Transcatheter closure of patent foramen ovale using the internal jugular venous approach

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Abstract

Transcatheter closure of patent foramen ovale is routinely performed using the transfemoral approach, which is safe and technically easy. Our case represents the rare situation where the procedure needs to be performed using the right internal jugular venous approach. According to our best knowledge this is the first report of a patent foramen ovale closure procedure with access through the internal jugular with necessity to advance the guide wire and transseptal sheath into the left ventricle. Developing alternative techniques of transcatheter patent foramen ovale closure seems to be especially important in rare cases where transfemoral access is unavailable.

Key words: paradoxical embolism, thromboembolism, patent foramen ovale.

Introduction

Transcatheter closure of patent foramen ovale (PFO) is a standard procedure at many health centers worldwide. The indication for this treatment is usually cryptogenic stroke with high probability of paradoxical embolism as its cause. The procedure is routinely performed using the transfemoral approach. This approach allows for relatively quick and safe implantation of the septal occluder. In contrast, other than femoral approaches are rarely used and are potentially difficult [1–4]. Our case was a situation in which the procedure needed to be performed using the right internal jugular venous approach with further procedure modification requiring wire and transseptal sheath advancement to the left ventricle.

Case report

A 26-year-old man with an 8-year history of venous thromboembolism and Crohn's disease with protein C deficiency was admitted to our center to consider percutaneous closure of patent foramen ovale. After a history of an ischemic neurological event with right hemiparesis in April 2013 (computed tomography scan of the head revealed no lesions of vascular origin), the patient was suspected to have an atrial septal defect, with an indication of urgent cardiological diagnostics. Transesophageal echocardiography (TEE) revealed presence of PFO associated with an atrial septal aneurysm (ASA) and Chiari network, with massive right-to-left shunting of contrast (agitated saline) during the Valsalva maneuver.

Since the diagnosis of thromboembolic disease, the patient has been systematically monitored by a vascular surgeon. He was repeatedly hospitalized for aggravation of symptoms. Clinical imaging (angio-computed tomography) in 2005 revealed massive thrombi in the femoral and iliac veins and inferior vena cava (IVC) at the level of the aortic bifurcation. Subsequently after PFO diagnosis, inferior vena cava occlusion with prominent venous collaterals and dilatated hepatic veins was revealed.

The patient was qualified for percutaneous closure of the PFO with the following indications: (1) long-term history of thromboembolic disease which is a direct risk factor for paradoxical embolism in patients with PFO; (2) anatomy of the PFO – massive right-to-left shunting during the

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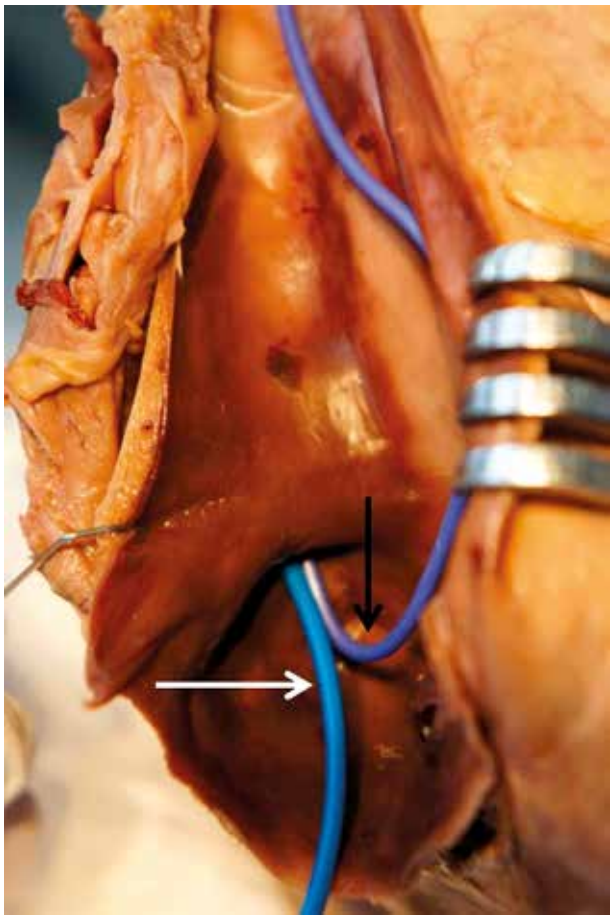

Figure 1. Anatomic preparation showing the channel of the foramen ovale physiologically directed towards the inferior vena cava. JL 3.5 catheter inserted into the PFO through the superior vena cava (black arrow) and typical access with the catheter advanced through the inferior vena cava (white arrow)

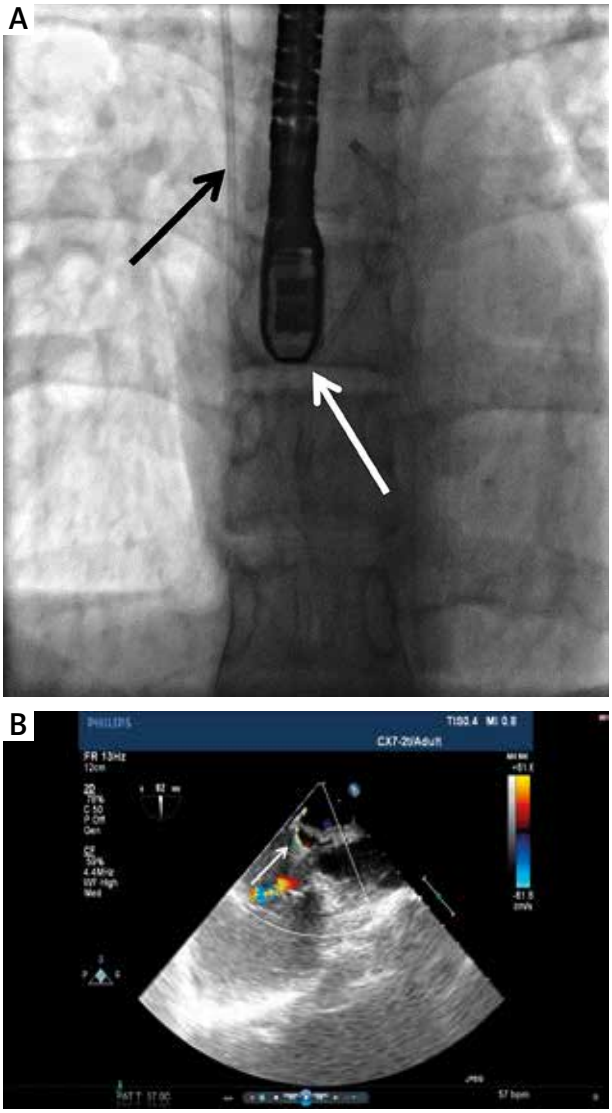

Figure 2. The black arrow marks a part of the JL 3.5 catheter located in the superior vena cava, the white arrow shows where the catheter passes through the interatrial septum. X-ray spectroscopy (**A**) and transesophageal echocardiography (**B**)

Valsalva maneuver, the presence of ASA and Chiari network; (3) history of transient ischemic attack with right hemiparesis; (4) potential surgical treatment of the vascular system of the IVC and the hepatic veins. Due to the inability to perform the procedure through the classical femoral venous access, a right internal jugular venous approach was planned.

The intervention was performed under general anesthesia and TEE control. A 6 Fr sheath was placed in the right internal jugular vein using the Seldinger technique, followed by a 0.035" vascular guidewire. The main difficulty in the course of the intervention was passing through the PFO into the left atrium (LA), which required curving the catheter superiorly and rotating it in the direction of the PFO channel (Figure 1). Initial attempts to probe the PFO using multiple catheters (Cordis Amplatz Right 1MOD, Cordis Amplatz Left 3, Cordis Internal Mammary, Cordis Judkins Right 4) were unsuccessful. Finally, using a JL 3.5 guiding catheter and a Terumo 260 Guide Wire M 0.035" hydrophilic guidewire allowed passing through the PFO channel into the left atrium (Figure 2).

In the next step, an Amplatz Ultra Stiff Wire Guide with a specially wrapped tip was passed through the JL 3.5 guide. The attempt to fix the wire in the left atrium was unsuccessful, so a decision was made to advance the wire through the mitral valve into the left ventricle (Figure 3). Then, a 9 Fr sheath, nominally used with the Occlutech Figulla sets, was cautiously advanced over the wire into the LV (Figure 4).

To close the PFO, the Figulla Flex II PFO 23/25 mm occluder device was selected due to its attachment mech-

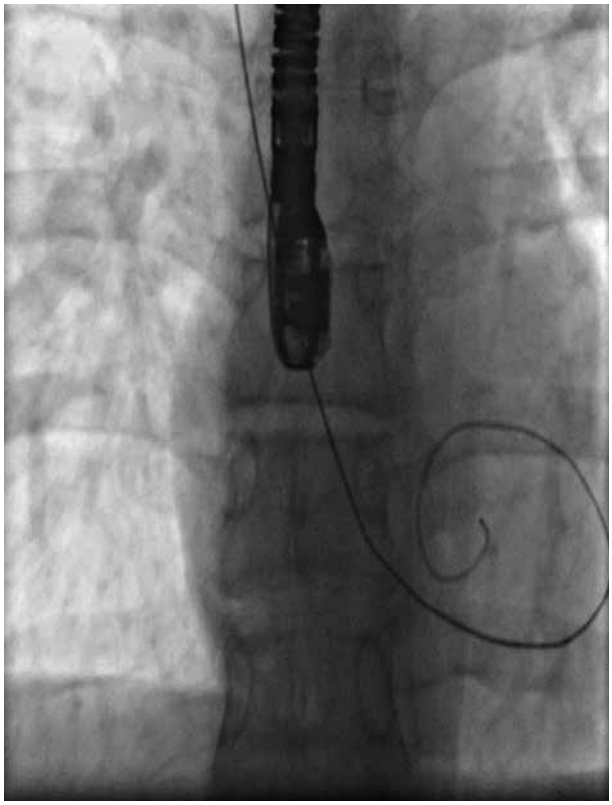

Figure 3. Amplatz Ultra Stiff Wire Guide with a wrapped tip positioned in the left ventricle

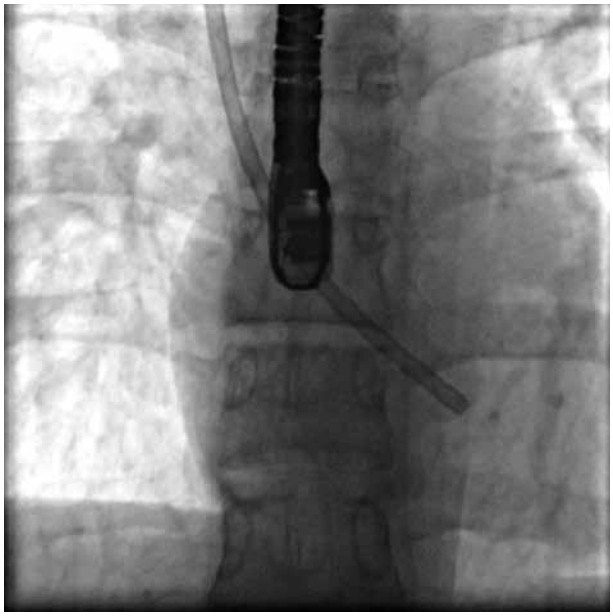

Figure 4. 9 Fr transseptal sheath with distal end in the left ventricle

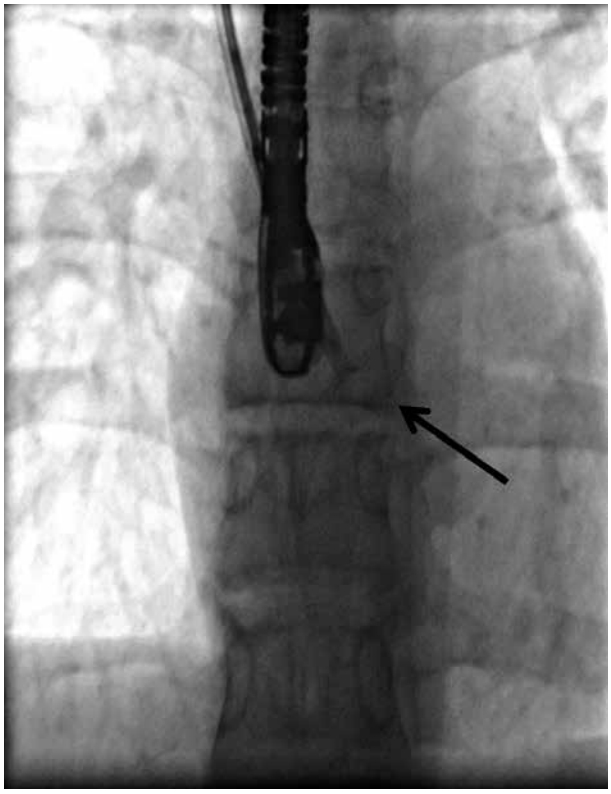

Figure 5. Arrow marks the left atrial disk while being advanced towards the interatrial septum

anism which allows the device to be placed at an acute angle to the delivery system, with minimal tension on the interatrial septum (IAS) directly after implanting the occluder. After carefully withdrawing the sheath above the mitral valve, the left atrial disk of a Figulla Flex II PFO 23/25 mm occluder device was opened (Figure 5) and pulled upon the interatrial septum. Through withdrawing the sheath the right atrial disk was deployed. After confirming proper apposition of the occluder by fluoroscopy and TEE, it was released from the delivery system (Figures 6 and 7).

The procedure was performed using routine antibiotic cover and anticoagulation. The patient received a loading dose of clopidogrel (300 mg) and 75 mg of aspirin. As a continuation of treatment clopidogrel and aspirin in a dose of 1 × 75 mg were prescribed for 6 months. Control transthoracic echocardiography (TTE) performed one and 2 days after the procedure showed correct position of the occluder on the interatrial septum. During hospitalization, the patient suffered from a non-convulsive epilepsy attack. A computed tomography scan of the head excluded embolic etiology. The episode resolved after conventional treatment without any neurological deficits. The consulting neurologist recommended further diagnostics for epilepsy in a neurology outpatient clinic. The patient was discharged home on the second day after the procedure. During a 3-month follow-up the patient was free of any neurological symptoms and TTE revealed proper position of the occluder on the interatrial septum.

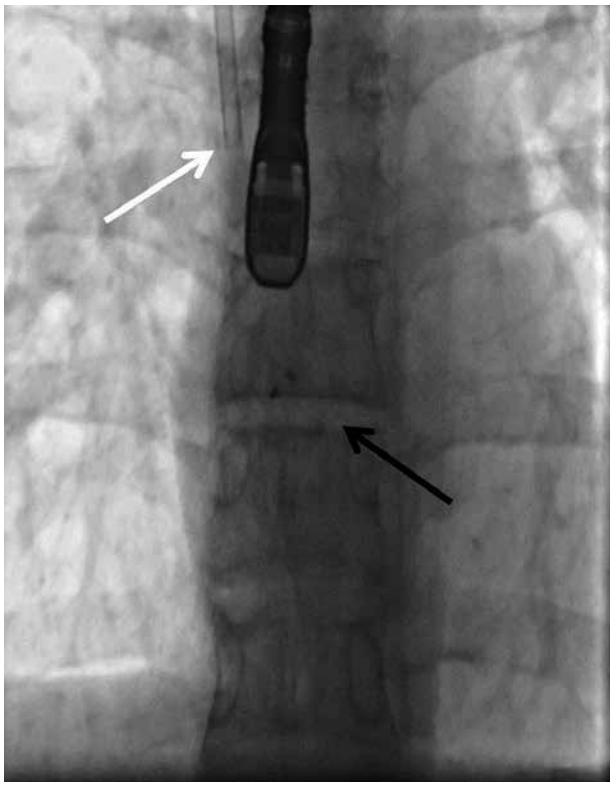

Figure 6. Occluder immediately after implantation (black arrow). 9 Fr sheath visible in the superior vena cava (white arrow)

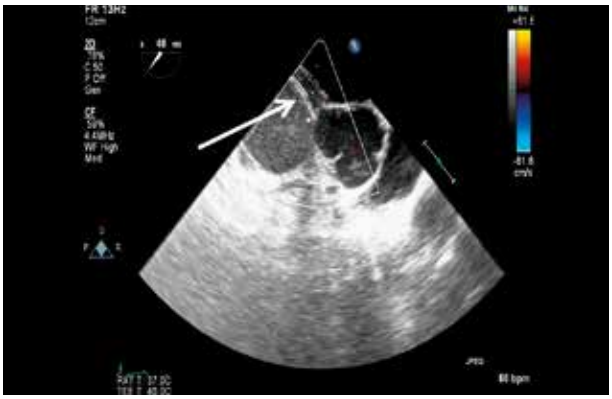

Figure 7. Transesophageal echocardiography image of the occluder immediately after implantation (white arrow)

Discussion

Results of randomized clinical trials, announced last year, on the one hand do not present a conclusive answer to the question of the benefit of performing percutaneous PFO closure, and on the other hand suggest that PFO closure procedures will become a permanent feature in cryptogenic stroke prevention, especially in young patients. These procedures are commonly performed and access through the femoral vein allows them to be effective and safe [1].

In the present case we had to deal with a patient with a very high risk of paradoxical embolism. Co-existing clotting disorder, a history of neurological incidents and the anatomy of the atrial septum were critical elements in the process of qualification for percutaneous PFO closure. Due to thrombosis of the inferior vena cava with prominent venous collaterals and dilatated hepatic veins, it was not possible to perform the procedure using the femoral venous approach or the transhepatic approach [2]. At the time of writing, there were only 2 publications on the use of the internal jugular venous access for percutaneous PFO closure.

In the first publication, Sader et al. reported two cases of PFO closure performed using the internal jugular venous approach [3]. In both cases advancing the catheter through the PFO channel and implanting the occluder directly from the left atrium did not pose any major difficulties. In the second publication, a steerable system was used for occluder implantation [4]. According to our best knowledge, this is the first report of a PFO closure procedure with access through the internal jugular vein using standard implantation equipment and necessity to advance the guide wire and transseptal sheath into the left ventricle.

Performing PFO closure using the right internal jugular venous approach is technically difficult but possible using standard equipment available in the majority of invasive cardiology centers. One of the most challenging stages is advancing the catheter through the PFO, which is physiologically directed towards the inferior vena cava, into the left atrium. This forced us to use a catheter routinely used for left coronary artery catheterization, the tip of which may be pointed towards the PFO channel. Furthermore, the use of a hydrophilic guidewire was crucial to probe the PFO.

As we performed the procedure advancing the JL catheter was difficult but possible after minor maneuvers. However, securing the guidewire in the left atrium was a significant problem, which eventually required advancing the JL catheter into the left ventricle and subsequently protruding the guidewire, curved prior to the maneuver. This maneuver allowed for stable and secure insertion of the 9 Fr transseptal sheath, withdrawing it above the mitral valve and, finally, occluder implantation. We selected the Figulla Flex II PFO 23/25 occluder due to its unique attachment mechanism, which enables implantation at an acute angle to the delivery system.

Conclusions

To our knowledge this is the first report of a successful occluder implantation using the internal jugular venous approach, with the necessity to advance the guide wire and the transseptal sheath into the left ventricle.

In rare cases of an absolute indication for PFO closure and lack of access through the femoral veins, developing alternative techniques seems to be especially important. Because of the potential difficulties in performing the procedure using alternative approaches, their routine use is unlikely but it may have great importance in rare cases where using the transfemoral access is not possible.

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