Transjugal closure of a residual septal device defect: a case report

Felipe Hernandez Hernandez 1*, Jose A. Linares Vicente 2, David Ibañez Muñoz 3, and Jose R. Ruiz Arroyo 2

1 Interventional Cardiology, Clinica Universidad de Navarra, C/ Marquesado de Santa Marta 1, 28027 Madrid, Spain; 2 Interventional Cardiology, Hospital Clinico Lozano Blesa, Zaragoza, Spain; and 3 Radiology Department, Hospital Clinico Lozano Blesa, Zaragoza, Spain

Received 2 February 2022; first decision 11 March 2022; accepted 13 September 2022; online publish-ahead-of-print 15 September 2022

Background
Severe residual shunts after percutaneous closure of atrial septal defects are unusual. These patients are usually considered candidates for surgery.

Case summary
We describe the transjugular closure of a residual atrial septal defect with significant left-to-right shunt due to a malpositioned large atrial septal device in a symptomatic 74-year-old female. Transjugular access was chosen first due to the unfavourable position of the device for delivery of a new one from the femoral approach. An overlapping Figulla® Flex II 27/30 mm PFO device was successfully implanted with the guidance of 3D-transoesophageal echocardiography.

Discussion
This case demonstrates the safety and feasibility of transjugular access as an alternative to femoral or transhepatic approaches in patients with difficult atrial septal anatomies, who are usually referred for surgery.

Keywords
Atrial septal defect • Transoesophageal echocardiography • Imaging • Three-dimensional imaging • Case report

ESC curriculum
2.1 Imaging modalities • 2.2 Echocardiography • 9.7 Adult congenital heart disease • 2.4 Cardiac computed tomography

Learning points
• To demonstrate the feasibility of the transjugular access as an alternative to femoral or transhepatic approaches in patients with complex atrial septal anatomy who are usually referred for surgery.
• To emphasize the value of real-time 3D-transoesophageal echo for planning and guiding these complex interventions. It can increase success rates and decrease potential complications, thus avoiding the need for open-heart surgery.

Introduction
Percutaneous closure is the established treatment for ostium secundum atrial septal defect (ASD). However, some malaligned, post-surgical, or unusually located defects pose a challenge to the interventionist. Such defects may not be amenable to closure from the femoral venous route and are often referred for surgical closure. Transhepatic and transjugular approaches have been described to be useful in patients in whom femoral venous approach is failed or not feasible, mainly due to a congenital or acquired inferior vena cava occlusion. 1 We describe the transjugular closure of a malaligned post-device residual ASD in a symptomatic patient with patent femoral venous access.
Timeline

| Sequence of events                                      |
|--------------------------------------------------------|
| **Background**                                        |
| Percutaneous closure of ASD several years before       |
| **Presentation**                                      |
| Dyspnoea with mild efforts (NYHA Class III) and right |
| heart failure                                         |
| **Diagnostic tests**                                  |
| Transthoracic echocardiogram (TTE): significant       |
| left-to-right shunt and device misalignment           |
| Transoesophageal echo (TEE): anterosuperior device    |
| protrusion into the right atrium, rest of the device  |
| correctly anchored                                     |
| **Decision**                                          |
| Percutaneous closure with a new device through a      |
| transjugular access                                    |
| **Procedure**                                         |
| A Figulla Flex II PFO 27/30 mm device was implanted   |
| partially overlapped with the prior one                |
| **Imaging**                                            |
| 3D-TEE guidance confirms correct position and a trace |
| residual shunt                                        |
| **Follow up**                                         |
| Symptoms resolution (NYHA Class I) and stable device  |
| position                                              |

Case presentation

A 74 year-old female, with a history of percutaneous closure of an ASD years ago and permanent atrial fibrillation, was admitted for evaluation due to dyspnoea with mild efforts and signs of right heart failure (peripheral oedema, abdominal distension) despite treatment with diuretics (furosemide, spironolactone) and low-dose beta-blockers (for rate control). She was also receiving enalapril and dabigatran.

The patient did not have a clinical report of the intervention, and follow-up revisions afterwards had been irregular. Clinical status had deteriorated progressively in the last months, and at the time of the visit she was in NYHA Class III.

The electrocardiogram showed atrial fibrillation with controlled ventricular response. A TTE confirmed a normal left ventricular function, moderate right chambers dilatation (right ventricular end-diastolic volume 116 ml/m²), the presence of a septal occluder device in the interatrial septum (IAS), and a significant left-to-right shunt in the anterior part of the device (estimated Qp/Qs 2.2:1), which showed a slight misalignment (Figure 1). A moderate tricuspid regurgitation was detected, and the estimated systolic pulmonary pressure was 60 mmHg.

A TEE was performed to better examine the IAS and the device position, and to identify the cause of the shunt. A clear misalignment of the device was observed, with a slight protrusion towards the right atrium in the anterosuperior part (Figure 2, see Supplementary material online, Video S1). A significant left-to-right shunt was evident, but the rest of the device was correctly anchored in the septum. 3D-TEE showed a ‘watermelon slice’ morphology of the defect between the device and the septum (Figure 3).

The case was discussed in the Heart Team meeting. The patient was considered high-risk for surgery (age, pulmonary hypertension, and chronic heart failure), so a percutaneous procedure was planned. The strategy was to implant a second device between the remanent IAS and the device. Preprocedure planning, based on imaging techniques (TEE and CT), suggested that going through the defect with a wire from a femoral access would pose an extreme angle to later cross with a delivery sheath, due to the protrusion of the device into the superior part of the right atrium. Thus a good support for a controlled deployment of the new device would be difficult to achieve. So the plan was to try from the transjugular approach first, and have the femoral access prepared as an alternative in case of failure, and use deflectable sheaths and high-support wires if needed.

Under general anaesthesia, the internal right jugular access was punctured and an 8F sheath was inserted. Pulmonary pressures and cardiac output were recorded and measured (54/21 mmHg, mean 34 mmHg, cardiac output by Fick method 4.2 L/min, Qp/Qs 1.9:1) and no evidence of elevated pulmonary resistances that could contraindicate the

![Figure 1](image1.png) Transthoracic echocardiogram apical four-chamber view (left) and short-axis view (right) showing right chambers dilatation, a moderate tricuspid regurgitation and a significant left-to-right shunt in the anterior part of the interatrial septum. IAS, interatrial septum; TTE, transthoracic echocardiogram; LA, left atrium; RA, right atrium; LV, left ventricle; RV, right ventricle.
Transjugular closure of a residual septal device defect

A 260 cm long 0.035″ hydrophilic wire was advanced through the defect with the help of a 5F multipurpose catheter and positioned in the inferior left pulmonary vein, with 3D-TEE guidance. The multipurpose catheter was exchanged for a 9F sheath and a 27/30 mm Figulla® Flex II PFO device was mounted in the delivery system and advanced into the left atrium (Figure 4). Careful and controlled deployment of the device was performed until a stable and adequate overlapping position was achieved (see Supplementary material online, Video S2). TEE showed a good position of the new device, without any interference with other intracardiac structures, and a very significant reduction of the shunt (see Supplementary material online, Video S3). After stability manoeuvres were performed (Wiggle test), the device was released. A negligible residual flow was observed with TEE. Successful haemostasis was achieved by manual compression after retrieval of the sheath.

The patient was discharged two days after the procedure. Three months later she was in NYHA Class I, and diuretics had been reduced. A follow-up TTE showed a marked reduction of right chambers size, a mild tricuspid regurgitation and an estimated systolic pulmonary pressure of 45 mmHg. There was a very small residual shunt between both devices, no pericardial effusion and no device impingement on the aorta. A cardiac CT confirmed a correct position of both devices, which remained unchanged from the obtained at the end of the procedure (Figure 5).

Discussion

Percutaneous closure of ASDs (native and residual) is considered the treatment of choice when technically suitable, as the 2020 ESC Guidelines for the management of adult congenital heart disease endorse. However, some complex ASDs (postsurgical, malaligned, or in unusual locations) have been classically referred for surgery because it was thought that such defects were not amenable for percutaneous closure. There are several reports of successful device closure of postsurgical residual defects as a reliable alternative to redo surgery. Interestingly, there are very few reports of percutaneous closure of severe residual defects after device implant, and most of them are described in PFO anatomies, but not with ASD devices.

Beyond the technical problems that can arise during the anchoring of a second device on a prior intervention, there are some other issues with the femoral access that can challenge a successful result. Some patients may have an interrupted inferior vena cava or a chronic thrombosis that preclude the use of that conduit. In such cases the alternative access routes are the transhepatic route (mainly used in children) or the transjugular access, which has been described in selected cases with good results. Although its use is really unusual, the transjugular route allows a different deployment angle of the device, with a very low rate of vascular complications. On the other hand, previous case reports of closure through this route mention the difficulty in maintaining a stable pulmonary venous wire position. Another important point is to perform a careful unsheathing of the device in the left atrium, under fluoroscopy and TEE guidance, in order to prevent any mitral valve dysfunction.
In this particular case, the angle to access the left atrium from the inferior vena cava was almost 180°. Maneuvers to access with a wire and then with a long sheath into the left atrium from the femoral route would probably have required specific material (deflectable sheaths, high-support wires) and techniques that can increase the risk of complications and the total time of the procedure. Transjugular access can avoid much of that angulation. It helped to perform the procedure in a very similar way as a standard one, and to achieve a final good result.

Finally, the concomitant use of real-time 3D-TEE should be routine in these complex structural cases. It facilitates the evaluation of the morphology of the defect, and thus provides clear information about the spatial relationship with the previous device. It is also a very useful tool for guiding device deployment and positioning, to confirm a good result and to rule out potential complications (device malposition or embolization, interference with intracardiac structures).

**Conclusion**

Percutaneous closure of residual shunts of IAS devices can be safely performed with a careful planification, which is key to obtain a good result. Transjugular access can be a feasible alternative to femoral or transhepatic approaches in patients with complex atrial septal anatomy who are usually referred for open-heart surgery. Advanced imaging tools (3D-TEE, cardiac CT) are extremely helpful for planning and guiding these complex interventions. Their use could increase success rates and decrease potential complications.

**Lead author biography**

Felipe Hernandez Hernandez graduated from the school of Medicine of the University of Salamanca in 1992. He received Cardiology training in the University Hospital 12 de Octubre in Madrid, Spain, from 1993 to 1997. His main dedication since then has been Interventional Cardiology, with especial interest in complex coronary interventions, structural and congenital heart disease and intravascular imaging. He has lectured in several national and international meetings, and published nearly 100 peer-reviewed articles. He is also a proctor for multiple
structural heart interventions (ASD and PFO closure, LAA closure, paravalvular leaks closure).

Supplementary material

Supplementary material is available at European Heart Journal – Case Reports online.

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as Supplementary data.

Consent: The authors confirm that consent for submission and publication of this case report has been obtained from the patient, in line with COPE guidance.

Conflicts of interest: As a potential COI, F.H.H. declares to be a proctor for structural heart interventions for Izasa Medical. The rest of authors have nothing to disclose.

Funding: None declared.

References

1. Dong HJ, Fan TB, Li B, Liang WJ, Song SB, Han Y, Wu KY, Zhou SJ. Transjugular closure of secundum atrial septal defects. J Card Surg 2017;32:151–153.
2. Baumgartner H, De Backer J, Babu-Narayan SV, Budts W, Chessa M, Diller GP, Lung B, Kluin J, Lang IM, Meijboom F, Moons P, Mulder BJM, Oechslin E, Roos-Hesselink JW, Schwerzmann M, Sondergaard L, Zeppenfeld K. 2020 ESC guidelines for the management of adult congenital heart disease: the task force for the management of adult congenital heart disease of the European society of cardiology (ESC). Eur Heart J 2021;42:563–645.
3. Jiménez-Méndez C, Cecconi A, Alvarado T, Domínguez L, Diego G, Díez-Villanueva P, Rivero F, Hernández-Hernández F, Jiménez-Borreguero LJ, Alfonso F. Percutaneous closure of a large iatrogenic atrial septal laceration. Circ Cardiovasc Imaging 2018;11:e008409.
4. Rosa SA, Ferreira F, de Sousa L, Fiarresga A, Martins JD, Galriño A, Agapito A, Fazendas P, Pinto FF, Ferreira RC. Successful percutaneous closure of a residual atrial septal defect due to device failure. Rev Port Cardiol 2017;36:475.e1–475.e3.
5. Mahesh Kumar S, Bijulal S, Krishnamoorthy KM. Percutaneous transjugular device closure of postoperative residual atrial septal defect. J Invasive Cardiol 2013;25:E78–E80.
6. López A, Palomas J, Rubio D, Ortiz M. Three-dimensional echocardiography-guided repair of residual shunt after percutaneous atrial septal defect closure. Echocardiography 2011;28: E64-E67.