

CASE REPORT

Intracardiac echocardiography-guided percutaneous mitral balloon valvuloplasty

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Received 26 July 2012; accepted 2 August 2012

Available online 20 March 2013

KEYWORDS

Intracardiac
echocardiography;
Mitral balloon
valvuloplasty

PALAVRAS-CHAVE

Ecocardiografia
intracardiaca;
Valvuloplastia mitral
percutânea por balão

Abstract Percutaneous mitral balloon valvuloplasty (PMBV) was initially described by Inoue in 1984 as a novel percutaneous technique for the management of mitral stenosis. Intracardiac echocardiography was initially used in the 1980s but was not universally accepted due to its high-frequency transducers and problems with steerability and manipulation. In the 1990s technical improvements led to more generalized use in various structural interventional procedures. We present the case of a successful PMBV guided exclusively by ICE.

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Ecocardiografia intracardiaca – Valvuloplastia mitral percutânea conduzida por balão

Resumo A valvuloplastia mitral percutânea por balão foi inicialmente descrita por Inoue em 1984 como uma nova técnica percutânea para o tratamento da estenose mitral. A ecocardiografia intracardiaca foi inicialmente utilizada na década de 80 sem aceitação universal devido à alta frequência dos transdutores e à sua capacidade de manobra e manuseamento problemáticos. Na década de 90 melhorias técnicas conduziram à sua utilização mais generalizada em diversos procedimentos de intervenção estrutural. Os autores apresentam um caso de uma valvuloplastia mitral percutânea conduzida por ecocardiografia intracardiaca.

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Introduction

Percutaneous mitral balloon valvuloplasty (PMBV) was initially described by Inoue in 1984 as a novel percutaneous technique for the management of mitral stenosis.¹ PMBV provides excellent immediate and mid-term results

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comparable to surgical mitral commissurotomy² and is currently the standard of care for selected patients with moderate or severe mitral stenosis.³

Although PMBV can be performed by a retrograde non-transeptal technique with comparable clinical results, most North American centers use the transeptal Inoue technique due to ease of use and greater experience.⁴ Transeptal puncture is a critical and challenging step because of the distorted septal anatomy in most mitral stenosis patients. It commonly constitutes the longest part of the procedure and a failure or complication may terminate the case or place the patient at significant risk or subject to unnecessary long hospitalizations. Traditionally, transeptal puncture was performed using angiographic landmarks. The use of transesophageal echocardiography (TEE) has improved the safety and efficiency of the procedure and it is currently the preferred method in most North American institutions.

Intracardiac echocardiography was initially used in the 1980s but was not universally accepted due to its high-frequency transducers and problems with steerability and manipulation.⁵ In the 1990s technical improvements led to more generalized use in various structural interventional procedures. The first successful balloon valvuloplasty using ICE was described in 2002 by Salem.⁶

Case report

A 31-year-old woman with known rheumatic mitral valve disease was referred for PMBV. She had been diagnosed with rheumatic heart disease four years previously after a routine transthoracic echocardiogram (TTE) and she had been asymptomatic during her recent annual clinic visits.

Over the previous three months she had noticed progressive dyspnea on exertion limiting her daily activities. The ECG showed normal sinus rhythm with left atrial enlargement. Repeat TTE revealed progressive moderate mitral stenosis with a mean valve area of 1.2 cm² and mild mitral regurgitation, preserved left ventricular ejection fraction (LVEF), moderate left atrial enlargement and normal pulmonary artery pressure. A treadmill stress echocardiogram with a standard Bruce protocol was ordered, during which she performed 6 METS, which was less than normal for her age. She experienced significant dyspnea towards the end of the test with no associated left ventricular wall motion abnormalities but with a mean transmitral gradient increased from 8 mmHg to 17 mmHg, consistent with severe obstruction.

Elective PMBV was scheduled. Standard right heart catheterization was initially performed to invasively assess right heart pressures. Through a second right transfemoral venous access, the ICE catheter probe was advanced to the mid segment of the right atrium in order to visualize the atrial septum and guide the transeptal puncture. All septal borders were assessed before and during the tenting of the septum with the Mullin catheter (Figure 1A). After identification of the optimal interatrial septal position for puncture, the Brockenbrough needle and the sheath were advanced to the left atrium. With angiographic and ICE guidance the mitral valve balloon was advanced and inflated (Figure 1B).

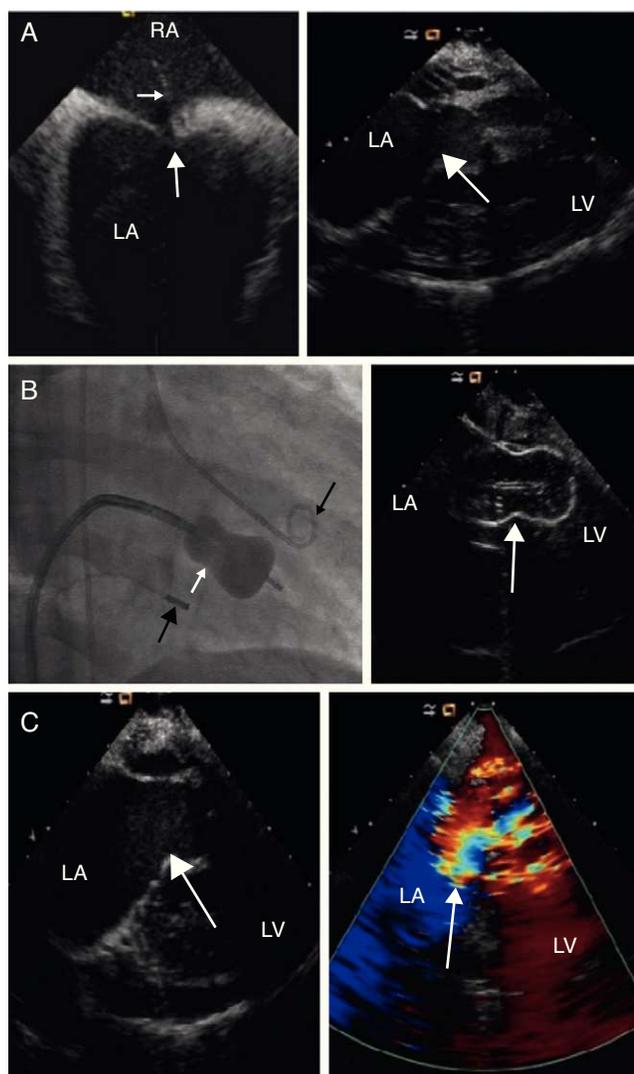


Figure 1 (A) Left: ICE image showing tenting of the interatrial septum (large white arrow) with the Mullins catheter and Brockenbrough needle (small white arrow). LA: left atrium; RA: right atrium. Right: ICE 2-chamber view after insertion of the ICE probe into the right ventricle (RV). Visualization of the mitral valve (white arrow) prior to percutaneous mitral balloon valvuloplasty. Left atrial enlargement and left ventricular function and dimensions can be assessed. (B) Percutaneous mitral balloon valvuloplasty. Angiographic and ICE visualization of the inflated Inoue balloon (white arrow). ICE catheter probe (large black arrow) is located in the RV and the pig-tail catheter (small black arrow) in the left ventricle. (C) Post-PMBV ICE assessment. Left: two-dimension assessment. Right: Doppler evaluation of the mitral valve showing 1+ mitral regurgitation.

Immediate assessment of the post-procedural mitral valve morphology, transmitral valve gradient and mitral regurgitation were performed by fluoroscopy and ICE (Figure 1C).

Discussion

Transeptal puncture is an important skill for interventional cardiologists. The significant decrease in the incidence of mitral stenosis in the USA and the universal acceptance of

echocardiography, cardiac computed tomography (CT) and cardiac MRI as alternative accurate and safe non-invasive imaging modalities have significantly decreased the number of transeptal punctures in most cardiac catheterization labs. Today fewer centers which are involved in structural heart interventions perform routine transeptal punctures and maintain their operators' expertise.

ICE-guided structural heart disease procedures have gained increasing attention due to the ease of ICE use, the improved imaging resolution, use of Doppler and the feasibility of three-dimensional imaging applications.⁷ Compared to plain angiography, it achieves accurate assessment of the atrial septum and the adjacent anatomic structures, improving the safety of the puncture and the operator's level of comfort with a lower radiation exposure. Compared to TEE it eliminates the need for deeper procedural sedation, patient intubation and the involvement of an additional operator, with a probable decrease of the overall procedural cost.⁸

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that no patient data appear in this article.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

Conflicts of interest

The authors have no conflicts of interest to declare.

References

1. Inoue K, Owaki T, Nakamura T, et al. Clinical application of transvenous mitral commissurotomy by a new balloon catheter. *J Thorac Cardiovasc Surg.* 1984;87:394–402.
2. Multicenter experience with balloon mitral commissurotomy. NHLBI Balloon Valvuloplasty Registry Report on immediate and 30-day follow-up results. The National Heart, Lung, and Blood Institute Balloon Valvuloplasty Registry Participants. *Circulation.* 1992;85:448–61.
3. Bonow RO, Carabello BA, Kanu C, et al. ACC/AHA 2006 guidelines for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (writing committee to revise the 1998 Guidelines for the Management of Patients With Valvular Heart Disease): developed in collaboration with the Society of Cardiovascular Anesthesiologists: endorsed by the Society for Cardiovascular Angiography and Interventions and the Society of Thoracic Surgeons. *Circulation.* 2006;114:e84–231.
4. Iakovou I, Pavlides G, Voudris V, et al. Outcome of percutaneous mitral balloon valvuloplasty: comparison of the inoue and retrograde non-transseptal techniques. A single-center experience. *J Invasive Cardiol.* 2002;14:522–6.
5. Jongbloed MR, Schalij MJ, Zeppenfeld K, et al. Clinical applications of intracardiac echocardiography in interventional procedures. *Heart.* 2005;91:981–90.
6. Salem MI, Makaryus AN, Kort S, et al. Intracardiac echocardiography using the AcuNav ultrasound catheter during percutaneous balloon mitral valvuloplasty. *J Am Soc Echocardiogr.* 2002;15:1533–7.
7. Smith SW, Light ED, Idriss SF, et al. Feasibility study of real-time three-dimensional intracardiac echocardiography for guidance of interventional electrophysiology. *Pacing Clin Electrophysiol.* 2002;25:351–7.
8. Budts W, Troost E, Voigt JU, et al. Intra-cardiac echocardiography in atrial septal interventions: impact on hospitalization costs. *Acta Cardiol.* 2010;65:147–52.