Totally Endoscopic Mitral Valve Repair in Situs Inversus Totalis: How to do it

Nguyen Sinh Hien[1], Ngo Thanh Hung[1], Duong Xuan Phuong[2], Pham Thi Hue[1]*

ABSTRACT

Background: Situs inversus totalis (SIT) is a rare congenital condition characterized by complete mirror-image transposition of thoracic and abdominal organs. When combined with dextrocardia, it poses significant anatomical and ergonomic challenges for cardiac surgery, particularly for minimally invasive approaches.

Case Presentation*:* A 68-year-old female was admitted to our hospital with dyspnea on exertion. Chest X-ray and chest computerized tomography (CT) confirmed SIT without venous anomalies. Transthoracic echocardiography demonstrated severe mitral valve regurgitation caused by rupture of the chordae posterior leaflet. The patient underwent totally endoscopic mitral valve repair through a left mini-thoracotomy, with implantation of a size 28 Carpentier annuloplasty ring.

Discussion: Totally endoscopic surgery allows for enhanced visualization and a broader operative field when approaching the mitral valve through a left mini-thoracotomy. The success of the procedure largely depends on the experience and technical expertise of the surgical team. The challenges in surgery include reversed visual orientation and hand movements compared to normal.

Conclusion: Totally endoscopic mitral valve repair in SIT is feasible and safe procedure.

Keywords: *Situs inversus totalis, Dextrocardia, Totally endoscopic, Mitral valve repair.*

1. Introduction

Situs inversus totalis (SIT) is a rare congenital anomaly, occurring in approximately 1 in 10,000 individuals[1], characterized by complete mirror-image transposition of thoracic and abdominal organs across the midsagittal plane[2]. Although physiologically benign in isolation, SIT presents significant technical challenges for surgical interventions, especially in cardiac operations where anatomical orientation is critical. Dextrocardia, often accompanying SIT, further complicates the surgical approach due to the heart's reversed position in the right hemithorax[3]. Some cases can be combined with primary ciliary dyskinesia or other genetic mutations, but most of the cause remains unknown[4].

Minimally invasive mitral valve surgery has become a standard approach in selected patients due to its proven benefits of reduced surgical trauma, shorter ICU and hospital stays, and

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improved cosmetic outcomes[5–7]. However, the application of minimally invasive techniques in SIT patients remains limited and requires tailored strategies including preoperative 3D imaging, mirrored setup of operating instruments, and reorientation of surgical ergonomics[8]. Recent case reports and series have validated the feasibility of such approaches, demonstrating outcomes equivalent to conventional sternotomy[9,10].

We report a successful totally endoscopic mitral valve repair in a 68-year-old woman with SIT and dextrocardia, presenting with symptomatic primary mitral regurgitation due to posterior leaflet prolapse. The case highlights essential modifications in surgical planning and intraoperative technique to overcome the anatomical challenges imposed by SIT.

2. Case presentation

A 68-year-old woman with a history of left breast cancer surgery more than 10 years ago was admitted due to exertional dyspnea. On physical examination, she was classified as NYHA class II–III. A surgical scar measuring 15 cm was noted below the left breast. Her BMI was 21.8 kg/m². The apical impulse was located at the fourth to fifth intercostal space along the right midclavicular line. Heart rate was 80 bpm with a 3/6 systolic murmur at the apex. The liver edge was palpable 3 cm below the left costal margin. There was no lower limb edema or pulmonary crackles. Chest radiograph and thoracic computed tomography confirmed situs inversus totalis (Figure 1).

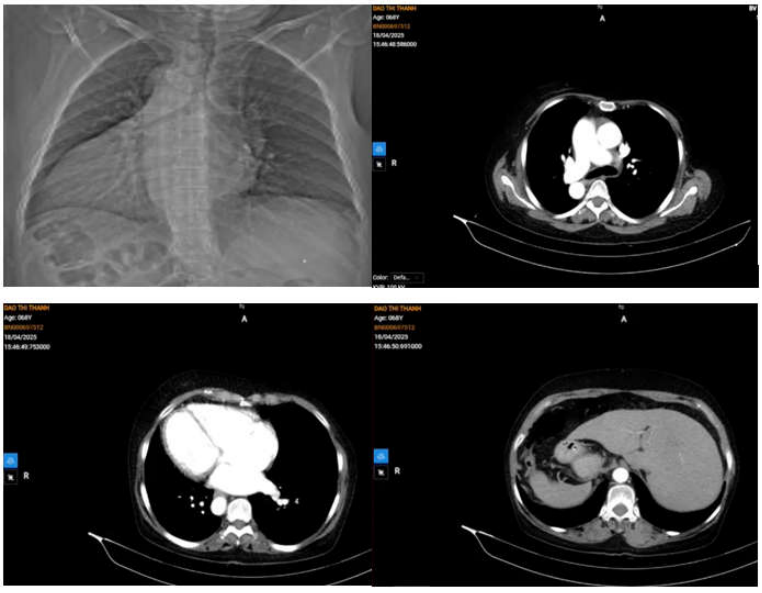

Figure 1. Chest X-ray and Thoracic computed tomography (CT) confirming situs inversus totalis

Transthoracic echocardiography demonstrated severe mitral regurgitation due to posterior leaflet prolapse (rupture of chordae tendineae at P2), with a regurgitant area of 16 cm². The left atrium was dilated (diameter 51 mm), and the left ventricular end-diastolic diameter was 48 mm. Left ventricular systolic function was preserved (LVEF 62%), and pulmonary artery systolic pressure was mildly elevated at 34 mmHg (Figure 2).

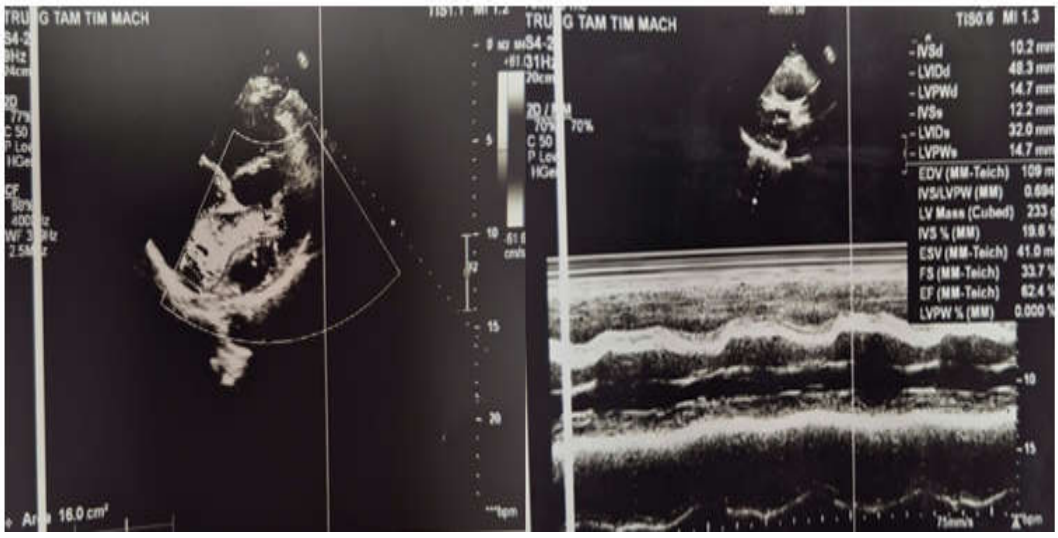

Figure 2. Preoperative echocardiography showing severe mitral regurgitation (regurgitant area 16 cm², LVEF 62%)

Surgical Procedure

The patient was positioned in a 30° left lateral decubitus with both arms along the body. A skin incision was made along the anterior axillary line over the fifth intercostal space left side. A thoracoscopic system was inserted on the right side of the patient. The surgeon stood on the left side of the patient (Figure 3).

Figure 3. Patient positioning and mirrored surgical setup

Peripheral cardiopulmonary bypass (CPB) was established via the right common femoral artery (19F arterial cannula), right common femoral vein (23F venous cannula to IVC), and left internal jugular vein (17F cannula to SVC), all using the Seldinger technique.

Cardioplegic arrest was achieved with Custodiol solution and systemic cooling to 34°C. CO_2 was

insufflated into the surgical field at 2 L/min. Left atriotomy revealed thin anterior mitral leaflet and posterior leaflet prolapse with ruptured chordae at P2 and part of P3. Quadrangular resection of P2 was performed, followed by leaflet edge approximation and posterior annular plication. A size 28 Carpentier-Duran ring was implanted. Intraoperative transesophageal echocardiography showed trivial residual regurgitation and preserved LV function (Figure 4).

Figure 4. Postoperative field with drainage tube placement

3. Discussion

Mitral valve repair in patients with SIT and dextrocardia represents a rare but technically feasible challenge in modern cardiac surgery[1,9]. While SIT is anatomically a mirror image of normal visceral arrangement, the fundamental challenge lies not in the pathology of the mitral valve itself, which remains anatomically symmetric, but in the surgical ergonomics, exposure, and reorientation required for a successful outcome[9].

Preoperative computed tomography (CT) and transthoracic echocardiography played a crucial role in confirming situs anatomy and identifying potential anomalies, particularly in the inferior vena cava (IVC) and venous return, which occur in up to 25% of dextrocardia[11]. In our case, the absence of IVC interruption allowed for standard peripheral cannulation.

In our case, the choice of a vertical incision along the anterior axillary line allowed us to avoid the previous surgical scar located beneath the patient's left breast. A hallmark of mitral valve surgery in SIT is the need to mirror the surgical field, including adjustment of the operating team’s orientation, camera angles, and cannulation routes[9,11]. In the literature, both transseptal and left atriotomy approaches have been described[12]. The choice between them often depends on individual anatomy and the depth of the left atrium due to cardiac rotation[12,13]. Due to left atrial dilation in our patient, we performed a left atriotomy to gain access to the mitral valve. The totally endoscopic approach, with visualization on a screen, allowed us to avoid the upward-looking angle encountered during direct visualization through a thoracotomy.

The selection of a mitral valve repair strategy largely depends on the surgeon’s expertise and type of anatomic lession. In totally endoscopic surgery, particularly in cases of SIT a simple technique with

a high success rate should be prioritized. We selected the posterior leaflet quadrangular resection technique (Carpentier's method) in this case because the area of chordal rupture was limited in the posterior leaflet of the mitral valve. Choosing a partial mitral annuloplasty ring, given that the patient's left ventricle was not significantly dilated, allowed us to simplify the procedure and reduce operative time, particularly important in SIT, while also reduce the risk of postoperative systolic anterior motion (SAM).

4. Conclusion

Mitral valve repair in patients with situs inversus totalis and dextrocardia is technically feasible using a minimally invasive approach when appropriate adaptations are made. This case reinforces the importance of preoperative anatomical mapping, flexible intraoperative planning, and surgeon experience in dealing with reversed organ orientation. With proper preparation, outcomes in SIT patients can parallel those of standard anatomical cases.

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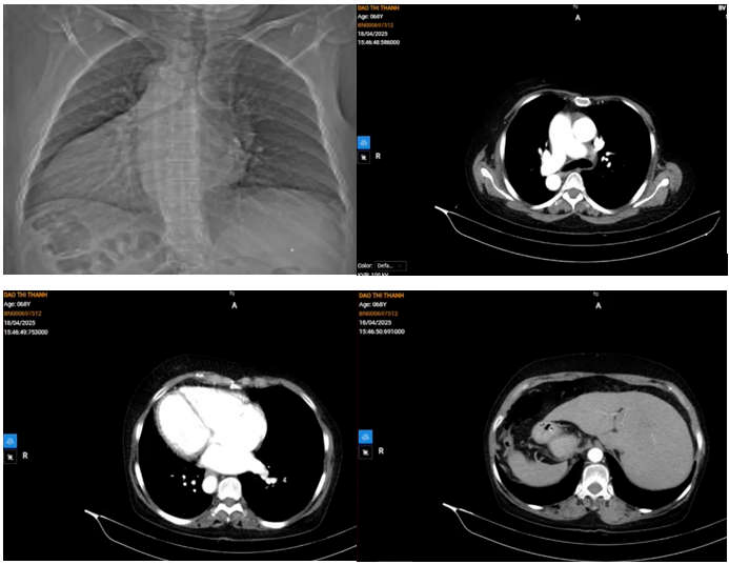

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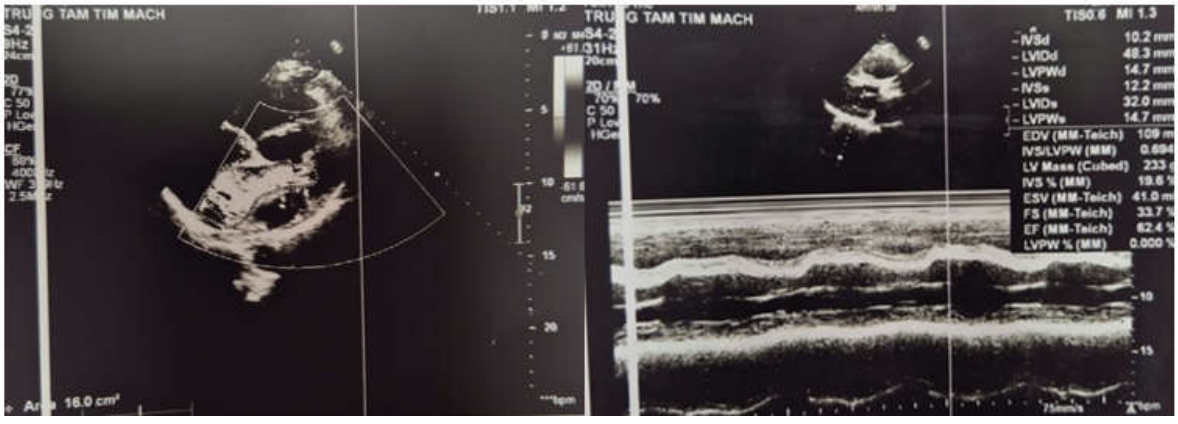

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