Minimally invasive mitral valve replacement and concomitant Cox-Maze IV procedure using radiofrequency energy in situs inversus totalis: A case report

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INTRODUCTION

Situs inversus totalis (SIT) is a rare congenital anomaly with the incidence of 1 in 100,000 births[1], characterized by the inversion of internal organs through the midsagittal plane, including the heart. In the absence of congenital heart defects, individuals with SIT can live healthy lives. Data on cardiac surgery of SIT patients is relatively limited. Minimally invasive cardiac surgery has been proved to have shorter ICU time and reduced hospital costs compared to conventional surgery[2–4]. However, minimally invasive approach has not been routinely employed in this group of patients. We report a successful minimally invasive mitral valve replacement and concomitant AF ablation using RF energy on an patient with SIT. The work has been reported in line with the SCARE criteria[5].

CASE DESCRIPTION

A 52-year-old female was hospitalized with palpitations and dyspnea on exertion. Her past medical history was not remarkable.

The patient's BMI was 19.47 kg/m^2. An AF with moderate ventricular response was detected on electrocardiogram. SIT was diagnosed by chest X-ray and echocardiography. A transthoracic echocardiogram was performed and showed severe rheumatic mitral stenosis, the mitral valve mean gradient was 11 mmHg. A type IIIA severe mitral regurgitation was also detected *(Fig. 1)*. The left atrial volume index was 80 mL/m$_2$. The ventricular contractility was good. A moderate pulmonary hypertension was noted.

A thoracoabdominal CT was performed for surgical planning. The result showed typical images of SIT, with no disruption of venae cavae. The 3D reconstruction showed a concordant connection of the heart and great vessels *(Fig. 2)*. Normal coronary arteries were confirmed by coronary angiography.

Mitral valve surgery and concomitant Cox-Maze IV (CM4) procedure were indicated based on the AHA/ACC guidelines. Minimally invasive approach was chosen with the consent of the patient and her family. The operation was performed by a senior surgeon in minimally invasive cardiac surgery.

The CPB machine was moved to the left side and the endoscopic system was relocated to the right side of the patient. A single lumen endotracheal tube was placed.

The cardiopulmonary bypass was established with one venous cannula placed in the left internal jugular vein, one venous cannula placed in the left femoral vein and an arterial cannula placed in the left femoral artery.

A 4 cm skin incision was made on the left anterior axillary line. The left pleural cavity was entered through the third intercostal space, the exposure was optimized using a soft tissue retractor.

A 30◦ endoscope was placed in the second intercostal space, the left venting line and the CO_2 line were passed through the fifth intercostal space.

Hypothermia at 32◦C was targeted and the lungs were deflated. The pericardium was opened at 2 cm above the phrenic nerve.

A Chitwood clamp was placed in the second intercostal space. The aorta was cross-clamped, antegrade Custodiol cardioplegia was administered. The left atrium was opened in the atrioventricular groove, and lifted by a retractor from the anterior chest wall. The left atrial appendage was closed using 4/0 Polypropylene. The left atrium CM4 lesion set was performed using irrigated monopolar RF ablation device (Medtronic Inc., Minnesota, USA).

The lines of block were performed by moving the unipolar tip at 1 mm/s speed with 30 W power of RF source. The ablation lines which isolated pulmonary veins were performed twice, one from the epicardial surface and one from the endocardial surface of the left atrium.

The rheumatic mitral valve was excised, a mechanical valve was implanted using pledgeted sutures, the basal part of the posterior leaflet and its chordae were preserved *(Fig. 3)*.

The right atrium was opened vertically from the interatrial septum toward the atrioventricular groove. Endocardial and epicardial ablation lines were applied from the inferior aspect of the atriotomy toward the superior vena cava and inferior vena cava. The superior aspect of the atriotomy was connected to the tricuspid annulus at the 2 o'clock position in the same manner using the RF device. The right atrium was then closed. Two pacing wires were placed on the right ventricle.

The patient was weaned from bypass. Intra-operative transesophageal ultrasound showed a well-implanted mechanical valve, with no paravalvular leak, and a good ventricular contractility. Sinus rhythm was achieved.

The aortic clamping time was 102 min, the CPB time was 135 min, the ablation time was 13 min. The patient was extubated on postoperative day 2 and discharged on day 7. Cardiac function was preserved, the mechanical mitral valve worked well, sinus rhythm was maintained at 3 months.

DISCUSSION

Valve surgery has been successfully performed on SIT patients. No mortality or serious cardiovascular complications were reported. The majority of cases were performed through standard sternotomy[6–9]. Minimally invasive surgery was the effective approach on SIT patients when the pre-operative data showed favorable anatomy of the heart and great vessels[10,11]; particularly when the conventional sternotomy approach was contraindicated[12]. Our case demonstrated the feasibility of this approach for mitral valve replacement and concomitant CM4 procedure.

Cases of SIT may be accompanied by cardiovascular abnormalities, notably disruption of the inferior vena cava[13]. Preoperative CT scan is the preferred imaging modality for the diagnosis of SIT and abnormal systemic venous return. The 3D reconstruction gave a spatial orientation of the heart and surrounding structures which helped to determine preoperatively the access sites of surgical instruments and peripheral cardiopulmonary bypass. We decided to cannulate the left jugular vein and left femoral vein to optimize the venous flow, which subsequently facilitated total cardiopulmonary bypass by using snares around the venae cavae.

Achieving transmurality is an important part of the CM4 procedure. The versatility and malleability of the unipolar pen allowed us to perform the ablation from both sides of the atrium. The bent shaft of the pen was pressed against the epicardium from outside, then the epicardial ablation line was performed under high resolution video-assisted thoracoscopic. The ablation was terminated only when a change in color of the endocardial layer was visible. Upon this indentation, the technical transmurality was achieved when the endocardium was ablated.

With the attention to the mirror anatomy of the heart and great vessels, we found that mitral valve replacement and concomitant atrial fibrillation ablation could be conveniently performed via minimally invasive access.



Fig. 1. Transthoracic echocardiography with color Doppler showing severe mitral valve regurgitation and severe mitral valve stenosis

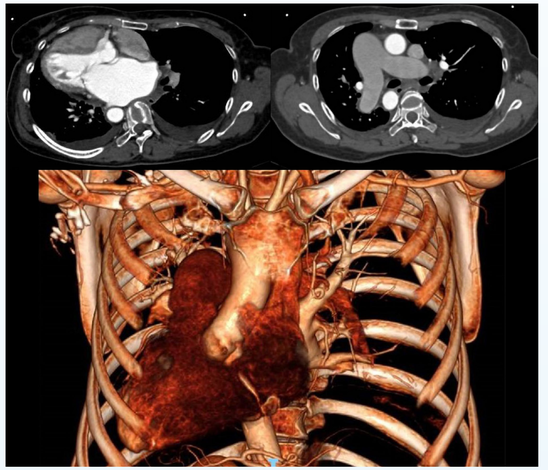


Fig. 2. Preoperative imaging demonstrating situs inversus totalis and dextrocardia

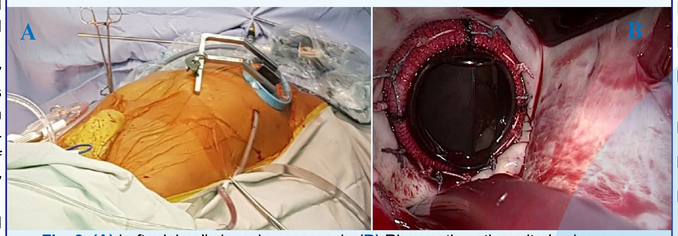


Fig. 3. (A) Left minimally invasive approach. **(B)** Rheumatic native mitral valve was replaced by an artificial mechanical valve.

CONCLUSION

In conclusion, we recommend that the minimally invasive approach should be considered as a safe and effective treatment option for patients with SIT.

Declaration of Competing Interest

No conflicts of interest.

Funding

University of Medical Center, Ho CHi Minh City, Viet Nam.

Ethical approval

The case was part of the data on minimally invasive mitral valve surgery, approved by the ethical board of the University of Medicine and Pharmacy at Ho Chi Minh City, number 141/DHYD-HDDD, on April 11th 2018.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contribution

Surgery: Dinh Hoang Nguyen; Chuong Viet Tran Pham; Ly Hai Phan
Data collection: Trang Thu Nguyen
Data interpretation: Anh Tuan Vo; Bac Hoang Nguyen
Writing the paper: Chuong Viet Tran Pham

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