

Original article

Atrial septal defect closure through ministernotomy VS full sternotomy in paediatric patients- a comparative study

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Abstract

Introduction - Surgical closure of atrial septal defect (ASD) is routinely done in children through conventional full sternotomy. Various minimally invasive techniques have been used for better cosmesis. Here we report our experience of surgical closure of ASD in 25 patients in our institute, comparing ministernotomy versus full sternotomy approach in paediatric age group.

Materials and methods- 25 patients with isolated ostium secundum ASD, with age 12 years and below referred to us for surgical closure from May 2021 to May 2022 were included in the study. The surgical technique, intra and postoperative course and surgical outcome of ASD closure through ministernotomy(n=12) in comparison to a full sternotomy(n=13) in paediatric patients were studied.

Results - There were no differences in outcome apart from a longer CPB time (58.1±10.5 vs 73.9±5.6 min) and cross clamp time (35.5±9.6 vs 50.7±5.5 min) in the ministernotomy group due to separate inferior vena cava cannulation on pump and demonstration for surgical trainees. Scar was much smaller and had excellent cosmetic outcome.

Conclusion - Ministernotomy patients had a better cosmetic outcome with significantly small scar and as safe in comparision to conventional full sternotomy. Ministernotomy is safe and reproducible way of minimally invasive closure of ASD in pediatic patients with good cosmetic results.

Keywords: atrial septal defect, ministernotomy, full sternotomy, pediatric

Introduction

Ostium secundum atrial septal defect (ASD) is one of the commonest congenital heart diseases treated surgically in the paediatric age group [1]. Many minimally invasive techniques have been used for a better cosmetic outcome with less pain, perioperative complications, improved post operative recovery, shorter hospital stay. These approaches include right lateral thoracotomy, minithoracotomy, ministernotomy, transxiphoid incision and video assisted thoracoscopic surgery [2-6]. The corner stone of these approaches still remains safety with low complication rates, better outcomes and reproducibility. Here we state our experience with ministernotomy for ASD closure in comparision to full sternotomy in paediatric age group.

Aims and objectives

To study the surgical technique, intra and postoperative course and surgical outcome of ASD closure through ministernotomy in comparison to a full sternotomy in paediatric patients.

Materials and methods

All patients with isolated ostium secundum ASD, with age 12 years and below referred to us for surgical closure from May 2021 to May 2022 were included in the study. A total of 25 patients were taken out of which 12 patients underwent ministernotomy as per choice of parents and 13 patients underwent full sternotomy. Patients with other types of ASD like ostium primum and sinus venosus, as well as other associated congenital malformations like patent ductus arteriosus, ventricular septal defect and anomalous pulmonary venous connections, atrioventricular canal defect were excluded from the study. History and clinical examination findings were noted and routine laboratory investigation were done. Preoperative transthoracic echocardiographic (TTE) evaluation was carried out to rule out other anomalies and postoperative transesophageal echocardiography (TEE) was used for surgical outcome routinely in all patients. The statistical analyses were performed using SPSS Software, version 2.0. Statistical significance was defined as a p-value of less than 0.05.

Surgical technique:

After routine general anaesthesia, patient in supine position with shoulder roll beneath, skin incision was given from a point at the level of nipples and extended till the end of xyphoid process approximately 4-5 cm in length (figure 1). Soft tissue dissected and small skin flap raised above the apex of incision. sternotomy was done from below upwards till the third intercostal space and extended to the right side. Paediatric sternal retractor was used to open the sternum, pericardial patch then harvested without dissecting much of thymus. Pericardial well created after taking stay sutures. First purse string suture was taken on right atrial appendage (RAA) which helped to retract it and expose great vessels for further cannulation. Aorta was then pulled down holding the adventitia and purse string suture taken as high as possible. Straight aortic cannulas were used for easy cannulation. Superior vena cava(SVC) was cannulated using straight cannula through RAA and cardiopulmonary bypass (CPB) was instituted after complete heparinisation. Inferior vena cava(IVC) was then cannulated with angled cannula from a separate skin stab incision just below the main incision under CPB (figure 2). Cardioplegic arrest was achieved through aortic root using Del Nido solution. Aortic cross clamp was applied with little traction on the skin incision. ASD was closed with pericardial patch through right atriotomy with continuous polypropylene sutures. After complete deairing of left heart, right atriotomy closed, cross clamp removed and patient weaned off CPB following return to sinus rhythm. Serial decannulation was then done and sternotomy closed with a single mediastinal drain through the stab incision given for IVC cannulation (figure 3). Patients undergoing full sternotomy had a complete sternotomy with a skin incision from suprasternal notch to subxiphoid area.

Results

A total of 25 patients were included in the study out of which 12(4 females and 8 males) underwent ministernotomy and 13(5 females and 8 males) underwent full sternotomy. Both the groups had similar age (7 ± 3.2 vs 7.8 ± 3.2 years), weight (18.2 ± 6.4 vs 18.6 ± 6.2 Kg) or body surface area (0.7 ± 0.1 vs 0.8 ± 0.2 /sq. m). The CPB time (58.1 ± 10.5 vs 73.9 ± 5.6 min) and cross clamp time (35.5 ± 9.6 vs 50.7 ± 5.5 min) was significantly longer in the ministernotomy than in the full sternotomy group (table 1). None of the patients required conversion to full sternotomy & postoperative TEE showed no residual shunts. All the patients were shifted to intensive care unit without any post operative complications and minimal or no ionotropes. All were extubated

on the same day of surgery. mean hospital stay was about 8.2 ± 0.7 days for both the groups. There were no deaths reported in study. The ministernotomy patients had a significantly smaller incision in comparison to full sternotomy (4.8 ± 0.8 cm vs 10.8 ± 2.1 cm) and parents of the children had more psychological satisfaction (figure 4). Mean follow up period was about 6.2 ± 5.1 months and are having no major complications.

Figure 1: Ministernotomy incision



Figure 2: Cannulation in ministernotomy, IVC through a separate stab incision

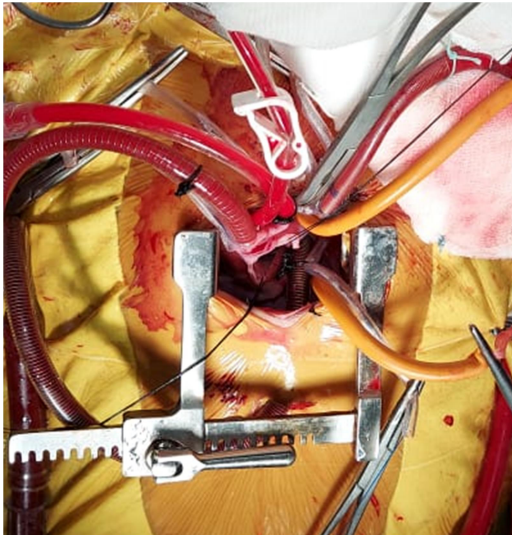


Figure3 : After closure with drain placement



Figure4 : Ministernotomy scar of 5 year old on follow up



Table 1

	Ministernotomy (n=12)		Full sternotomy (n=13)		p-value
	Range	Mean \pm SD	Range	Mean \pm SD	
Age (in years)	3-12	7 \pm 3.2	3-12	7.8 \pm 3.2	0.126
Weight (in kg)	9-28	18.2 \pm 6.4	10-31	18.6 \pm 6.2	0.211
BSA(per sq. m)	0.49-1.12	0.7 \pm 0.1	0.53-1.1	0.8 \pm 0.2	0.168
Cross clamp time (min)	43-62	50.7 \pm 5.5	19-48	35.5 \pm 9.6	0.041
CPB time(min)	70-84	73.9 \pm 5.6	40-70	58.1 \pm 10.5	0.038
Incision (cm)	4-6	4.8 \pm 0.8	9-15	10.8 \pm 2.1	0.031
Hospital stay(day)	7-9	8.1 \pm 0.7	7-9	8.2 \pm 0.7	0.164
BSA- body surface area, cm- centimeter, Kg – kilogram, min- minutes, sq.m – square meter. SD– standard deviation					

Discussion

ASD is a common congenital cardiac disease both in paediatric and adult population in developing countries like ours. Closure of ASD is indicated in the preschool going age population when detected early childhood with normal life expectancy thereafter [7]. If device closure is not possible, surgical approaches are required for closure of the defect. As the mortality and morbidity with congenital cardiac diseases are declining with closure of ASD having negligible risk, focus is more on a cosmetic approach along with less complications, pain, hospital stay and cost [8]. Different types of approaches have been used for ASD closure including median sternotomy, right thoracotomy, right minithoracotomy, ministernotomy, transxyphoid and video assisted thoracoscopic surgery [2-6]. As the public awareness is increasing in this minimally invasive surgical approach era surgeons are trying to decrease their incision further. In cardiac surgery minimally invasive techniques have a limitation of peripheral cannulation especially in pediatric population where vessels are small in calibre. With the advent of newer instruments and possible central cannulation, minimally invasive surgery is gaining popularity as well being taken up by younger generation surgeons.

In our study we used ministernotomy due to various reasons: approach is similar to full sternotomy, right atrium is just beneath the incision giving better exposure and manipulation, no breast mobilisation, easier to convert into full sternotomy if the need arises, less painful than thoracotomy incision and it can be performed with regular instruments, surgical skills similar to regular approach and better cosmetic result. During conduct of CPB and coming off, it has better myocardial protection and de-airing before cardiac activity resumes [9]. In our study we encountered longer CPB and cross clamp time most probably due to IVC cannulation on CPB and

procedure performed by surgical trainees under supervision implicating its reproducibility and minimal learning curve. Hospital stay was equal both groups as per our institutional protocols though studies have shown reduced hospital stay after ministernotomy approach [10-11]. There were no early or late postoperative complications in either group. Our study had the limitation of a small sample size and large randomized studies are required for further implications of the procedure.

Conclusion

Our experience shows ministernotomy is a safe and feasible option in the surgical management of ASD closure in paediatric age group with good surgical exposure, enhanced post operative outcomes and can be easily taught to future cardiac surgeons under training. Outcomes are similar to conventional full sternotomy with better cosmetic results and patient satisfaction.

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