	4
Total	25	100

Table 7: Comparison between transcatheter group and surgical group.

Variable	Transcatheter group	Surgery group	p-value
Mean age (years)	21.33	29.33	0.8975
Female: male ratio	2.75	1.72	0,6523
Cardiopulmonary bypass Time/Fluoroscopy Time (min)	32.3	15.89	0.3108
Hospital stay time (days)	1.5	6.3	0.0446
Procedure time (hours)	0.98	3.5	0.2996
Failure rate	13.33	0	0.9805
Mean ASDs Size(mm)	17.66	23.33	0.1016
Cardiac tamponade	1(3.33%)	0(0%)	0.3125
Wound infection	0 (0%)	7(23.33 %)	0.0048
Groin hematoma	6(20%)	0(0%)	0.0098
Present of multiple ASDs	0(0%)	4(13.33%)	0.0384
Pre closure pulmonary hypertension	0(0%)	4(13.33%)	0.0384
Respiratory tract infection	0(0%)	4(13.33%)	0.0384
Tachyarrhythmia	2(6.66%)	3(10%)	0.6383
Residual shunt	0(0%)	0(0%)	1.00
Mortality	0(0%)	0(0%)	1.00

——————————Discussion

Atrial septal defect can be closed by either surgical or transcatheter closure, the surgical closure is the standard treatment of ASD defect in any type and if it is associated with any congenital cardiac defect[10,11]. The surgical closure is associated with less than 1% mortality[12,13]. In present study, there was no death, the morality was 0% in both group which reflect safety of both mode of closure which match the result abroad. Residual shunt was not observed in any patient in both groups, which reflect efficacy of both method in closure of ASD. Failure rate was 13.33% in transcatheter group which reflect this procedure not suitable to every ASD morphology were the transcatheter closure is limited to

isolated ASD secundum with diameter less than (20 mm) and presence at Least (5 mm) rim of tissue surround the defect[6,14]. Failure rate was 0% in surgical groups were no limitation of surgical procedure for closure of ASD regarding ASD size and ASD morphology. Failure trials of transcatheter closure in our study was high in comparison with other studies abroad when a figure of (0.8%) was shown[15].

This may be due to poor patients' selection, error of TEE and low experience in this procedure in our center. In this study the post closure morbidity was higher in surgical closure than transcatheter closure were incidence of post closure wound infection, respiratory tract infection and tachyarrhythmia were higher in surgical group. But the transcatheter closure not without complication were more serious complication cardiac tamponade was noted in one patient 3.33% which necessitated urgent pericardiocenthesis and surgery. Also, groin hematoma was seen 6 patients 20% versus 0% in surgical group. Female : male ratio was much higher in transcatheter group which preferable approach in females due to lack of sternotomy scar. The major advantage of transcatheter closure is its relative non-invasive approach, reduced scarring and an easier, rapid recovery, the patients may return to work or school within 1-2 days, usually done under local anesthesia, and no need for cardiopulmonary bypass[8,16,].

In present study, procedure time and hospital stay time much lower in transcatheter group, which reflect it less invasive procedure than surgery. Sixteen patients 53.33% underwent transcatheter device under local anesthesia and under guide of TTE and fluoroscopy versus 14 patients 46.67% underwent transcatheter device under general anesthesia and under guide of TEE and fluoroscopy were the trend in our center to applied the procedure under local anesthesia in adult patient with feasible ASD morphology as assessed by TTE to get rid of general anesthesia. But usage of fluoroscopy to guide device placement is a disadvantage; however, the fluoroscopy time needed is short. Radiation time can be reduced further with increased operator experience and with the aggressive use of TEE monitoring of the procedure, fluoroscopy not needed in surgery[17].

Mean ASDs size which underwent closure by surgery was much higher than transcatheter closure were mean ASDs size was 17.66 mm in transcatheter group which reflect this procedure limited to ASDs sized >20 mm and there was no limitation of surgery regarding ASDs size. All cases which underwent closure by transcatheter closure were isolated ostium secundum, ostium primum and sinus venosus defects are not candidates for this procedure[18]. Pre closure pulmonary hypertension and multiple ASDs were founded in surgical group only which reflect that transcatheter closure of ASD was used exclusively for single defect in our center although it has been used for multiple ASDs closure abroad, and when ASD defects were associated with pulmonary hypertension the trend in our center is not to try transcatheter closure, this is not the case in many other centers worldwide[19].

TEE is essential in assessment not only of ASD size and morphology but also the relations of the defect to other cardiac structures. This seems to be particularly important in selecting patients for percutaneous ASD closure by transcatheter device placement[7,20]. Our study showed that TEE findings were not correlated with surgical observations in 11 patients of surgical group 36.67% most common error in TEE findings was in detect multiple ASDs 75% versus 62.5 % in detect inferior rim and this error percentage was much higher than that abroad were the percent of error of TEE in assessment of the ASD defects is 19.5% only as shown by study done Edinburgh, UK in 1997, this discrepancy in the results is

due to learning curve in experience in our center[21]. Range of age in our study for use of transcatheter closure of ASD is small between (3 and 36 years) where international this included between (10 days-88 years)[5,21]. Limitation of present study lack long-term outcome of both groups.

In conclusion; surgical closure is standard option for management of all type of ASDs and if they are associated with any other congenital cardiac anomalies. The transcatheter closure is limited to isolated ASD secundum with size less than 20 mm and a rim of 5 mm and over, there is no role of transcatheter closure in ostium primum and sinus venosus defects. Our experience of transcatheteric closure of ASD still away from that abroad.

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