

CASE REPORT

Open Access



# Transcatheter mitral valve-in-valve for pregnancy with anti-phospholipid syndrome: a case report

Zhenzhong Wang<sup>1</sup>, Yuxin Li<sup>1</sup>, Shuo Xiao<sup>1</sup>, Qiuji Wang<sup>1</sup>, Zhaolong Zhang<sup>1</sup>, Fengzhen Han<sup>2\*</sup> and Huanlei Huang<sup>1\*</sup>

## Abstract

**Background** Perioperative management and cardiac surgery in pregnant women with anti-phospholipid syndrome combined with heart valve disease have been rarely reported.

**Case presentation** We describe a case of transcatheter mitral valve-in-valve replacement in a pregnant woman with bioprosthetic valve failure and anti-phospholipid syndrome at 18 weeks' gestation. The patient underwent a cesarean section delivery at 34 weeks of gestation, resulting in the birth of a healthy baby.

**Conclusions** Transapical mitral valve-in-valve surgery resulted in safe maternal and infant outcomes in a pregnant woman with anti-phospholipid syndrome combined with mitral bioprosthetic valve failure. The success of this procedure underscored the importance of multidisciplinary teamwork.

**Keywords** Anti-phospholipid syndrome, Pregnancy, Transcatheter mitral valve-in-valve

## Background

Cardiac surgery during pregnancy has always been challenging due to the inherent difficulties and risks involved. There are very few cases wherein surgeons successfully performed interventional procedures during pregnancy [1, 2]. Particularly, this challenge can be seen in patients who also have anti-phospholipid syndrome (APS), a systemic autoimmune disorder with vascular and obstetric manifestations, including venous thromboembolism,

stroke, recurrent early miscarriages, and late pregnancy losses [3]. Fetal mortality could reach up to 27.1% in patients with known APS [4]; even if APS is treated with heparin and low-dose aspirin, fetal mortality could reach up to 10–12% [5]. Performing repeat cardiac surgery in such a complex situation to achieve safe maternal and infant outcomes is extremely rare. Presenting this case, we opt for offering insights into medical care experiences in patients facing similar situations during the perinatal period.

## Case presentation

A 35-year-old woman, gravida two para zero, at 18<sup>+</sup>4 weeks of gestation presented with shortness of breath and palpitations. In 2018, she underwent double bioprosthetic valve replacement (21 mm Carpentier-Edwards Perimount aortic prosthesis and 25 mm Carpentier-Edwards Perimount prosthesis), tricuspid valvuloplasty (30 mm Carpentier-Edwards MC3), and atrial fibrillation

\*Correspondence:

Fengzhen Han  
hanfengzhen@gdph.org.cn  
Huanlei Huang  
hhuanlei@hotmail.com

<sup>1</sup>Department of Cardiovascular surgery, Guangdong Provincial People's Hospital (Guangdong Academy of Medical Sciences), Southern Medical University, Guangzhou 510080, P.R. China

<sup>2</sup>Department of Obstetrics, Guangdong Provincial People's Hospital (Guangdong Academy of Medical Sciences), Southern Medical University, Guangzhou, P.R. China



© The Author(s) 2024. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>. The Creative Commons Public Domain Dedication waiver (<http://creativecommons.org/publicdomain/zero/1.0/>) applies to the data made available in this article, unless otherwise stated in a credit line to the data.

(AF) ablation due to rheumatic cardiac valve disease. Concurrently, she was diagnosed with APS and administered hydroxychloroquine (200 mg/day for) and methylprednisolone (4 mg/day for). Due to APS, the patient experienced difficulty conceiving naturally, with two failed artificial inseminations in 2019 and 2020. Of note, her first test-tube baby ended in an abortion in June 2021 at 8 weeks of gestation due to an unexplained silent miscarriage. Low-molecular-weight heparin (LMWH; 0.6 mg twice daily) was initiated from the sixth week of gestation.

A coagulation test showed a slight increase in fibrinogen and D-dimer levels without other abnormalities. Blood tests for rheumatic immune indicators revealed anti-nuclear antibody (+); anti-cardiolipin antibody, IgA 53.7 APL/ml; anti- $\beta$ 2-glycoprotein I antibody, IgA 56.3 U/ml; and anti-SSA/Ro60 antibody (+++). Preoperative echocardiography showed severe intravalvular regurgitation (color flow jet area, 8.1 cm<sup>2</sup>; mean gradient, 17.3 mmHg) and severe pulmonary artery hypertension (PAH; 91 mmHg) (Fig. 1). Fetal ultrasonography confirmed a healthy fetus.

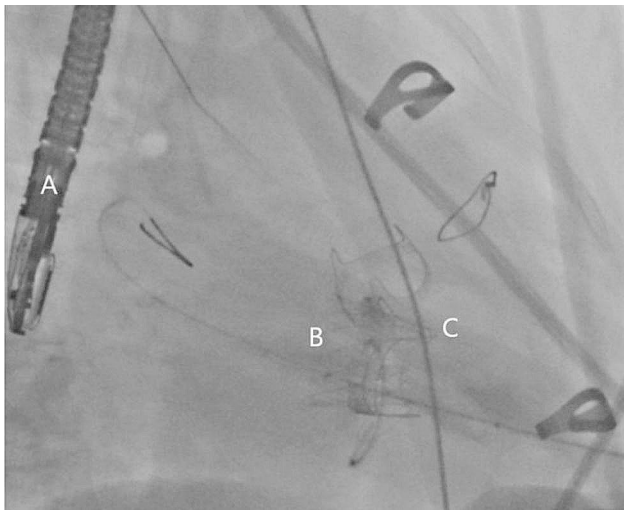
Transcatheter mitral valve-in-valve (TMViV) was performed in a hybrid operating room. Anesthesia was

administered according to the principles of general anesthesia during pregnancy. To minimize radiation exposure to the fetus, the patient's abdomen was wrapped 360° with a lead coat, and fetal electrocardiogram was performed by an obstetrician.

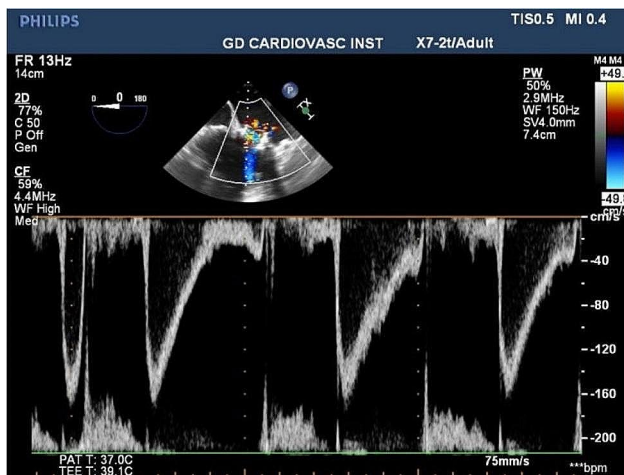
A temporary endocardial pacing lead was inserted into the right internal jugular vein. The left ventricular apex was located under digital subtraction angiography (DSA) and transesophageal echocardiography (TOE) guidance. A 4-cm incision was made in the fifth intercostal space. Heparin was administered to achieve an activated clotting time (ACT) of  $\geq 250$ ; the actual ACT reached 450. After exposing the apex, double layers of a 2–0 prolene apical purse with a spacer were punctured at the midpoint. Guidewires were placed through the mitral valve into the left atrium, a 6Fr vascular sheath was inserted. Thereafter, the super-hard guidewire was exchanged carefully to avoid wrapping the mitral chordae tendineae. A support track across the original mitral valve bioprosthesis was formed, for which a 20Fr vascular sheath was used to dilate it. During paused breathing and a paced heart rate of 140 beats/min, a 25 mm J-valve (JieCheng Medical Technology Corporation Ltd., Suzhou, China) was delivered (Fig. 2). Breathing was resumed after the



**Fig. 1** Preoperative transthoracic echocardiogram: The top left corner shows the measured reflux area of 8.1 cm<sup>2</sup>



**Fig. 2** Fluoroscopic image depicting (A) transesophageal echocardiogram probe, (B) 25 mm J-valve, and (C) mitral bioprosthetic valve failure



**Fig. 3** Postoperative transesophageal echocardiogram showed no significant mitral regurgitation

valve was released. The fetal heart rate did not decrease significantly. The valve position was determined using DSA and TOE; the mitral valve was not fully expanded. The shape of the valve after dilation with a 25Fr balloon was more appropriate. The J-valve system was released; the purse string was tightened; and protamine was administered for heparin neutralization. A drainage tube was placed to avoid tamponade. Postoperative TOE revealed a mean mitral valve gradient of 2 mmHg without obvious valvular regurgitation (Fig. 3). The systolic blood pressure remained >70 mmHg throughout the procedure. Ichthyosin (50 mg) was used to neutralize the heparin. The overall operating time was 127 min. Moreover, no contrast agent was administered during the procedure. The endotracheal tube was removed in the operating room.

The patient was discharged three days after surgery. Fetal and transthoracic ultrasounds were performed at least every two weeks, and rheumatic immune indicators were tested monthly. No significant changes were observed in postoperative blood test results for rheumatic immunity. With the approval of the rheumatologist, hydroxychloroquine (200 mg), methylprednisolone (4 mg), aspirin (100 mg) and LMWH (0.6 ml: 6000iu) were administered daily. At 29 weeks of gestation, aspirin was discontinued, and LMWH dosage was changed into 0.4 ml. At 33<sup>+3</sup> weeks of gestation, the patient was diagnosed with threatened premature labor. Echocardiography revealed a left ventricular ejection fraction of 40% and a PAH of 50 mmHg. After a multidisciplinary team consultation, a cesarean section was performed due to the high maternal and fetal risks of continued pregnancy. The patient gave birth to a healthy baby at 34<sup>+1</sup> weeks, and the APGAR scores of the newborn were 10 at both the 1st and 5th min. Echocardiographic and electrocardiographic data before surgery, after surgery, before delivery, after delivery, and at the most recent time points are presented in Table 1.

**Table 1** Comparison of echocardiographic and electrocardiographic data

	Pre-operation	Post-operation	Pre-delivery	Post-delivery	Latest
Color flow jet area of mitral valve (cm <sup>2</sup> )	8.1	No obvious regurgitation was observed	No obvious regurgitation was observed	3.9	1.8
Color flow jet area of tricuspid valve (cm <sup>2</sup> )	3.3	3.0	4.4	4.5	1.9
Peak velocity of aortic valve (m/s)	3.2	3.1	2.6	2.6	3.4
Left atrium (mm)	69	51	48	64	63
Left ventricular ejection fraction (%)	63	70	43	50	53
Pulmonary artery systolic pressure (mmHg)	91	38	41	44	29
Electrocardiogram	AF, 152 bpm	AF, 76 bpm	AF, 127 bpm	AF, 70 bpm	AF, 87 bpm

Abbreviation AF, atrial fibrillation; bpm, beats per minute

## Discussion and conclusions

A 38-year-old pregnant woman at 15 weeks of gestation with an unknown primary APS underwent tricuspid valve tumor resection under cardiopulmonary bypass (CPB). A case, as reported in the literature, underwent a cesarean section at 35 weeks' gestation, giving birth to a healthy fetus [6, 7]. The biggest difference between the two cases is that our case involved recurrent cardiac surgery. Approximately 20% of fetal losses are caused by CPB [8]. In addition, reoperation is a risk factor for maternal and fetal mortality [9]. The most obvious advantage of TMViV over other methods is that it does not require CPB. Moreover, obstetric morbidity in patients with APS includes early recurrent miscarriage, unexplained fetal loss, and/or premature birth [10]. The patient did not give consent to undergo abortion before cardiac surgery. The main reason for choosing a surgical method was to maximize the duration of the gestation period, thereby increasing the probability of fetal survival. Considering the potential for reoperation and the value of the "precious child", TMViV was considered the most viable approach to ensure the safety of both the patient and fetus, mainly due to its avoidance of CPB and shorter operative time. However, this could carry risks and pressures. Surgeons must be highly experienced, given the lack of preoperative examination using computed tomography and magnetic resonance imaging. If a miscarriage occurs after surgery, the patient would undergo a third cardiac surgery due to bioprosthetic valve failure, diminishing the significance of the initial cardiac surgery.

The surgical technique itself was not the most difficult process, minimizing additional risks was a key factor. First, a semi-monthly multidisciplinary team consultation was conducted regarding patients' APS antibody levels and cardiac ultrasound findings. The patients had a direct access to a multidisciplinary team of physicians at any time via telephone or social media. Cardiac surgery was the most recommended procedure time to perform. Second, abdominal radiological isolation was necessary to reduce the risk of fetal radiation exposure. Third, we ensured that the mother's systolic blood pressure was >70 mmHg, including that during valve release, and recommended elevating the blood pressure with phenylephrine. Fourth, if the fetus showed signs such as a slow heart rate, atosiban could have been considered [11]. Fifth, it was important to adjust the anticoagulant regimen according to the rheumatologist. To avoid thrombosis and reduce the risk of adverse fetal outcomes, we used aspirin and LMWH therapy during pregnancy, as recommended [3]. Finally, the patient was administered a small oral dose of diuretics postoperatively to avoid amniotic fluid reduction due to hypovolemia.

TMViV might be an effective method to ensure the safety of mothers and fetuses in pregnant cardiac patients

with APS who require heart valve reoperation and strongly deny abortion.

## Abbreviations

ACT	activated clotting time
AF	atrial fibrillation
APS	anti-phospholipid syndrome
CPB	cardiopulmonary bypass
DSA	digital subtraction angiography
LMWH	low-molecular-weight heparin
PAH	pulmonary artery hypertension
TMViV	transcatheter mitral valve-in-valve
TOE	transesophageal echocardiography

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s13019-024-02702-1>.

Supplementary Material 1

## Acknowledgements

Not applicable.

## Author contributions

Zhenzhong Wang and Yuxin Li were responsible for drafting the article, Shuo Xiao and Qiuji Wang and Zhaolong Zhang were responsible for collecting data, Fengzhen Han was responsible for postoperative follow-up, and Huanlei Huang was responsible for the implementation of the surgery as well as the conception of the article. All authors read and approved the final manuscript.

## Funding

This work was supported by the Basic and Applied Basic Research Foundation of Guangdong Province (No.2019B1515120071), the National Natural Science Foundation of China (No. 82270373) and Guangzhou Municipal Science and Technology Bureau (202201011136, 2023A04J0495).

## Data availability

All data generated or analysed during this study are included in this published article.

## Declarations

### Ethics approval and consent to participate

The studies involving human participant were reviewed and approved by the Ethics Committee of Guangdong Provincial People's Hospital (KY-Q-2022-147-01).

### Consent for publication

The patient consented for participation in research.

### Competing interests

The authors declare no competing interests.

Received: 8 November 2023 / Accepted: 27 March 2024

Published online: 19 June 2024

## References

1. Johnson MZ, Damianopoulos NJ, Lee F, Yong G. Mitral valve-in-valve implantation during pregnancy. *BMJ Case Rep.* 2021;14:e244270. <https://doi.org/10.1136/bcr-2021-244270>.
2. Ribeyrolles S, Diakov C, Veugeois A, Berbebi A, Caussin C. Transcatheter mitral valve-in-valve implantation: an option for failed bioprosthetic mitral valve stenosis during pregnancy. *JACC Case Rep.* 2020;2:145–9. <https://doi.org/10.1016/j.jaccas.2019.11.050>.

3. Tektonidou MG, Andreoli L, Limper M, Amoura Z, Cervera R, Costedoat-Chalumeau N, et al. EULAR recommendations for the management of antiphospholipid syndrome in adults. *Ann Rheum Dis*. 2019;78:1296–304. <https://doi.org/10.1136/annrheumdis-2019-215213>.
4. Cervera R, Serrano R, Pons-Estel GJ, Cervera R, Hualde L, Shoenfeld Y, de Ramón E, et al. Morbidity and mortality in the antiphospholipid syndrome during a 10-year period: a multicentre prospective study of 1000 patients. *Ann Rheum Dis*. 2015;74:1011–8. <https://doi.org/10.1136/annrheumdis-2013-204838>.
5. Knight JS, Branch DW, Ortel TL. Antiphospholipid syndrome: advances in diagnosis, pathogenesis, and management. *BMJ*. 2023;380:e069717. <https://doi.org/10.1136/bmj-2021-069717>.
6. Pilato E, Pinna GB, Grande L, Cirillo V, Izzo R, Tufano A, et al. Challenging report of cardiopulmonary bypass in 16th week pregnant patient with endoventricular mass. *Heart Lung J Crit Care*. 2021;50:174–6. <https://doi.org/10.1016/j.hrtlng.2020.05.008>.
7. Migliorini S, Santoro C, Scatteia A, Dellegrattaglia S, Tufano A, Cuomo V, et al. A rare case of tricuspid valve Libman-Sacks endocarditis in a pregnant woman with primary antiphospholipid syndrome. *J Clin Med*. 2022;11:5875. <https://doi.org/10.3390/jcm11195875>.
8. Regitz-Zagrosek V, Roos-Hesselink JW, Bauersachs J, Blomström-Lundqvist C, Cifková R, De Bonis M, et al. 2018 ESC guidelines for the management of cardiovascular diseases during pregnancy. *Eur Heart J*. 2018;39:3165–241. <https://doi.org/10.1093/eurheartj/ehy340>.
9. Arnoni RT, Arnoni AS, Bonini RCA, De Almeida AFS, Neto CA, Dinkhuysen JJ, et al. Risk factors associated with cardiac surgery during pregnancy. *Ann Thorac Surg*. 2003;76:1605–8. [https://doi.org/10.1016/S0003-4975\(03\)01188-3](https://doi.org/10.1016/S0003-4975(03)01188-3).
10. Truglia S, Capozzi A, Mancuso S, Recalchi S, Spinelli FR, Perricone C, et al. A Monocentric Cohort of Obstetric Seronegative Anti-phospholipid Syndrome. *Front Immunol*. 2018;9:1678. <https://doi.org/10.3389/fimmu.2018.01678>.
11. Tyler B, Walford H, Tamblyn J, Keay SD, Mavrelis D, Yasmin E, et al. Interventions to optimize embryo transfer in women undergoing assisted conception: a comprehensive systematic review and meta-analysis. *Hum Reprod Update*. 2022;28:480–500. <https://doi.org/10.1093/humupd/dmac009>.

### Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.