

Comparison of Clinical Outcomes of Different Approaches of Atrial Septal Defect Closure: Our Experience

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Abstract

There is a global concern about the aesthetic implications of open surgical repair of ASD among patients and the medical community that forcing patients to seek minimally invasive techniques or transcatheter device closure. We reviewed clinical outcome of different approaches of atrial septal defect closure in fifty nine cases from November 2013 to May 2018 and divided patients into three groups-A-Conventional median sternotomy (64.4% cases). B- Minimally invasive cardiac surgery (8.47% cases). C- Percutaneous trans catheter device closure (27.11%). All patients were diagnosed (49 cases as ostium secundum, 09 case sinus venosus, 01 case ostium primum, 07 cases with associated cardiac defects) on TTE & TEE using selection criteria. Aortic cross clamp and cardiopulmonary bypass times were in group A (range of 26-42, 43-94 minutes respectively) and group B (range of 78-90, 92-135 minutes respectively). All the cases of percutaneous trans catheter device closure were performed under local anaesthesia with duration of procedure in range of 40-58 minutes. Cocoon occluder device were commonly used in 12 cases. There were no mortality and no conversions to sternotomy in group B while in group C there were one device migration & one deployment failure. ICU stay and hospital stay was shorter in group C. Surgical device retrieval of migrated device from RVOT via sternotomy approach in 6.2% case. Overall success rate in group A, B, C was 97.3%, 100%, 87.5% respectively. There were no significant cost differences in the entire group. Aesthetically group C & B was better than group A. Overall, improved aesthetic implication, reduced operative pain, and a relatively fast rehabilitation are important considerations for less invasive approaches (PTDC & MICS) of ASD closure. Conventional median sternotomy approach is gold standard if associated cardiac defects, contraindication to MICS, unsuccessful or complicated percutaneous closure of ASD.

Keywords: Minimally Invasive; Transcatheter Closure; Device; Cardiopulmonary Bypass; Device Retrieval.

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Introduction

Atrial septal defect (ASD) is the most common congenital cardiac disorder requiring intervention. Why should we care for closure of ASD to prevent Pulmonary vascular obstructive disease, arrhythmias, Symptoms later in life, myocardial functional deterioration, heart failure and paradoxical embolism? Various studies showed surgical repair of simple & complex ASD has been performed via midline sternotomy with low perioperative risks and excellent long-term outcomes. In the modern era, most patients undergoing ASD closure are often younger,

have less co morbidities and may have greater concerns about the aesthetic implications of open surgical repair. To avoid a median sternotomy and its related discomfort, we have option to choose for closure of ASD patients with a minimally invasive cardiac surgery or percutaneous device closure. Concerns remain that minimally invasive atrial septal defect (ASD) repair may compromise patient outcomes. Minimally invasive surgical approaches include partial sternotomy, right mini-thoracotomy, and totally endoscopic repair for closure of adult ASD. Transcatheter closure of ostium secundum ASD is standard practice and excellent results have been reported in literature with low early and late

complication rates but require prosthetic device implantation and lifelong antiplatelet therapy. We compared clinical outcomes of patients undergoing ASD closure via conventional median sternotomy, minimally invasive right mini-thoracotomy and transcatheter device closure.

Material Methods:

In our prospective study, the comparison of clinical outcomes of different approaches of atrial septal defect closure was done in fifty nine cases from November 2013 to May 2018 were analyzed. According to the approaches of atrial septal defect closure we divided patients into three groups-A- Conventional median sternotomy using central

cannulation (64.4% cases). B- Minimally invasive cardiac surgery using peripheral cannulation (8.47% cases) (Figure-1). C- Percutaneous trans catheter device closure (27.11%)(Figure 2). We reviewed clinical outcome of different approaches of atrial septal defect closure in terms of success rate, procedural complications, aesthetic expectations, and cost analysis. Routine blood investigations, echocardiography (transthoracic and transoesophageal TTE, TEE) and right heart catheterization were done for correct preoperative assessment of atrial septal defect to define selection criteria of different approach of closure. The Selection criteria was based on- location and size of ASD, rims around it, associated cardiac defects (Table1). The aesthetic issue of surgical procedure was also discussed.

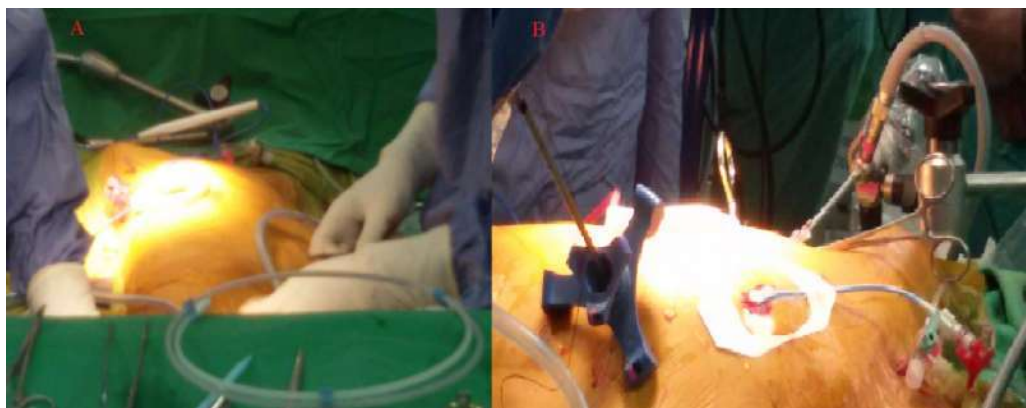


Fig. 1: MICS setup showing external defibrillator

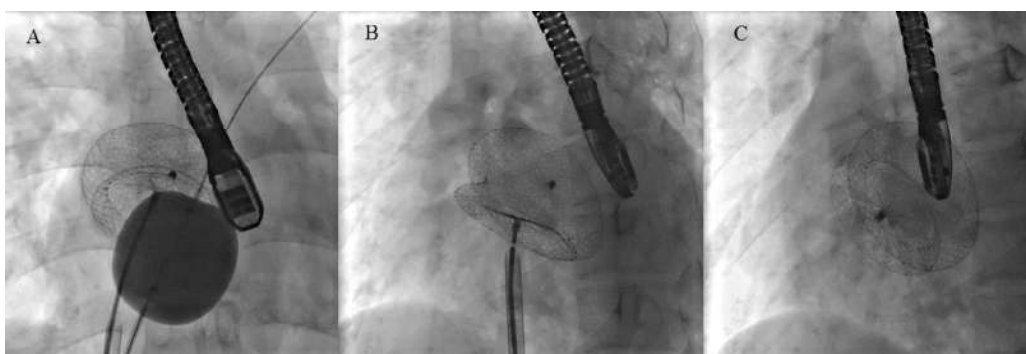


Fig. 2: Percutaneous trans catheter closure of ASD showing deployment of device

Table 1: Selection Criteria

Variables	Conventional median sternotomy	Minimally invasive cardiac surgery (MICS)	Percutaneous trans catheter device closure (PTDC)
Location of ASD	OS,SVC,IVC Type	OS,SVC Type	OS
Number of ASD	Single/multiple	Single/multiple	Single
Size of ASD	any	Any	<40 mm
Rim around ASD	Adequate/inadequate	Adequate/inadequate	>5mm on all sides
Associate cardiac defects	Yes	no	no

OS= ostium secundum, SVC=superior vena cava, IVC=inferior vena cava

Results

Out of 59 cases, 27 were males and 32 were females with age in the range of 07 to 51 years. All patients were diagnosed (49 cases as ostium secundum, 09 case sinus venosus, 01 case ostium primum, 07 cases with associated cardiac defects) on TTE & TEE using selection criteria. Conventional median sternotomy was performed in 64.4% cases, minimally invasive cardiac surgery in 8.47% cases, and percutaneous trans catheter device closure was applied in 27.11% cases. Aortic cross clamp and cardiopulmonary bypass times were in group A (range of 26-42, 43-94 minutes respectively) and group B (range of 78-90, 92-135 minutes respectively). All the cases of percutaneous trans catheter device closure were

performed under local anaesthesia with duration of procedure in range of 40-58 minutes. Cocoon occluder device were commonly used in 12 cases. There were no mortality and no conversions to sternotomy in group B while in group C there were one device migration & one deployment failure. ICU stay and hospital stay was shorter in group C. Surgical retrieval of migrated device from right ventricle outflow tract via sternotomy approach and closure of ASD was done with autologous pericardium in 6.2% case (Figure 3). Overall success rate in group A, B, C was 97.3%, 100%, 87.5% respectively. There were no significant cost differences in the entire group. Aesthetically group C & B was better than group A (Figure 4). Postoperative echocardiography showed no residual shunt.

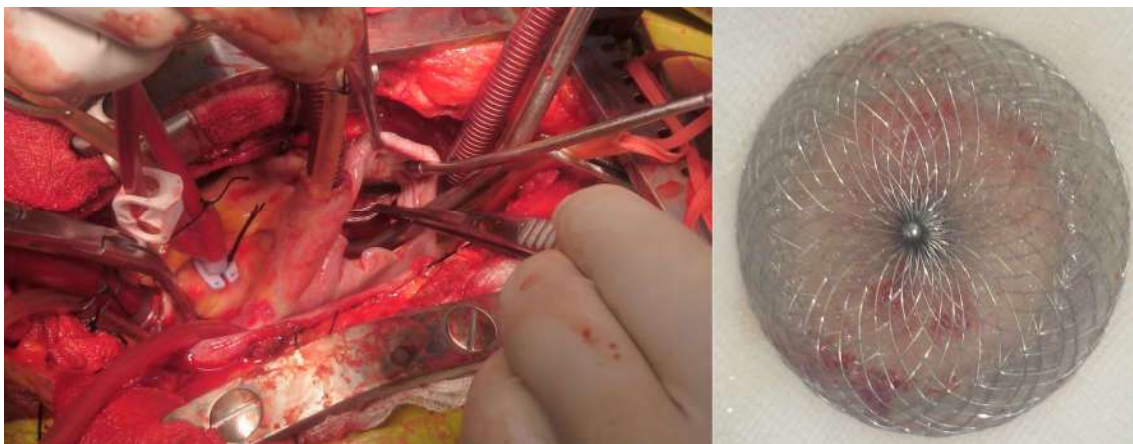


Fig. 3: Retrieval of migrated ASD device from right ventricle outflow tract via Conventional median sternotomy approach showing peridevice thrombosis

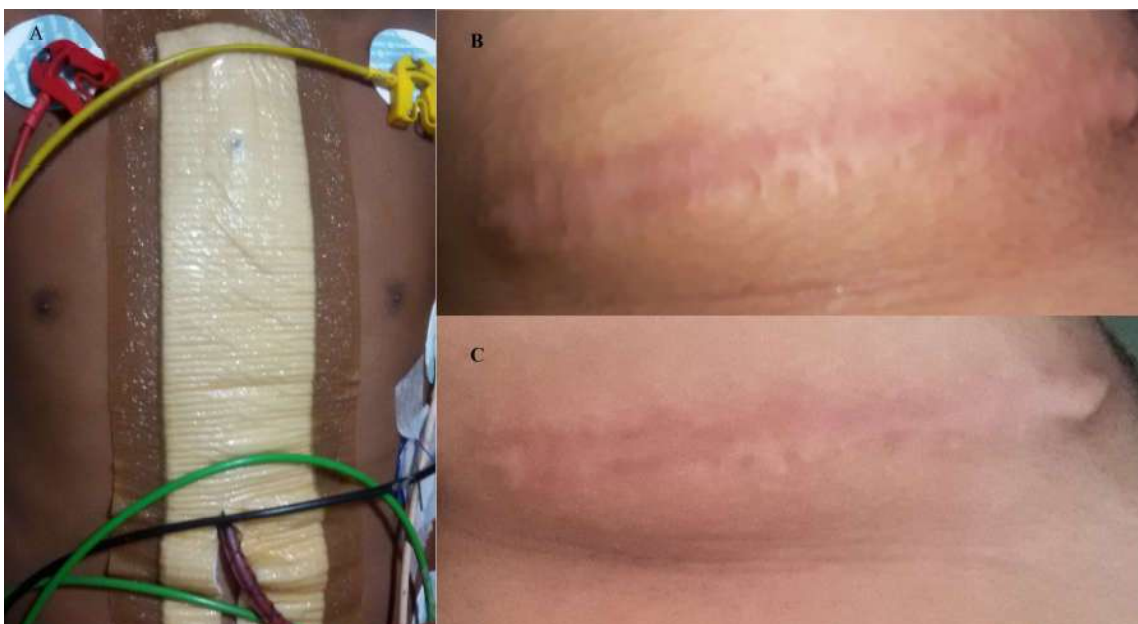


Fig. 4: Conventional median sternotomy showing usual large scar and MICS showing fine scar

Table 2: Patients profile data

Serial No.	Variables	Conventional median sternotomy (n=38)	Minimally invasive cardiac surgery (n=5)	Percutaneous trans catheter device closure (n=16)
1.	Age (in years)	07-51	07-36	12-50
2.	Sex (%)			
	-male	50	40	37.5
	-female	50	60	62.5
3.	Type of ASD (%)			
	-ostium secundum	76.3	80	100
	-Sinus venosus	20.1	20	00
	- ostium secundum	2.63	00	00
4.	No. Of ASD (%)			
	- single	89.4	100	100
	-multiple	10.6	00	00
5.	Associated cardiac defects	07 (03 MV,03TR 01 AV canal)	00	00
6.	Anaesthesia	general	general	local
7.	Procedure time (in minutes)	85-138	128-162	40-58
8.	CPB time (in minutes)	43-94	92-135	00
9.	Aortic cross clamp time (in minutes)	26-62	78-90	00
10.	Device used			
	- cocoon	00	00	12
	-amplazter	00	00	03
11.	Size of device (range in mm)	00	00	14-40
12.	ICU stay (in days)	03-04	02-03	01-02
13.	Hospital stay (in days)	06-09	05-07	02-03
14.	Success rate (%)	97.3	100	87.5
15.	Aesthetic value	Usual large scar	Minimal scar mark	No scar mark
16.	Complications (%)	Neurological 5.2	00	Device migration-6.2 Deployment failure-6.2
17.	Management of complication (%)	Conservative 2.63	00	Device retrieval-6.2
18.	Mortality (%)	2.63	00	00
19.	Cost (range in INR)	80000-100000	100000-125000	900000-110000

MV= mitral valve disease, TV= tricuspid valve disease, AV= atrioventricular canal defect, CPB=cardiopulmonary bypass, ICU=intensive care unit

Discussion

The gold standard surgical ASD closure provides excellent results with a very low operative mortality and morbidity. However, cardiac surgery and medicine as a whole are strongly evolving in a minimally invasive direction. As an alternative to standard median sternotomy, several groups have reported their experience with right anterolateral thoracotomy as the surgical approach. The contraindications of MICS includes severe peripheral vascular disease, severe right pleural adhesions, presence of chest deformities, aortic valve insufficiency, and aneurysm of ascending aorta young children (because of smaller diameter of femoral artery for peripheral arterial cannula). Moreover, the advent of percutaneous transcatheter closing devices has substantially shifted the treatment of ASDs (mainly secundum type) from the surgeon towards the cardiologist. In very large secundum-type ASD, a defect with an insufficient

rim to anchor the device, and a fenestrated or aneurysmal interatrial septum have also proved to be less optimal indications for transcatheter closure [1]. Hence, open surgical repair certainly still has a place in the treatment of ASD closure, even in the secundum type [2]. Chu et al. [3] retrospectively reviewed 73 patients of repair of secundum and sinus venosus ASD with PAPVC and find that repair can be performed safely via minithoracotomy with similarly excellent outcomes as sternotomy. He noticed that less invasive techniques allow for a more cosmetically appealing incision without compromising patient outcomes. Chang et al. [4] did surgical closure of isolated ASD via Minimally invasive cardiac surgery (MICS) in 60 patients and via median sternotomy (MS) in 58 patients. He find no difference between these two groups in gender, age, body weight, ratio of systemic to pulmonary blood flow, and pulmonary arterial pressure. The duration of cardiopulmonary bypass was more in the MICS group than in the MS group [27 to 126

min (42 ± 12) and 14 to 158 min (27 ± 11), respectively. The other parameters like length of incision, incidence of temporary pacemaker wire insertion rate, duration of endotracheal intubation, timing of oral intake, postoperative day drainage amount, incidence of parenteral analgesic injection, postoperative length of stay, and return to normal activity interval were significant shorter and lower in patients of the MICS group than in those of the MS group. Follow-up was without late complications and residual shunt. They suggest that MICS is a good option for surgical closure of ASD. Casselmen et al. [5] studied in 74 patients, who underwent an endoscopic ASD closure and they find that endoscopic ASD closure can be safely done with a high degree of patient satisfaction and where percutaneous treatment is not indicated or has failed. Chessa et al. [1] studied in 417 patients who underwent transcatheter occlusion of secundum type ASD. Ten patients underwent elective surgical repair because of device malposition (three patients) or device embolization (seven patients). Devices were retrieved using a gooseneck snare and/or a basket; 11 patients experienced arrhythmic problems. Two patients had late complications: peripheral embolization in the left leg one year after implantation of an Amplatzer device and sudden death 1.5 year later. In his series of patients with ASD by transcatheter occlusion showed that the procedure was safe and effective in the vast majority of cases. To further reduce the complications rate, the criteria of device selection according to ASD morphology and some technical tips during implantation are discussed. The reported success rate of devices in closing ASD is as high as 98% [6]. Device embolization occurs in about 0.55% of cases; regardless of ASD size, device size, or the physician's expertise [1]. Balbi M et al [7]. reported that percutaneous retrieval was successful in 50% of the cases of ASD device embolization. The common reasons for the device embolization immediately after the procedure are undersized ASD device, small left atrium to accommodate the device, insufficient or floppy rim, and operator-related technical issues [8]. Ufuk Yetkin et al. [9] studied in 6 patients underwent emergency operations due to device emboli secondary to migration of the transcatheter atrial septal defect occluder and concluded that unfavourable anatomy, device diameter and over sizing are major issues in device migration. S. Das et al. [10] was found that application of strict criteria for selecting ASD device closure by comprehensive evaluation and

careful monitoring for the possible embolization of device are mandatory. They also noticed that the anaesthesiologists has dual role in such emergency situations by not only play greater role in administering anaesthesia but also pivotal in stabilizing vital parameters in the moment of hypoxia and hemodynamic instability due to device embolization.

In contrary to above literature, we find that correct preoperative diagnosis of ASD by using TTE & TEE is must to choose the different approaches for closure with good results. Right heart catheterization is required in PTDC approach to find out suitability. Aesthetic expectation of patients is now a day is very high and more inclined towards lesser invasive approaches in suitable cases. Surgical retrieval of migrated device from right ventricle outflow tract via sternotomy approach and closure of ASD was done with autologous pericardium with combined team approach in emergency situation. Despite off all advantages of trans catheter closure of ostium secundum ASD, cardiologist must have clear communication to his /her cardiac surgical and anaesthetic team when they are doing such procedure in cath laboratory because even in experienced hand there is chance of embolization of device and failure to percutaneous retrieval may require urgent surgical retrieval of device under cardiopulmonary bypass and in last but not least to avoid the medico legal issues in modern era.

Conclusion

All ASD in adults should be closed. PTDC must be considered for suitable anatomy and availability of expertise because it is very safe, high success rate along with avoidance of scar, cardiopulmonary bypass and its complications, meets the public expectations. MICS should be preferred over conventional median sternotomy approach in suitable cases. Conventional median sternotomy approach is gold standard if associated cardiac defects, contraindication to MICS, unsuccessful or complicated percutaneous closure of ASD. Overall, improved aesthetic implication, reduced operative pain, and a relatively fast rehabilitation are important considerations for less invasive approaches of ASD closure.

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