



Contents lists available at ScienceDirect

## Journal of Cardiology Cases

journal homepage: [www.elsevier.com/locate/jccase](http://www.elsevier.com/locate/jccase)

## Editorial

## Editorial: Percutaneous mitral valvotomy: Balloon made in Japan still dominates the world



## Keywords:

Mitral stenosis  
Balloon mitral valvotomy  
Echocardiography

Balloon mitral valvotomy (balloon mitral valvuloplasty/percutaneous transvenous mitral commissurotomy) has been established as an effective procedure for rheumatic mitral stenosis, since the interventional procedure was firstly introduced by the Japanese cardiologist Kanji Inoue MD in the early 1980s [1,2]. The interventional procedure utilizing the Inoue balloon has been reported to be technically successful in over 90% of patients with its excellent long-term durability. In these decades, the prevalence of rheumatic fever has been decreasing in developed countries, and the number of patients with rheumatic mitral stenosis has also been decreasing. Nevertheless, rheumatic fever still affects numerous areas in the nonindustrialized world, and mitral valve balloon valvotomy using the Inoue balloon helps patients worldwide who are suffering with stenotic mitral valve. The Inoue balloon has been used internationally as the first choice for catheter intervention for significant mitral stenosis for over 30 years, with its high technical feasibility and excellent results.

The effectiveness of balloon valvotomy is known to be related to the etiology of valve stenosis, and severe rheumatic mitral stenosis with minimally deformed or calcified submitral apparatus was originally considered as an ideal candidate for the balloon mitral valvotomy. Patients with severely calcified valves or subvalvular apparatus are generally considered as candidates for surgical intervention, and other structural findings might suggest balloon valvuloplasty to be less likely successful or even contraindicated.

Transthoracic and transesophageal echocardiography play a major role in the patient selection for balloon mitral valvotomy. Etiology and severity of the mitral stenosis should be observed by echocardiography as a first step in considering the indication of balloon mitral valvotomy. Once the degree is diagnosed as moderate to severe, its functional disability should be investigated considering other clinical findings. Pulmonary pressures at rest and with exercise are the important parameters in considering the indication of intervention. Coexistence of more than moderate mitral regurgitation and the presence of left atrial thrombus are considered as contraindications to balloon mitral valvotomy

[3]. Subvalvular involvement and its degree should also be carefully evaluated by transthoracic and transesophageal echocardiography. A recent study has reported that balloon valvotomy is effective even in patients with mild–moderate degree of calcification [4]. According to their results, long-term functional outcome depends on calcification extent, patient characteristics, and immediate results of valvuloplasty. The authors suggested that percutaneous mitral balloon valvotomy can be considered as first-line treatment in selected patients with calcific mitral stenosis.

Echocardiography also plays an important role during the catheter intervention. Echocardiographic guidance is necessary in the stepwise dilation technique using the Inoue balloon, which comes in four sizes, ranging from 24 to 30 mm. The balloon size is chosen depending on the body size of the patients, and the first inflation is performed to the minimum diameter of the balloon chosen. After the initial ballooning, morphological changes in the mitral valve should be observed, according to the types of valve split. Mitral valve area can be measured by 2D or 3D planimetry with transthoracic short-axis view. Mitral valve area should be measured in its smallest plane, which should be carefully scanned with 2D echocardiography. Real-time 3D scanning helps in imaging the smallest area of the stenotic valve orifice during balloon valvuloplasty [5]. Echocardiographic findings immediately after valvuloplasty are the key to determine when to stop the procedure. Mitral valve area, pattern of crackle, existence and degree of regurgitation should be carefully observed after each ballooning procedure. Pre/post-procedural echocardiography also contributes to find other abnormal findings. A manuscript from India in the current issue of *Journal of Cardiology Cases* [6] reports an incidental diagnosis of subclinical patent ductus arteriosus by preoperative transthoracic echocardiography before balloon valvotomy for severe mitral stenosis. Once other cardiac disease was found, clinical significance and hemodynamic impact of the abnormal finding in combination with mitral stenosis should be carefully investigated. Iatrogenic atrial septal defect caused by atrial septal puncture during the procedure can be imaged by using color Doppler echocardiography. Serial follow-up study by transesophageal echocardiography has shown that there was a significant decrease in the diameter of an interatrial septal defect

DOI of original article: <http://dx.doi.org/10.1016/j.jccase.2016.01.011><http://dx.doi.org/10.1016/j.jccase.2016.03.009>

1878-5409/© 2016 Japanese College of Cardiology. Published by Elsevier Ltd. All rights reserved.

with the time course after the procedure, and the left-to-right shunt remained in 20% of the study subject 6 months after valvotomy [7].

Balloon mitral valvotomy is feasible in patients with recurrent mitral stenosis who have undergone surgical commissurotomy. Overall results are good, although they are slightly less satisfactory when compared with those of primary balloon commissurotomy. A case of successful percutaneous balloon mitral valvotomy for bioprosthetic stenosis is also reported by the group of the balloon pioneer. Usefulness of catheter commissurotomy for those different conditions should be evaluated.

Successful results of percutaneous balloon valvotomy in patients with nonrheumatic mitral stenosis have been reported. Lo et al. reported 7 symptomatic patients with stenotic double-orifice mitral valve of incomplete bridge type. They performed stepwise dilations only to the posteromedial orifice with the use of an Inoue balloon, which resulted in successful split of the fibrous bridge tissue between the leaflets [8]. Nonrheumatic calcific/degenerative change in the mitral valve has been recently reported as an important cause of clinically significant mitral stenosis in this aging society [9]. A case of successful balloon valvotomy in a patient with nonrheumatic calcific mitral stenosis has been reported [10], and further clinical evaluation should be needed to appreciate the feasibility, safety, and effectiveness of the percutaneous catheter intervention for nonrheumatic mitral stenosis.

## References

- [1] Inoue K, Owaki T, Nakamura T, Kitamura F, Miyamoto N. Clinical application of transvenous mitral commissurotomy by a new balloon catheter. *J Thorac Cardiovasc Surg* 1984;87:394–402.
- [2] Inoue K, Feldman T. Percutaneous transvenous mitral commissurotomy using the Inoue balloon catheter. *Cathet Cardiovasc Diagn* 1993;28:119–25.
- [3] Nishimura RA, Otto CM, Bonow RO, Carabello BA, Erwin 3rd JP, Guyton RA, O’Gara PT, Ruiz CE, Skubas NJ, Sorajja P, Sundt 3rd TM, Thomas JD. *AHA/ACC guideline 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*. *J Am Coll Cardiol* 2014;63:e57–185.
- [4] Bouleti C, Iung B, Himbert D, Messika-Zeitoun D, Brochet E, Garbarz E, Cormier B, Vahanian A. Relationship between valve calcification and long-term results of percutaneous mitral commissurotomy for rheumatic mitral stenosis. *Circ Cardiovasc Interv* 2014;7:381–9.
- [5] Zamorano J, Perez de Isla L, Sugeng L, Cordeiro P, Rodrigo JL, Almeria C, Weinert L, Feldman T, Macaya C, Lang RM, Hernandez Antolin R. Non-invasive assessment of mitral valve area during percutaneous balloon mitral valvuloplasty: role of real-time 3D echocardiography. *Eur Heart J* 2004;25:2086–91.
- [6] Sahoo D, Kumar S, Kapoor A. Silent patent ductus arteriosus incidentally found before balloon mitral valvotomy for severe rheumatic mitral stenosis. *JC Cases* 2016;13:165–8.
- [7] Yoshida K, Yoshikawa J, Akasaka T, Yamaura Y, Shakudo M, Hozumi T, Fukaya T. Assessment of left-to-right atrial shunting after percutaneous mitral valvuloplasty by transesophageal color Doppler flow-mapping. *Circulation* 1989;80:1521–6.
- [8] Lo PH, Hung JS, Lau KW, Kim MH, Ku PM, Krayyem M. Inoue-balloon mitral valvuloplasty in double-orifice mitral stenosis. *J Invasive Cardiol* 2003;15:301–3.
- [9] Iwataki M, Takeuchi M, Otani K, Kuwaki H, Yoshitani H, Abe H, Lang RM, Levine RA, Otsuji Y. Calcific extension towards the mitral valve causes non-rheumatic mitral stenosis in degenerative aortic stenosis: real-time 3D transesophageal echocardiography study. *Open Heart* 2014;1:e000136.
- [10] Knapper JT, Hartlage GR, Clements SD. Transfemoral balloon mitral valvuloplasty for severe nonrheumatic mitral stenosis. *JACC Cardiovasc Interv* 2014;7:e167–8.

Nozomi Watanabe (MD, PhD, FJCC, FACC, FESC)\*  
Miyazaki Medical Association Hospital Cardiovascular Center,  
Miyazaki, Japan

\*Correspondence to: Department of Clinical Laboratory,  
Noninvasive Cardiovascular Imaging, Miyazaki Medical  
Association Hospital Cardiovascular Center, 738-1 Funado,  
Shinbeppu-cho, Miyazaki 880-0834, Japan. Tel.: +81 0985 24 9119;  
fax: +81 0985 23 2210  
E-mail address: [n\\_watanabe@cure.or.jp](mailto:n_watanabe@cure.or.jp) (N. Watanabe).

1 March 2016