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CASE REPORT
Structural intervention

Primary percutaneous closure of a traumatic ventricular septal defect after stab wound to the chest: a case report

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Background Traumatic ventricular septal defects (VSDs) are life-threatening complications of blunt or stab chest trauma. The standard of care is surgical closure or secondary percutaneous closure due to high surgical risk because of recent sternotomy.

Case summary We present a 22-year-old male with an ice pick–related VSD. It was successfully closed by primary percutaneous approach. After 6 months, the echo Doppler shows no residual shunt, normal pulmonary artery pressure, and normal biventricular function.

Discussion To our knowledge, this is one of the first primary percutaneous closures for knife-related VSD. Early diagnosis and treatment can prevent heart failure and long-term complications. Less necrotic tissue surrounding the VSD compared with post-infarction (PI) VSD allows for early and secure treatment. Percutaneous closure is a feasible and effective choice even in patients who had no prior sternotomy or who reject surgery as a primary treatment strategy.

Keywords Case report • Ventricular septal defect • Primary percutaneous closure • Chest trauma

ESC curriculum 2.2 Echocardiography • 6.4 Acute heart failure • 9.2 Trauma to the aorta or the heart • 7.4 Percutaneous cardiovascular post-procedure

Learning points

- To describe the alternative presentation of a chest stab wound trauma without tamponade.
- To understand and differentiate the pathophysiology between post-infarction (PI) and traumatic ventricular septal defect (VSD).
- To recognize the potential complications after chest trauma in the emergency room.
- To illustrate the safety role of transcatheter closure as a primary strategy in traumatic ventricular septal defect.

Introduction

Acquired ventricular septal defects (VSDs) are uncommon and can be due to myocardial infarction, chest trauma (either penetrating or blunt), and infective endocarditis. The mechanism of traumatic VSDs is variable, with muscular VSDs being the most frequently reported type in the literature and case reports.[1] The diagnosis of VSDs due to stab wound trauma may not be made at the first workup in the emergency department.

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Summary figure

Timeline of case events

Day	
0	Presentation. Stab wound. Arrival to general hospital. TTE showing an apical VSD and no signs of tamponade. Haemothorax. Pre-shock status. Left chest tube. The patient was referred for level 3 trauma centre.
3	Heart team discussion.
5	Percutaneous closure of VSD with 14 mm device.
8	TTE showing mild residual leak.
10	Discharge from hospital.
6th month	TTE showing complete occlusion with no residual shunt.

TTE, transthoracic echocardiography; VSD ventricular septal defect

Case description

A 22-year-old man presented to the emergency department at the general hospital no 58 (IMSS León Guanajuato México) after being stabbed once with an ice pick in the chest during a bar fight. On arrival, the patient was unstable with a blood pressure of 90/50 mmHg, no paradoxical pulse was noticed, heart rate was 110 beats/min, and respiratory rate was 28 breaths/min. The physical examination was notable for one penetrating stab wound, the object was not *in situ*, the entry site was a tiny hole in the fifth intercostal space to the left of the sternum, and there was a left pleural effusion syndrome and a holo-systolic murmur at the heart apex. The X-ray confirmed the haemothorax, and 3D transthoracic echocardiography showed an LV ejection fraction of 60%, a VSD located at the apex with a diameter measured around 6 × 8 mm, and no signs of tamponade or free wall of the right ventricle rupture (Supplementary material online, *Video S1*, and *Figure 1*). A left chest tube was placed draining 700 mL of blood, and no transfusion was required. The patient was transferred to UMAE T1 Bajío Hospital (third-level centre) for treatment of the VSD. There was a discussion with the heart team and the patient. Because there was only one central defect with good rims and the patient rejected surgery, it was decided to perform percutaneous closure.

The procedure was performed under general anaesthesia and transthoracic echocardiography guidance. Right femoral arterial access and right internal jugular venous access were obtained. We considered no need to perform coronary angiography. Right and left heart haemodynamics demonstrated mild pulmonary hypertension and a QP:QS >1.5. A left ventricular angiogram shows an apical 10 mm VSD (Supplementary material online, *Video S2*). From the right femoral sheath, a 5F JR3.5 catheter was advanced into the left ventricle (LV). A 0.035″×260 cm glidewire was used to cross the VSD to the left pulmonary artery. A 20 mm Ensnare was used to snare and externalize the wire through the jugular sheath (*Figure 2*). We used the arteriovenous loop to introduce the 8 Fr TorqVue delivery sheath and placed it into the LV. The VSD was sealed by deploying an Amplatzer 14 mm muscular VSD occlude (St Jude Medical, St. Paul, MN) (Supplementary material online, *Video S3*).

Transthoracic echocardiography performed on the third day after the procedure showed the excellent location of the device with a trace of flow through the mesh in colour Doppler imaging. The patient was discharged on the fifth postoperative day. After 6 months, the echo Doppler shows no residual shunt, normal pulmonary artery pressure, and normal biventricular function (*Figure 3* and Supplementary material online, *Video S4–S5*). The patient remains asymptomatic.

Discussion

Penetrating chest and heart trauma are still one of the most devastating scenarios in the emergency room; it carries significant morbidity and

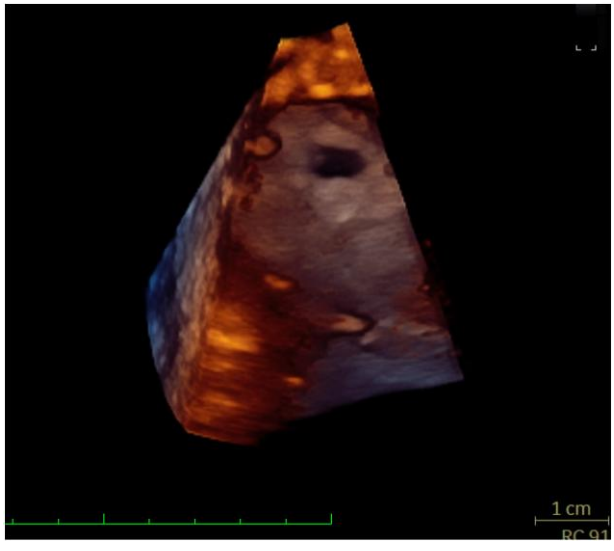

Figure 1 Three-dimensional transthoracic echocardiography shows an apical VSD.

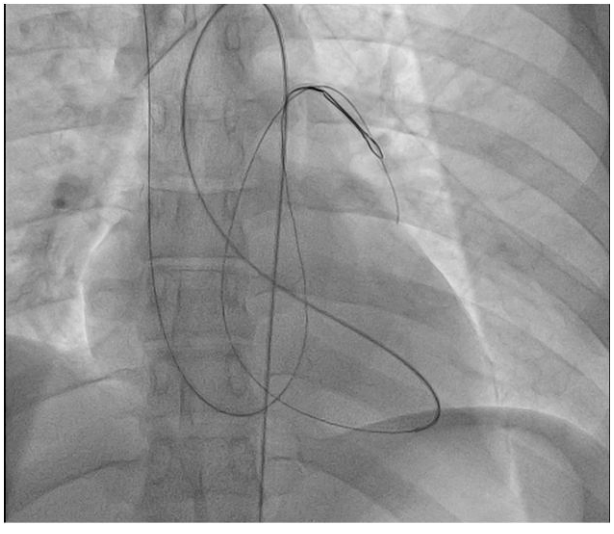

Figure 2 An arteriovenous loop was created with a 20 mm Snare in the left pulmonary artery.

Figure 3 Three-dimensional transthoracic echocardiography shows a nice position of the device.

mortality of ~60–%. Most of the patients die prior to reaching medical attention.[2] Several cases show haemodynamic instability due to free wall rupture and tamponade. Ventricular septal defects occur in 1–5% of cases of penetrating chest trauma.[1] Patients presenting with tamponade who reach the hospital warrant transfer to the cardiac surgery room urgently for sternotomy and right ventricular wall repair, leading to incomplete echo evaluation of the cardiac structures.[3] There are a few cases in the literature that demonstrate that percutaneous closure is a feasible and effective treatment for traumatic VSD, particularly as a secondary closure strategy in patients who have undergone recent sternotomy for the repair of other cardiac structures.[4–6] There is not much information about when to close these defects, as we know the management for post-infarction (PI) VSDs has been emergent primary surgical closure. Delayed surgical or percutaneous closure is preferred to allow the edges surrounding the VSD to undergo fibrosis with better results in terms of mortality between the second and third week after the presentation. There is a difference in the nature of the surrounding tissue in a traumatic VSD compared with a PI VSD. The intact surrounding myocardium with a knife-related VSD gives the theoretical advantage of closing in the very first days after the chest wound.[5,6]

Our case showed mild pulmonary hypertension (36/10/20 mmHg) and a pulmonary flow/systemic flow ratio of 1.9:1; we decided to use 3D transthoracic echocardiography guiding because of the feasibility to demonstrate diagnostic quality in apical VSD rather than transoesophageal echocardiography (TEE) which is more helpful in visualizing inlet or outlet defects.[7] Jugular access gives a more straightforward and smooth delivery of the TorqVue catheter and a better coaxial deployment of the VSD occluder in apical defects.

To our knowledge, this is one of the first primary percutaneous closures for knife-related VSD. Early diagnosis and treatment can prevent heart failure and long-term complications. Less necrotic tissue surrounding the VSD compared with PI VSD allows for early and secure treatment. Percutaneous closure is a feasible and effective choice even in patients who had no prior sternotomy or who reject surgery as a primary treatment strategy.

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Lead author biography

Dr Alejandro Solórzano was born in Leon, Mexico. He received his medical training as a cardiologist and interventional cardiologist at the National Institute of Cardiology in Mexico City. In 2017, he graduated from National Autonomous University of Mexico School of Medicine. Since 2018, he is employed at the third-level medical unit of the Mexican Social Security Institute in Leon Guanajuato, Mexico.

Supplementary material

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

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Data availability

The data underlying this article are available in the article and in its online Supplementary material.

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