Blade Balloon Atrial Septostomy to Enlarge a Restrictive Atrial Septal Defect

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SUMMARY

A nonrestrictive atrial septal defect is mandatory in order to maintain an adequate cardiac output or to achieve an acceptable blood mixing in some patients with complex congenital heart defects. We successfully performed a blade balloon septostomy in a patient with a restrictive atrial septal defect who had previously undergone a failed static balloon dilation of the atrial septum.

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Key words > Heart Defects, Congenital - Heart Septal Defects, Atrial - Septostomy

Abbreviations >

RA	Right atrium	TEE	Transesophageal ecochardiogram
LA	Left atrium	IAS	Interatrial septum
ASD	Atrial septal defect	RVOT	Right ventricular outflow tract

BACKGROUND

A nonrestrictive atrial septal defect is mandatory in order to maintain an adequate cardiac output or to achieve an acceptable blood mixing in some patients with complex congenital heart defects. Up to the present, percutaneous techniques used to enlarge a restrictive ASD include Rashkind balloon septostomy, blade atrial septostomy with Park blade catheter, static balloon dilatation of the atrial septum and stent placement. (1-4) Balloon septostomy turns out to be difficult after the newborn period as the interatrial septum (IAS) becomes thicker and hemodinamically ineffective. We successfully performed a blade balloon septostomy in an infant with a restrictive atrial septal defect who had previously undergone a failed static balloon dilation of the atrial septum. The intervention was monitored with transesophageal echocardiogram (TEE) and a significant enlargement of the atrial septal defect was achieved with favorable clinical outcomes.

CASE REPORT

We describe the case of a full-term male newborn with appropriate weight for gestational age (3.5 kg), delivered by cesarean section, with a diagnosis of tricuspid atresia type IB performed 48 hours after birth. ASD diameter was 5 mm with no signs of restriction. When the baby was 53 days old, he was readmitted with progressive cyanosis and congestive heart failure. A color-Doppler echocardiogram showed a reduction in ASD size to 3.2 mm with signs of restriction and an increase in the RVOT gradient from 29 to 55 mm Hg. A static balloon dilation of the atrial septum was performed with a balloon catheter 14 mm in diameter and 30 mm long; the transatrial gradient fell from 3 to 0 mm Hg, and arterial oxygen saturation breathing room air increased from 75% to 82%.

At the age of 3 months and a half, the baby weight was 3.6 kg and presented progression of the cyanosis; he was hospitalized again with clinical and ecocardiographic evidence of restrictive ASD which had a diameter of 3.2 mm. Right atrium (RA) size had increased; the liver was enlarged 6 cm below the right costal margin, respiratory rate was 66 breaths per minute and peripheral oxygen saturation was 77%.

A new cardiac catheterization was performed under general anesthesia and a 7F system was introduced into the right femoral vein. Heparin (100 U/kg) and a cephalosporin (50 mg/kg) were administrated. RA and left atrium (LA) pressures were 14 mm Hg and 9 mm Hg, respectively. TEE reported an ASD diameter of 3.7 mm with accelerated blood flow passing through the defect. A 0.018” guide wire was positioned in the LA, adopting the shape of the LA body. We intentionally avoided placing the guide wire in the pulmonary veins to prevent possible damages. With the help of TEE monitoring, a balloon catheter with blades 7mm in diameter and 10mm in length

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(Boston Scientific®) was advanced over this guide wire to the interatrial septum. Then the balloon was insufflated several times and it was slightly advanced, withdrawn and rotated clockwise with each insufflation, making incisions in different parts of the septum. Afterwards a balloon catheter (Cordis®) 15 mm in diameter by 30 mm long was advanced over a 0.035" guide wire and was insufflated until the notch disappeared (Figure 1 A and B) in order to enlarge the interatrial septum.

Immediately, the TEE showed that the ASD diameter had significantly increased to 9.8 mm and there were no signs of restriction. In addition, transatrial pressure gradient had disappeared (LA and RA pressures were 9 mm Hg) (Figure 2A and B), and peripheral saturation had increased to 85%.

Thirteen months after the intervention, the patient remains clinically stable, waiting for the moment to undergo Glenn surgery. The last transthoracic color echo-Doppler reported that the diameter of the ASD was 7.5 mm with no signs of restriction; peripheral oxygen saturation was 83% breathing room air.

DISCUSSION

Limiting factors for favorable outcomes after a conventional septostomy are a small LA, an elastic aneurysm of the IAS, and a thick IAS. These factors reduce the effectiveness of the procedure and increase the risk of pulmonary veins and LA perforation and/or avulsion. In the same way, a small LA size is a limitation to blade atrial septostomy with Park blade catheter, so it is not recommended for small infants; the procedure uses long and wide sheaths which may damage the vessels, and obstructions of the inferior vena

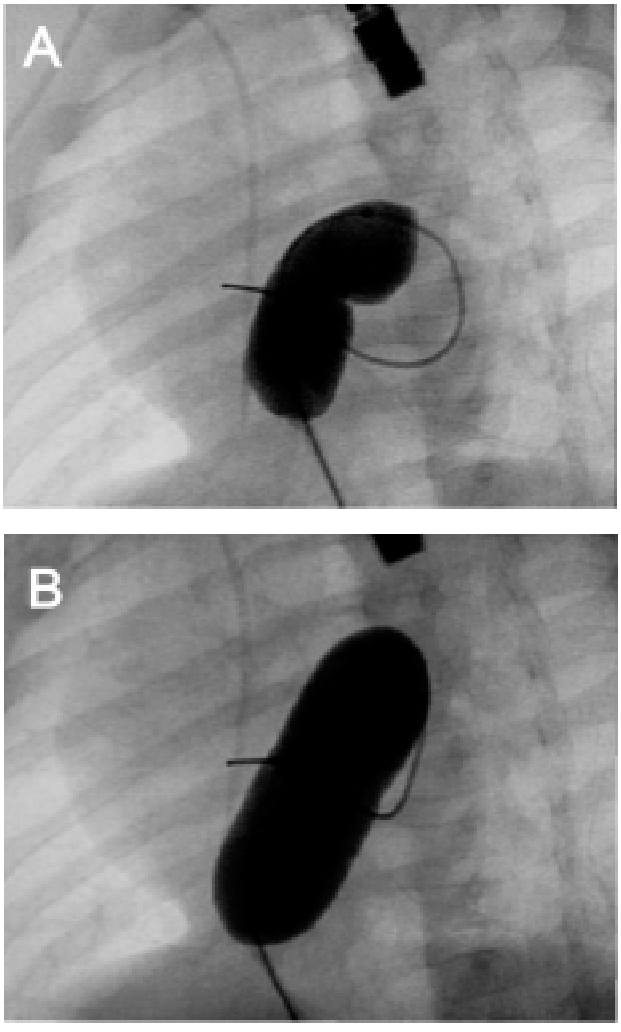

Fig. 1. A y B. Fluoroscopic image of the balloon on the IAS before (A) and after (B) the complete insufflation until the notch disappeared, employing axial projections 30 degrees LAO/ 30 degrees cranial. See the position of the guide wire adopting the shape of the LA.

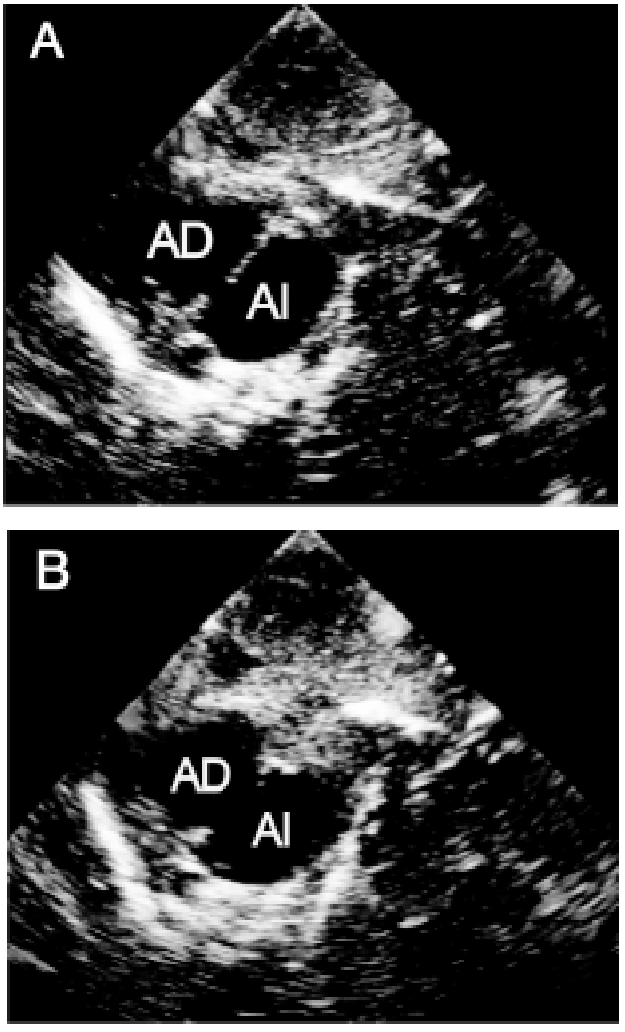

Fig. 2. A y B. Transthoracic echocardiogram images. Subcostal views before (A) and after (B) subsequent enlargements of the IAS with cutting balloon and conventional balloon catheter; a significant increase in the size of the ASD is observed.

cava or other conditions that prohibit the femoral approach preclude using this technique.

Static balloon dilatation of the atrial septum is an alternative option in small infants, but the evidence shows that the results do not last long as progressive stenosis develops. (4, 10)

During the last years, stent placement in the IAS has been exceptionally reported, particularly in patients with hypoplastic left heart syndrome and intact IAS, to maintain an adequate ASD. The novel concepts of "butterfly" or "dog-bone" stents placed across the atrial septum might create a precisely sized ASD that may be more conducive to effectively lower left atrial hypertension, yet avoiding excessive pulmonary blood flow associated with large ASD. (12)

The use of cutting balloon catheters has been described with diverse outcomes in pediatric patients to enlarge a great number of lesions, such as resistant peripheral pulmonary artery stenosis, pulmonary vein stenosis, renal artery stenosis, systemic and pulmonary collateral artery stenosis, and recanalization of the femoral artery and of the right ventricular outflow tract in patients with tetralogy of Fallot. (5-11) Radiofrequency perforation and cutting balloon septoplasty have been performed in newborns with hypoplastic left heart syndrome and transposition of the great arteries with intact IAS to create and ASD. (9, 10)

Although the evidence regarding the use of cutting balloon catheter to enlarge an ASD and the durability of a restrictive ASD is limited, short-term outcomes are promising. Several authors have suggested that the microblades of the cutting balloon allow a controlled tear of the IAS, which is contrary to the stretching produced by the static balloon dilatation in patients with a thicker IAS. The advance/withdraw movements and clockwise/counterclockwise rotation of the balloon which tend to produce tears in different points of the IAS might improve the outcomes of a subsequent static balloon dilatation, possibly resulting in a long-lasting and larger ASD. (9)

TEE plays an outstanding role to guide the procedure and monitor its outcomes. It is extremely helpful during the placement of the cutting balloon over the IAS (placement guided by angiography is difficult as the blades are10 mm long), it provides immediate information of the results of the procedure (diameter of the orifice, degree of restriction) and minimizes its duration, avoiding the manipulation of catheters to estimate pressures and to perform a post-procedure angiography. TEE is also useful to rule out acute complications such as hemopericardium, new valvular regurgitations, etc.

Finally, we consider that the use of cutting balloon catheter to enlarge a restrictive ASD is a valid option in selected cases. TEE monitoring is very important to warrant the success of the procedure.

RESUMEN

La presencia de una comunicación interauricular no restrictiva es obligatoria para mantener un gasto cardíaco adecuado o para lograr una mezcla de sangre aceptable en algunos pacientes portadores de cardiopatías congénitas complejas. Describimos un paciente en quien luego de un intento fallido de dilatación estática con balón de una comunicación interauricular restrictiva se utilizó un balón con cuchillas con éxito para su ampliación.

Palabras clave > Cardiopatía congénita - Defectos del septum interauricular - Septostomía

BIBLIOGRAPHY

1. Rashkind WJ, Miller WW. Creation of an atrial septal defect without thoracotomy. A palliative approach to complete transposition of the great arteries. JAMA 1966;196:991-2.

2. Mullins CE. Blade/balloon atrial septostomy, special atrial septostomies, atrial "stent septostomy". En: Mullins CE. Cardiac Catheterization in Congenital Heart Disease: Pediatric and Adult. Blackwell Publishing; 2006. p. 392-409.

3. Park SC, Neches WH, Mullins CE, Girod DA, Olley PM, Falkowski G, et al. Blade atrial septostomy: collaborative study. Circulation 1982;66:258-66.

4. Galantowicz M, Cheatham JP. Lessons learned from the development of a new hybrid strategy for the management of hypoplastic left heart syndrome. Pediatr Cardiol 2005;26:190-9.

5. Seale AN, Daubeney PE, Magee AG, Rigby ML. Pulmonary vein stenosis: initial experience with cutting balloon angioplasty. Heart 2006;92:815-20.

6. Haas NA, Ocker V, Knirsch W, Holder M, Lochbuehler H, Lewin MA, et al. Successful management of a resistant renal artery stenosis in a child