# Percutaneous closure of atrial septal defect with a fenestrated device in a high-risk patient. Report of the first case in Argentina

## Cierre percutáneo de comunicación interauricular con dispositivo fenestrado en paciente de alto riesgo. Reporte del primer caso en Argentina

Juan Manuel Lange[1], Paula Virginia Guiroy[1], Juan Héctor Guiroy[1], Iara Taragano[1], Jesús Damsky Barbosa[1,2]


## ABSTRACT

Atrial septal defects (ASD) are associated with complications such as pulmonary arterial hypertension (PAH) and left ventricular diastolic dysfunction (LVDD). Closure of complicated ASD is linked to adverse events; among the treatment options we can find the fenestrated patch or percutaneous fenestrated device (FASDD). We report a case of closure of complicated ASD due to PAH using a FASDD, with residual flow persistence immediately and at 6 months, and PAH improvement. FASDDs are an option in patients with complicated ASD


***Keywords:*** atrial septal defect, pulmonary hypertension, percutaneous closure, fenestrated device.


## RESUMEN

La comunicación interauricular (CIA) se asocia a complicaciones, como la hipertensión pulmonar arterial (HAP) y la disfunción diastólica del ventrículo izquierdo (DDVI). El cierre de la CIA complicada se asocia a eventos adversos, el parche fenestrado o dispositivo percutáneo fenestrado (DPF) son opciones de tratamiento. Presentamos el cierre de una CIA complicada por HAP con DPF con persistencia del flujo residual inmediatamente y a los seis meses con mejoría de la HAP. Los DPF son una opción en pacientes con CIA complicadas.


***Palabras clave:*** comunicación interauricular, hipertensión pulmonar, cierre percutáneo, dispositivos fenestrados.

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## INTRODUCTION

ASD accounts for 8-10% of all cases of congenital heart disease (CHD)[1]. PAH is one of its complications[2]. Unfortunately, in adult patients, PAH is not the only frequent complication: there are also LVDD and increased left ventricular filling pressure, leading to pulmonary edema and right ventricular dysfunction once the ASD is completely occluded[3]. ASD closure is contraindicated in adult patients with mean pulmonary artery pressure (mPAP) >20 mmHg and pulmonary vascular resistance (PVR) >5 Wood units. Surgical strategies like the fenestrated patch/device technique are a good alternative in the medium term for these high-risk patients[4, 5]. In manual fenestrations, the amount of residual shunt created can be excessive or occluded. Therefore, preformed fenestrated ASD closure devices are an alternative because their residual shunting is predictable. We report the case of a patient with complicated ASD due to PAH who underwent percutaneous closure with a FASDD.

## CASE REPORT

The patient was a 50-year-old woman, 96 kg (211 lb), diagnosed with symptomatic *ostium secundum* ASD, New York Heart Association (NYHA) functional class III dyspnea, 94% saturation in ambient air, and 85% saturation on exertion.

A transesophageal echocardiographic evaluation revealed an ASD with a 20-mm major static diameter bidirectional shunt and a 39-mm diameter atrial septum. The posteroinferior and posterior edges were 3 mm and 2 mm, respectively, with flexible constitution. Both ventricles had preserved function, and there was no LVDD. There was right ventricular dilation: the Z-score was 2.0[6].

The hemodynamic assessment and the first ASD occlusion test are included in **Table 1.** mPAP was 63% of the systemic blood pressure, even when the PVR was 4.6 uW/m$^2$. The pulmonary vascular resistance/systemic vascular resistance (PVR/SVR) ratio was 0.7, with a 95.5% systemic blood saturation in ambient air without other causes of desaturation. Consequently, researchers assumed the presence of PAH. In spite of that, a Qp/Qs of 1:1.3 led to the suggestion of elevated pulmonary pressure (hyperdebit). In the ASD occlusion test, mPAP remained the same and Qp/Qs decreased along with PVR, but the values for the latter were still out of the normal range. Left pulmonary vein pressure and left atrial pressure remained at pre-test values.

The patient underwent medical treatment for heart failure and PAH; she was prescribed sildenafil 25 mg twice daily for three months. Then, repeat catheterization was performed to assess the ASD. PVR had decreased to 2.95 uW/m$^2$. Given this new situation and anatomical feasibility, ASD closure with a fenestrated device was considered.

1. Instituto Cardiovascular Chaco. Chaco, Argentina.
2. Hospital Pedro Elizalde, CABA, Argentina.

✉ Corresponding author: *Juan Manuel Lange. Instituto Cardiovascular Chaco. Resistencia, Chaco, Argentina. juanmanuellange@gmail.com*

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**TABLE 1.** First hemodynamic assessment.

| | Pressure mmHg $FiO_2$ 21% | $O_2$ saturation % at $FiO_2$ 21% | Pressure mmHg Occlusion test | $O_2$ saturation % in occlusion test at $FiO_2$ 21% |
|---|---|---|---|---|
| SVC | 9 | 82.7 | 9 | 78.2 |
| mPAP | 39 | 82.7 | 40 | 86.2 |
| sPAP | 59 | | 69 | |
| dPAP | 29 | | 34 | |
| LA | 9 | | 10 | |
| LPP | 8 | 98.6 | 10 | |
| sAo | 90 | 95.9 | 94 | 96.7 |
| mAo | 62 | | 62 | |
| dAo | 50 | | 46 | |
| PVR uW/$m_2$ | 4.6 | | 3.2 | |
| SVR uW/$m_2$ | 6.7 | | 11.7 | |
| PVR/SVR | 0.7 | | 0.27 | |
| mPP/mAoP | 0.63 | | 0.64 | |
| Qp/Qs | | 1:1.2 | 1:1.1 | |
| Qp | 6.6 | | 10 | |
| Qs | 8.0 | | 9.2 | |
| Frecuencia cardíaca lpm | 80 | | 83 | |
| OC ml/min/m2 | 105 | | | |

*SVC: superior vena cava. mPAP: mean pulmonary artery pressure. sPAP: systolic pulmonary artery pressure. dPAP: diastolic pulmonary artery pressure. LA: left atrium. LPP: left pulmonary pressure. sAo: systolic aortic pressure. mAo: mean aortic pressure. dAo: diastolic aortic pressure. PVR: pulmonary vascular resistance. SVR: systemic vascular resistance. mPP/mAoP: mean pulmonary pressure/mean aortic pressure ratio. OC: oxygen consumption. bpm: beats per minute.*

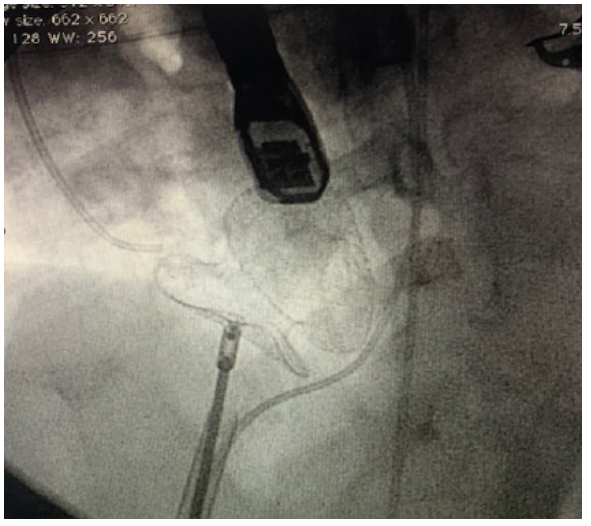


***Figure 1.*** *Angiographic image of the fenestrated occlusion device, FASDD. Before device deployment, control by means of transesophageal echocardiography (TEE).*

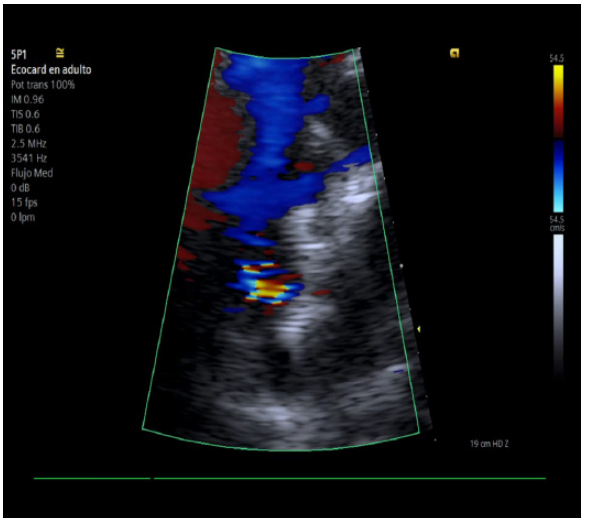


***Figure 2.*** *TEE image. Color Doppler image of the implanted prosthesis and the flow through its fenestration.*

In the cath lab, the stop-flow diameter with a 34-mm AGA® balloon was 24 mm. The implanted device was an OCLUTECH® FASDD with a 27-mm stent,a 42-mm left disc, and 6-mm fenestration (**Figure 1**).

There were no mechanical or arrhythmic complications. There was a residual shunt of 6 mm left-to-right through the prosthesis. An echocardiography at 24 hours showed preserved biventricular systolic and diastolic function with a normally implanted device. There was a 5.6-mm left-to-right residual shunt in the device.

Six months after the ASD closure procedure, the patient was NYHA functional class II, with 97% saturation in ambient air. A transthoracic echocardiography revealed a 16.5-mmHg mPAP and a 14.1-mmHg pulmonary diastolic pressure. Device implantation was normal, and there was a 3.0-mm shunt in the device **(Figure 2).** The patient had no complications neither at one month after the cardiac catheterization nor during the six-month follow-up. She underwent another right-heart catheterization was 6.3 months after the closure procedure under local anesthesia with ambient air; the mPAP was 17 mmHg and the PVR was 1.7 uW/$m^2$.

## DISCUSSION

This is a case of closure of complicated ASD due to PAH using a FASDD that progressed without complications and with good tolerance over the medium-term follow-up.

PVR was 4.6 uW/$m^2$; fortunately, the hemodynamic profile changed after three months of sildenafil treatment, and researchers considered closure of the high-risk ASD. Ayman *et al.* used a homemade fenestration ASD device to treat complicated ASD in eight consecutive elderly patients. The indication for fenestration was primarily PAH, right ventricular dysfunction in two patients, and LVDD in one patient. The homemade fenestration in the conventional ASD closure device was developed according to clinical status. The average diameter of the fenestration was 6 mm. All patients

showed clinical improvement without adverse events over one year of follow-up. The fenestration remained patent in 50 % of patients at 4 months of follow-up[7]. Schneider *et al.* used a homemade 4-mm fenestration in a conventional ASD closure device in 3 patients; indications for fenestration were two cases of restrictive left ventricular physiology and one case of PAH. These patients showed a gradual reduction in residual shunt at the 18-month follow-up[8]. Burch *et al.* closed ASD in 15 patients with PAH using a homemade fenestration and a conventional device. The average fenestration diameter was 5.2 mm. In follow-up, the fenestration remained patent in all patients[9].

Regarding our patient, we hypothesized that the residual shunt could be more stable long-term with the FASDD. Based on the literature, we considered a 6-mm fenestration. Hemodynamic and clinical status remained stable during follow-up. Stability was maintained even at 6 months.

Stumper *et al.* used the Diabolo stent technique in the atrial septum in 12 consecutive patients to relieve symptoms of inadequate Fontan circulation. All these patients showed clinical improvement regarding their PAH and protein-losing enteropathy[10].

After the intervention, our patient showed acceptable clinical conditions and the results of her 6-minute walk test were also good. We conducted a hemodynamic assessment of mPAP and PVR six months after the procedure while the patient was under sildenafil treatment. Pressures and PVR were normalized. We believe that hemodynamic changes in our patient were possibly due to the procedure being performed at the correct moment in the natural history of the ASD. To our knowledge, this is the first FASDD implanted in Argentina.

## CONCLUSION

Closure with a FASDD to treat complicated ASD is a useful tool because it improves clinical and hemodynamic conditions through a low-complication procedure in high-risk patients. Further studies should be considered to prove consistency regarding complications and PAH improvement.

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