

# Implementation of a minimally invasive approach program for atrial septal defect correction in pediatric patients. Initial results

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**Objective.** The initial objective of minimally invasive cardiac surgery for congenital heart disease was to perform it through smaller incisions, avoiding a complete sternotomy and its inherent complications, as well as being more aesthetically attractive. It is currently added to reduce psychological trauma and improve post-surgical body acceptance. The aim is to present the current status of the correction of atrial septal defects with minimally invasive approaches in pediatric patients at our institution. **Material.** Retrospective study from December to March 2022, pediatric patients with atrial defects with minimally invasive repair were included. **Results.** To date, three patients have been corrected; two females, aged 3 to 12 years, with an average weight of 22 kg. The size of the defect a minimum of 16mm by 8mm and a maximum of 30mm by 28mm. In 2 patients, a lateral axillary and anterolateral thoracotomy was performed, and another with an anterior periaerolar thoracotomy. Mean cardiopulmonary bypass time was 52 minutes and aortic cross-clamping time of 69 minutes. No patient required vasoactive inotropic support for more than 24 hours, and ventilation time was less than 4 hours. All patients were discharged at 72 hours after procedure. **Conclusions.** Minimally invasive pediatric cardiac surgery is now becoming routine practice in many centers. Our recent experience demonstrates that a comprehensive program allows for a safe approach for the patient.

**Key words:** Atrial septal defect; Congenital Heart Disease; Minimally Invasive Cardiac Surgery.

**Objetivo.** El objetivo inicial de la cirugía cardíaca mínimamente invasiva de las cardiopatías congénitas era realizarla con incisiones más pequeñas, evitando una esternotomía completa y sus complicaciones inherentes, además de ser más atractiva estéticamente. Actualmente se agrega para reducir el trauma psicológico y mejorar la aceptación corporal posquirúrgica. El objetivo es presentar el estado actual de la corrección de la comunicación interauricular con abordajes mínimamente invasivos en pacientes pediátricos de nuestra institución. **Material.** Estudio retrospectivo de diciembre a marzo de 2022, se incluyeron pacientes pediátricos con defectos auriculares con reparación mínimamente invasiva. **Resultados.** Hasta la fecha se han corregido tres pacientes; dos femeninos, de 3 a 12 años, con un peso promedio de 22 kg. El tamaño del defecto un mínimo de 16 mm por 8 mm y un máximo de 30 mm por 28 mm. En dos pacientes se realizó una toracotomía lateral axilar y anterolateral y otra con toracotomía anterior periaerolar. El tiempo medio de circulación extracorpórea fue de 52 minutos y el pinzamiento aórtico de 69 minutos. Ningún paciente requirió soporte inotrópico vasoactivo por más de 24 horas y el tiempo de ventilación fue menor a 4 horas. Todos los pacientes fueron dados de alta a las 72 horas después del procedimiento. **Conclusiones.** La cirugía cardíaca pediátrica mínimamente invasiva se está convirtiendo en una práctica habitual en muchos centros. Nuestra experiencia reciente demuestra que un programa integral permite un abordaje seguro para el paciente.

**Palabras clave:** Comunicación interauricular; Cardiopatías congénitas; Cirugía cardíaca mínimamente invasiva.

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Congenital heart disease (CHD) is one of the most frequent causes of infant mortality with an approximate incidence of 8 cases per 1000 live births [1]. The goal of a successful congenital heart surgery procedure is com-

plete repair of the defect with no mortality, minimal morbidity, and no residual defect. Surgical repair with adequate exposure remains the gold standard to achieve this end. The history of minimally invasive surgery dates back to the 1990s, mainly with accesses through inferior mini sternotomy and lateral thoracotomy.

The initial objective of minimally invasive cardiac surgery for congenital heart disease in pediatric patients was to perform it through smaller incisions and to be more aesthetically attractive [2]. However, the field has evolved, and the goal is now to reduce the psychological and physical trauma of an operation using technical advances. The concept of minimally invasive cardiac surgery is broader than simply limiting the length of the surgical incision. The goal includes reducing the trauma of an operation at every stage of congenital heart disease management: in the operating room, in the intensive care unit, on the hospital ward, and even after discharge. The concept of reducing global trauma and morbidity related to the surgical procedure requires a coordinated multidisciplinary approach involving congenital disease surgeons, perfusionists, anesthesiologists, intensivists, cardiologists, and nurses [3].

In our center we noticed that some patients after total median sternotomy correction of interatrial septal defects presented symptoms of anxiety and major depression secondary to the thoracic scar, requiring management by the pediatric psychiatry service; for this reason, it was decided to start a pediatric minimally invasive cardiac surgery program under the premise of “treating with less bodily aggression”, always maintaining high quality standards and performing the procedure in a comprehensive manner [4].

## MATERIAL

This is a descriptive, observational, cross-sectional, and retrospective study in patients with atrial septal defects with repair with a minimally invasive approach in the period from December to March 2022. Demographic data, surgical evolution and postoperative follow-up were described. Recording of median, maximum, and minimum was made for the continuous numerical variables and for the categorical variables the percentage was measured.

### Surgical protocol

All patients undergoing correction of congenital heart disease are previously evaluated by the pediatric cardiology team and presented at a medical-surgical session. Patients considered suitable for surgical management and who require extracorporeal circulation are admitted with complementary studies that include blood count, coagulation times, chest X ray, electrocardiogram and evaluation by the pediatric nutrition, dentistry, and pediatric infectious disease services. The basic parameters for admitting a patient for minimally invasive cardiac surgery include:

1. Patients of any gender.
2. Weight greater than 10 kg.
3. Interatrial septal defects not accompanied by other congenital heart diseases.

In the surgery room, regarding the surgical procedure, we arbitrarily choose different approaches according to the patient gender: right anterior mini thoracotomy (AMT) is less visible when the incision is within the inframammary fold, mini sternotomy (MS) when a better exposure of the great vessels is required, and other maneuvers are required and finally a right posterior mini thoracotomy has been offered (RPT) as a surgical option (Fig. 1).

### Surgical procedure

After asepsis and antisepsis, under general anesthesia and cardiovascular anesthesiology care, peripheral cannulation is performed in femoral vessels for cardiopulmonary bypass in patients weighing more than 30 kg and a bicaval and central aortic cannulation is used for patients weighing less than 30 kg. If necessary, SVC cannulation is performed by echo guided jugular puncture, after administering systemic sodium heparin 300 UI/Kg. A 2cm incision in the inguinal crease to expose the femoral vessels. After achieving systemic heparinization, direct arterial cannulation is performed, followed by venous cannulation (Fig. 2)

An approach is performed, either by axillary, lateral or peri areolar mini thoracotomy and subsequently dissection



Figure 1. Patient in room with surgical marking.

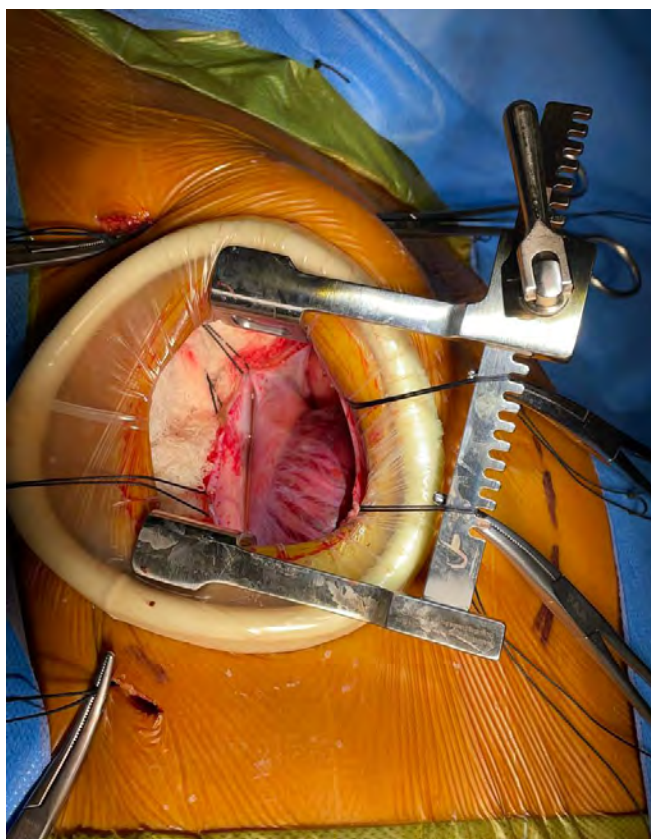


Figure 2. Cardiac exposure during the surgical procedure.



Figure 3. Post-surgical patient.

by planes to the pleural cavity; pericardiotomy and points of repair in the pericardium are performed. Extracorporeal circulation is started, a tourniquet is installed in both caves. Aortic clamping was performed, cold antegrade Nido type blood cardioplegia by aortic root. Right atriotomy, visualization of the defect and its repair. Closure of the right atrium, prior deaeration maneuvers, aortic clamp is removed. Slow weaning from extracorporeal circulation. At the end of the procedure, an echocardiographic evaluation is performed. Modified ultrafiltration is performed, anticoagulation reversal with protamine and probes are left in the pleura and in the mediastinum, epicardial ventricular electrode. Partial closure of the pericardium, intercostal infiltration with bupivacaine, closure of the pleural cavity, closure by layers of skin and inguinal wound are performed.

A two-dimensional echocardiogram is performed in the immediate postoperative period. He is transferred to the pediatric post-surgical care unit where pain control and early extubation (<12 hours) are performed and early discharge from the Pediatric Intensive Care Unit is attempted.

## RESULTS

To date, three patients have been corrected by minimally invasive approaches; 100% of the patients presented only

interatrial septal defects. 67% of the cases belong to the female gender, with a mean age of 7.3 years (minimum of 3 and maximum 12). The mean weight was 22.4kg (15.3 to 32 kg), two patients underwent thoracotomy, one with lateral axillary thoracotomy, another with anterolateral thoracotomy (**Fig. 3**) and another patient with anterior periaerolar thoracotomy, the mean pump time was 71.6 minutes (50 to 108), and the mean clamping time was 70 minutes. Discharge tool place on average at 2.5 days (**Table 1**).

## COMMENT

Heart disease does not imply only physiological conditions. They also affect social relationships, psychological issues, and quality life. This is something that has only gradually begun to be considered [5]. Negative emotional factors such as anxiety and depression have been linked to adherence and the results of medical, pharmacological, and surgical treatments [6].

MICS turns out to be a novel technique, which is presented as a less invasive alternative, with a similar safety profile and appropriate corrections, compared to the conventional surgical approach, for the repair of simple congenital heart defects, approachable by the right heart in pediatric patients, operated on in centers with experience in the treatment of congenital heart disease [7].



**Table 1. Demographics data**

Case	Age (years)	Gender	Weight (Kg)	ASD size (mm)	Type of approach	CPB time (min)	ACC time (min)	Ventilation (hours)	LOS in ICU (days)	Hospital discharge (days)
1	7	Female	20	28 /30	RT AL	101	50	6	2	3
2	3	Female	15.3	16/18	RT AL	57	37	5	1	2
3	12	Male	32	15/8	APT	108	71	8	2	3

ACC: Aortic-cross clamping; CPB: Cardiopulmonary bypass; RT AL: Right thoracotomy anterolateral; APT: Anterior periareolar thoracotomy

Pediatric minimally invasive cardiac surgery is now becoming routine practice in many centers around the world. Different approaches need their own learning curve. Our recent experience demonstrates that a comprehensive program allows for a safe approach for the patients. A log of conversion rate and complications should be used as a performance marker and quality standard.

An increase in minimally invasive procedures was observed. The short-term results are good.

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