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LETTER TO THE EDITORS

Percutaneous closure of a large atrial septal defect presenting with acute severe hemolysis

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Sirs:

Hemolysis induced by occlude devices to repair the structural cardiac defects is not very infrequent in intervention cardiology. The unavoidable residual leaks, which are featured by high velocity, vortices, and rapid deceleration, impose significant shear on red blood cells leading to hemolysis [1, 2]. There are several cases that reported acute hemolysis after transcatheter closure of VSD or PDA in the literature [3, 4]. However, hemolysis due to intracardiac device for ASD closure is rather rare. Although in some cases surgical removal of the device or transcatheter occlusion of a residual shunt may be necessary, most hemolysis can be conservatively managed with fluids, sodium bicarbonate, and corticosteroids.

A 51-year-old female weighing 54 kg was admitted to the catheter lab with the aim of performing a transcatheter device closure of ASD. She presented a 2-year history of exertional chest distress. The second heart sound was prominent, and a grade 3/6 systolic murmur was heard at the left midsternal border during physical examination. Any marked abnormality was not detected in the laboratory tests. Electrocardiogram showed complete right bundle branch block and echocardiography revealed the presence of a large secundum-type ASD with a diameter of 35 mm, as well as mild mitral valve regurgitation and severe tricuspid regurgitation. The pulmonary artery systolic pressure (PASP) gradient was 90mm Hg as estimated by the Doppler method (Fig. 1a).

After preoperational preparation, diagnostic catheterization revealed an elevated mean pulmonary artery pressure (mPAP) of 38 mm Hg, and a 50-mm SHSMA™ (Shanghai Shape Memory Alloy Co., Ltd., Shanghai, China) ASD occluder was implanted via right femoral venous approach through a 14F delivery sheath (Fig. 1b). Intraoperative echocardiography showed the proper position of the occluder (Fig. 1c, d). After the procedure, the patient was treated with heparin and aspirin as well as continuous ECG monitoring during hospitalization.

On the first day after the operation, the patient had developed intense hemolysis marked by dark coloured urine and her haemoglobin was 10.7 g/dL. Anticoagulation was ceased, while sodium bicarbonate for urinary alkalization and dexamethasone was immediately administered. On the second day, her haemoglobin dropped to 9.7 g/dL, but fortunately the vital signs were stable and the colour of urine turned lighter. Echo on day three showed minor residual shunt across the device which is common in large arial septal defect. Severe mitral and tricuspid valve regurgitation were observed and impinging on the left and right discs of the prosthesis, respectively (Fig. 1e). The patient was discharged when urine colour changed gradually from Coca Cola to normal on day 8, with Hb 95 g/L.

Four months after the closure, the patient came to our hospital for a reexamination. Her haemoglobin increased to 11.6 g/dL and urine test was normal. Echo showed minor residual shunt across the device and severe tricuspid regurgitation with normal cardiac function. What was interesting was that her mitral valve regurgitation turned from severe to moderate.

Device closure of septal defects may result in various complications such as endocarditis, device embolisation, cardiac rupture and arrhythmias. Haemolysis, a rare but potentially hazardous complication that can cause acute renal failure and even mortality, has been documented after transcatheter device closure of congenital heart diseases, including PDA, ASD and VSD. Although surgery or transcatheter intervention is required in some patients with severe intravascular haemolysis, this complication is generally managed conservatively.

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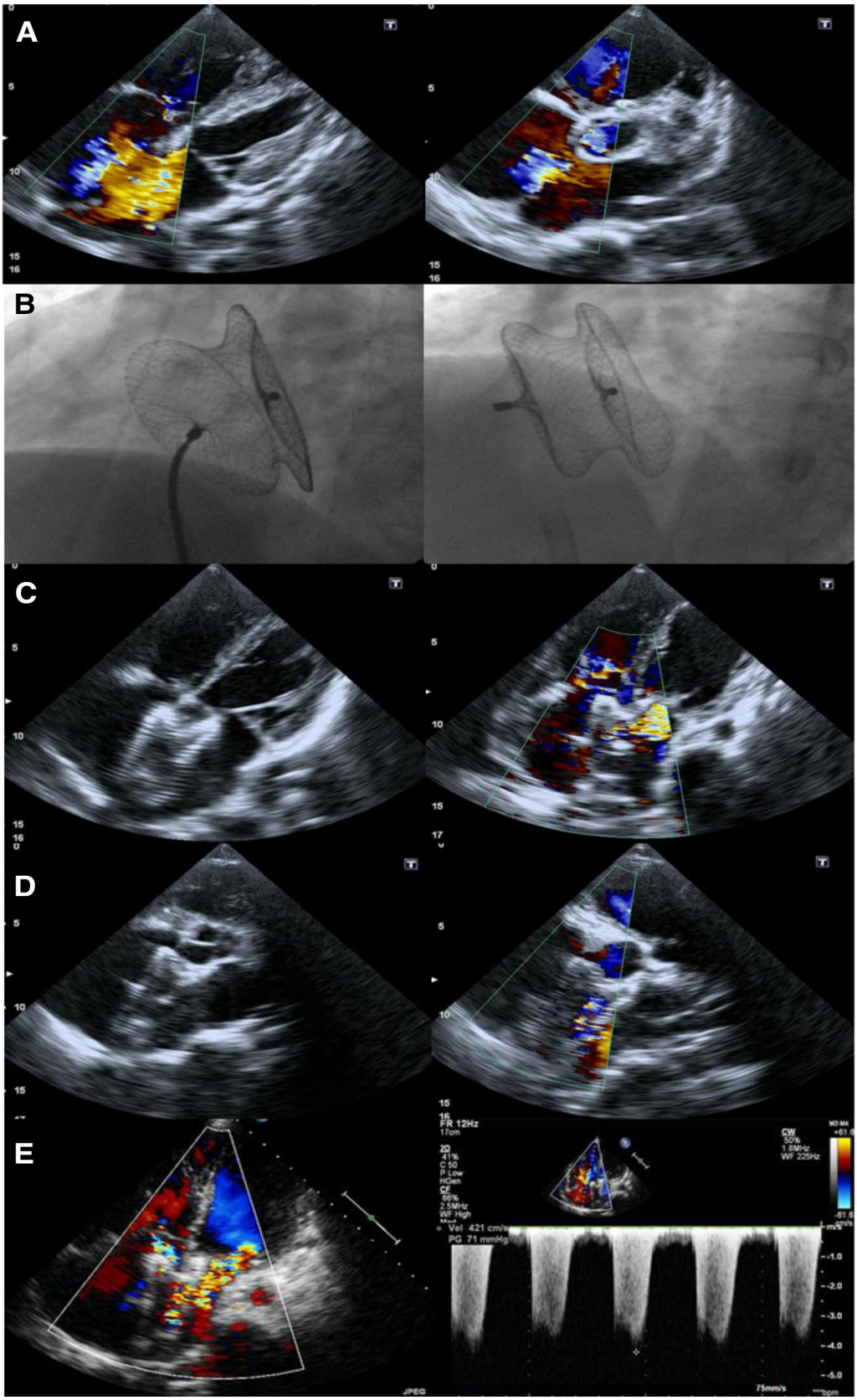

Fig. 1 **a** Echo demonstrating ASD before the closure. **b** Angiogram shows atrial septal occluder. **c, d** Intraoperative echocardiography showed the proper position of the occluder. **e** Echo on day 3 after the procedure

Transcatheter device closure of secundum ASDs has been described as an effective and acceptable alternative to surgical intervention with encouraging short-term and long-term results. Nowadays, almost 85–90% of all secundum ASD can be closed using a transcatheter approach with infrequent complications such as device embolization, new complete AV block onset and myocardial erosion, which may limit closure feasibility and success [5, 6]. However, as one of the rare complications, hemolysis has not been come across as related to ASD closure in our experience from 2008 to 2017. In cases of VSD or PDA, ongoing remodeling, serpiginous pathway, improper size of the device, and incorrect alignment of device during implantation are the several reasons for device malposition leading to tiny high-velocity residual leaks. In our case, due to very minor residual shunt occurrence and proper device size delineated by echocardiography and DSA, it was thought that the big size of ASD as well as severe mitral and tricuspid valve regurgitation were the reasons for significant shear on red blood cells which may be the mechanical cause for hemolysis.

Compared to the small defect, the formation of thin membrane on the surface of our larger occluder was relative slow. The association of a residual shunt with flow of atrioventricular valve regurgitation, impinging on the left or right disc of the occluder, increased erythrocyte fragility and resulted in rupture of erythrocyte. Discontinuation of aspirin and heparin can help fibrin and platelet adhere to the surface of the device and promote the formation of a protective tissue on its surface; thus, red blood cells avoided direct collision with the nickel–titanium wire, which helps to alleviate hemolysis.

Acute hemolysis is a rare but severe complication for transcatheter occlusion of ASD. The reason is probably the mitral regurgitation jet hitting the occluder rim sticking out in the left atrium. The oversized closure device is not well aligned to the wall initially but flattens out on the first day or two and the jet no longer hits the rim after that, leading to alleviative hemolysis. Conservative therapy including fluids, sodium bicarbonate and corticosteroids may be effective with stable hemodynamics.

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Compliance with ethical standards

Conflict of interest All authors declare that they have no conflict of interest.

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