CASE REPORTS

MINI ATRIAL SEPTAL DEFECT CLOSURE IN DEXTROCARDIA WITH SITUS INVERSUS BY LEFT ANTEROLATERAL THORACOTOMY(LALT) APPROACH - A SURGICAL CHALLENGE

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Abstract

Background: *Atrial septal defect (ASD) is a relatively rare among patients with situs inversus dextrocardia with concordant atrioventricular (AV) connection and a minimally invasive approach in dextrocardia has yet to be standardized. The present case describes surgical closure of ostium secundum ASD by left mini-thoracotomy approach in patient with dextrocardia and situs inversus.*

Case presentation: *The present case describes a 44-year female diagnosed with ostium secundum ASD in dextrocardia with situs inversus. The patient underwent minimal invasive ASD closure by left anterolateral thoracotomy approach (LALT). The procedure has achieved good clinical and cosmetic results*

Conclusion: *This article describes surgical techniques to overcome the challenges in subset of dextrocardia with situs inversus patients.*

Keywords*: Dextrocardia, Left anterolateral thoracotomy, Cardiopulmonary bypass .*

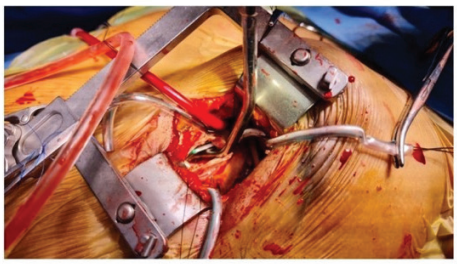
BACKGROUND

Atrial septal defect ranks among the most prevalent congenital heart anomalies in the adult population. Dextrocardia with situs inversus represents the most common variant of dextrocardia [1]. Within this subset, ASD occurrence remains relatively rare [1,2]. The development of a standardized minimally invasive surgical approach for dextrocardia is still an ongoing challenge. This case report elucidates the surgical management of an ostium secundum ASD via a left mini-thoracotomy in a patient with dextrocardia and situs inversus.

CASE PRESENTATION

A 44-year female presented to our hospital with a history of dyspnoea on exertion for 3 months (New York Heart Association-NYHA2). Transthoracic echocardiography showed dextrocardia with situs inversus with 26 mm ostium secundum ASD having deficient inferior rim. It also showed pulmonary veins draining into right sided atrium (morphological left atrium), mild tricuspid regurgitation (TR), and normal right and left ventricular function. Chest X-ray (figure 1a) showed dextrocardia. Contrast-enhanced computed tomography (CECT) showed dextrocardia and visceral situs-inversus with large ostium secundum ASD and no systemic or pulmonary venous anomalies. Patient underwent cardiac catheterization with Qp/Qs of 2.22 and 3.88 before and after administration of oxygen, respectively. The patient was planned for surgical repair via LALT approach. She was intubated with a single-lumen endotracheal tube, a small 4 to 5-cm left anterolateral thoracotomy (LALT) was used to enter the thorax through 3rd intercostal space (ICS) which was corresponding to mid of right atria. An intercostal rib spreader was used for additional exposure and we did not perform rib transection/resection.

A. Preoperative Chest X-ray



B. Intraoperative picture showing Atrial Septal Defect

Figure 1 *A) Pre-operative chest x-ray showing dextrocardia, B) Intra-operative picture showing the atrial septal defect.*

Moderate hypothermic Cardiopulmonary bypass (CPB) was established by percutaneous cannulation of the left common femoral artery 18 Fr and left common femoral vein 25 Fr (dual stage venous cannula; Medtronic, Bio- Medicus TM). Pericardial stays taken, which enhances the exposure of right atrium. The aortic cross-clamp is applied by meticulously creating a dissection plane between the aorta and left pulmonary artery (LPA) using diathermy. This technique ensures sufficient proximal aortic length for the precise placement of the cardioplegia cannula, while also optimizing the surgical field by minimizing instrument crowding. The external Chitwood aortic cross-clamp is introduced via the 2nd intercostal space at the left midaxillary line and advanced with precision into the pre-established plane between the aorta and LPA. Antegrade cardioplegia was delivered directly into the aortic root. An oblique incision is made at the base of right atrial appendage allowing a direct examination of ASD. The defect was approximately 40 mm, with an oval shape ostium secundum with a deficient IVC rim (figure 1b). ASD closed with a PTFE patch with 5-0 polypropylene suture in a continuous fashion. Epicardial pacing wires were placed. Under TEE control, de-airing of the left atrium and left ventricle was performed. After de-clamping the aorta, CPB was weaned off. LALT incision was closed in a routine fashion. The CPB time was of 69 min and cross-clamping times was of 47 min. The patient was in ICU for one day and discharged on postoperative day 3. On follow-up after 1 month, and 1 year the patient was asymptomatic without any surgical site pain or complication. On echocardiography, she has no residual defect with normal right and left ventricular function.

DISCUSSION

Dextrocardia, a rare form of cardiac malposition, is defined by the location of the heart within the right hemithorax with the apex directed to the right. This anatomical anomaly was first described by Fabricius in 1606 [1].

Dextrocardia may present alongside atrial situs solitus, situs inversus, or situs ambiguous. The congenital anomaly of situs inversus with dextrocardia has an incidence ranging from 1 in 10,000 to 50,000 births [1].

PATIENT SELECTION AND PREOPERATIVE PLANNING

Numerous minimally invasive techniques have been documented for the surgical closure of ASD in patients with levocardia and situs solitus, including partial sternotomy [3-5], trans-xiphoid approach [6], right anterolateral approach [7], as well as right axillary and right thoracotomy approaches. However, there are no established reports or guidelines for ASD closure in patients with dextrocardia and situs inversus. Generally, the primary challenge in these operations is achieving adequate exposure, as the technical aspects of the procedure are similar to those performed in patients with levocardia and situs solitus. Critical considerations include the surgeon's positioning, choice of surgical incision, exposure of the right atrium, and the right atrial incision itself. These factors must be carefully planned preoperatively, guided by detailed imaging assessments. Consequently, thorough preoperative evaluation is essential to determine the suitability of the left anterolateral thoracotomy (LALT) approach.

Dextrocardia is typically accompanied by congenital anomalies. To ensure thorough preoperative evaluation, we planned to conduct a contrast-enhanced chest computed

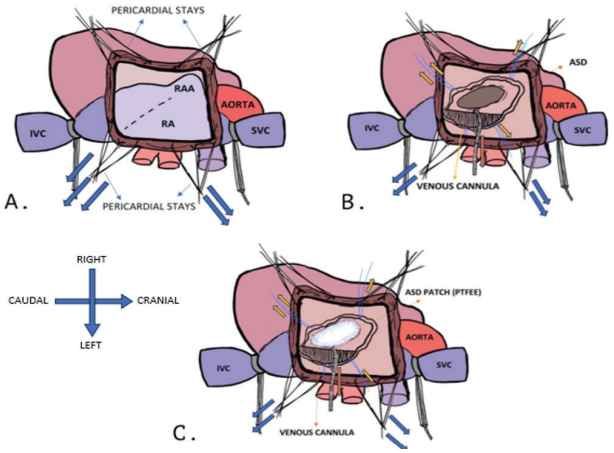


Figure 2 *Figure 2: A) Diagram showing pericardial stays and oblique incision over RA for good exposure, B) Diagram showing OS ASD with retraction of the venous cannula for good exposure of ASD. C) Diagram showing ASD repair with PTFEE patch.*

tomography (CECT) scan to exclude specific conditions such as juxtaposed appendage on the left side, venous anomalies like interrupted inferior vena cava (IVC) below the liver requiring modification of venous cannulation techniques, and anomalies such as right-sided superior vena cava (RSVC), dual SVC, arterial anomalies, and peripheral arterial occlusive disease (PAOD).

In cases where there is a juxtaposed atrial appendage on the left side, the right atrium (RA) may be comparatively smaller, potentially complicating the feasibility of a mini-atrial septal defect (ASD) repair. This assessment is challenging with 2D echocardiography due to the retrosternal positioning of the RA, underscoring the necessity for thorough preoperative exclusion of this anomaly.

Additionally, the established exclusion criteria for minimally invasive ASD closure via right anterolateral thoracotomy (RALT), such as soft plaque calcification of the ascending aorta, history of pleuritis, or a deeply positioned chest [5-7], are pertinent considerations for left anterolateral thoracotomy (LALT) as well.

During our intraoperative approach, ensuring optimal exposure was essential, especially given the retrosternal location of the right atrium (RA). To achieve this, we performed a precise pericardiotomy 2 cm above the phrenic nerve. Retraction sutures were strategically placed below the phrenic nerve and near the junction of the pulmonary vein and RA. These sutures were meticulously drawn toward the surgeon and anchored to the chest wall lateral to the incision (refer to Figure 2A). In cases of dextrocardia, where the RA lies more medially to laterally, the incision over the right atrium required a more oblique and downward trajectory compared to the conventional approach used in right anterolateral thoracotomy (RALT) for mini-ASD closure (see Figure 2A). To optimize visualization of the atrial septal defect, the venous cannula was looped with an umbilical tape and carefully maneuvered up during the procedure (see Figures 2B, C).

The selection of a PTFE patch or other alternatives typically depends on the surgeon's preference.With the increasing adoption of ASD device closure procedures, there is a growing imperative to provide surgical options that offer robust durability while minimizing surgical trauma and preserving cosmetic outcomes [7,8]. As evidenced in this study, the mini-ASD closure via left anterolateral thoracotomy (LALT) appears to satisfy these dual objectives effectively.

In our case involving a patient with dextrocardia and situs inversus, we employed a mini-thoracotomy approach, through cannulation of the left femoral artery and vein. Moderate hypothermia facilitated the administration of antegrade cardioplegia for cardiac arrest. The advantages of mini-ASD closure via left anterolateral thoracotomy (LALT) are modified, encompassing expedited postoperative mobilization, reduced pain levels, enhanced chest wall stability, favorable cosmetic outcomes, and abbreviated hospital stays. The LALT approach preserves the integrity of the sternum and ribs. This sternum-sparing technique minimizes the risk of bleeding and the need of transfusions, there by reducing associated complications. The applicability of this approach is constrained in patients meeting established exclusion criteria for minimally invasive ASD closure via right anterolateral thoracotomy (RALT). Anatomical variations, such as an interrupted IVC or juxtaposed atrial appendage, can further complicate this method, as they need alternative cannulation strategies in the presence of an interrupted IVC, while a smaller right atrium in juxtaposed appendage makes exposure difficult and cumbersome.

CONCLUSIONS

In the realm of surgical practice, there are significant implications:

When managing patients with dextrocardia requiring cardiac surgery, meticulous planning of cannulation techniques and surgical strategies is paramount to navigate the variable anatomy and mirror-image orientation of anatomical structures. In carefully selected patients within this subgroup, the LALT approach can be executed with early postoperative mobilization, reduced pain, enhanced chest wall stability, and excellent cosmetic outcomes.

List of abbreviations

ASD - Atrial septal defect
LALT - Left anterolateral thoracotomy approach
RALT- Right anterolateral thoracotomy approach
AV- Atrioventricular
IVC- Inferior Vena cava
TR - Tricuspid regurgitation
CECT - Contrast-enhanced computed tomography
ICS - Intercostal space
PTFE – Polytetrafluoroethylene
TEE - Trans esophageal echocardiography
CPB - Cardiopulmonary bypass
ICU - Intensive Care Unit
ICS- Intercostal space
LPA- Left Pulmonary Artery
SVC - Superior vena cava
NYHA- New York Heart Association
PAOD - Peripheral artery occlusive disease
RSVC- Right sided superior vena cava
RA - Right atrium

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