

Importance of apico-mitral axis during percutaneous transmitral commissurotomy

Znaczenie osi koniuszkowo-mitralnej w trakcie przezskórnej komisurotomii mitralnej

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Abstract

The development of acute severe mitral regurgitation (MR) requiring surgery is one of the most dreaded complications of percutaneous transmitral commissurotomy. We present the case of a 29 year-old female with severe rheumatic mitral stenosis whose mitral valve dilatation was performed using an Accura balloon. Once the balloon catheter had crossed the mitral valve to reach the left ventricle, it was facing away from the apico-mitral axis. It was inflated in distal portion, and mitral valve dilatation was done in the usual fashion. She developed acute severe MR. As it was misaligned with the apico-mitral axis, it caused a chordae rupture of the postero-medial papillary muscle which was identified during surgery. We conclude that a misaligned Accura balloon catheter during balloon inflation can pluck the chordae tendinae and can cause acute severe mitral regurgitation, and therefore can unearth the underlying subvalvular pathology.

Key words: severe mitral regurgitation, Accura balloon, apico-mitral axis, chordal rupture

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Introduction

Since it was first described in 1984 by Inoue, percutaneous transmitral commissurotomy (PTMC) has been the gold standard in patients with symptomatic severe mitral stenosis (MS) and suitable valve anatomy [1]. It leads to significant changes in mitral valve morphology and improvements in leaflet mobility. PTMC has a high success rate and a low complication rate. Such complications include tamponade, perforation, complete heart block, thromboembolism, left-to-right shunt across the septal puncture, and acute mitral regurgitation (MR). This last-named complication is usually mild and can be well tolerated up to a moderate degree, with the main concern being the development of severe MR following PTMC. This requires valve replacement in some patients. The incidence rate of severe MR following PTMC is 1.4–7.5% [2].

Case report

A 29 year-old female presented with exertional dyspnoea – New York Heart Association (NYHA) class III of three years' duration. Transthoracic echocardiogram revealed severe mitral stenosis with a mitral valve area of 0.9 cm², and a Wilkin's score of 8/16 (M₂, C₂, T₂, S₂). Her height was 151 cm. Transoesophageal echocardiography was done to look for a left atrial clot, the degree of mitral regurgitation (MR), and her suitability for PTMC. PTMC was planned after procedural consent. The femoral artery and vein were accessed with a 6 F and an 8 F sheath respectively. A Mullins sheath was parked over the 0.035" guidewire in the left brachiocephalic vein. Wire was removed and a Brockenbrough needle was inserted into the sheath. Interatrial septum was punctured with the Brockenbrough needle after making a gradual descent, and subsequently

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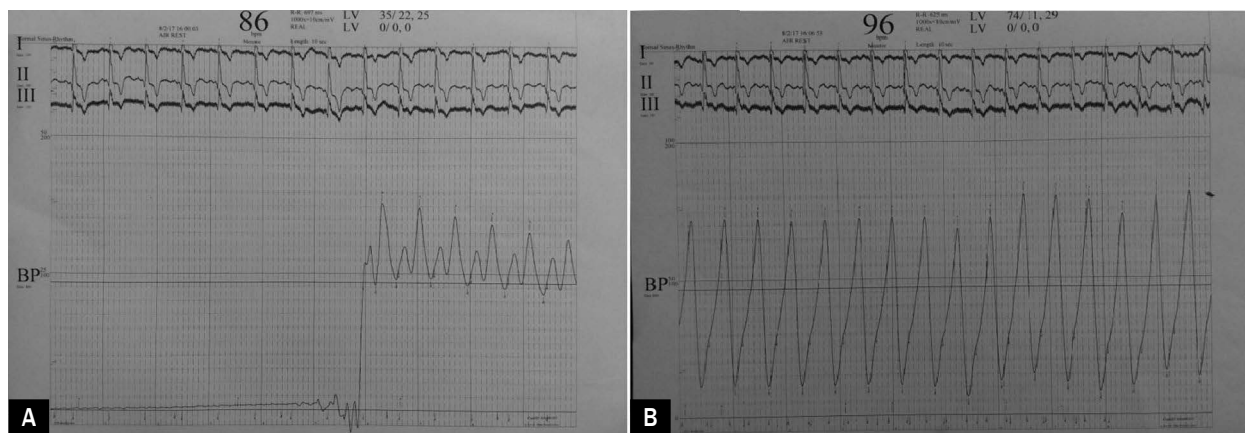


Figure 1A. Left atrial pressure trace before procedure; **B.** Rise in left atrial mean pressure with cardiovascular wave indicating acute severe mitral regurgitation

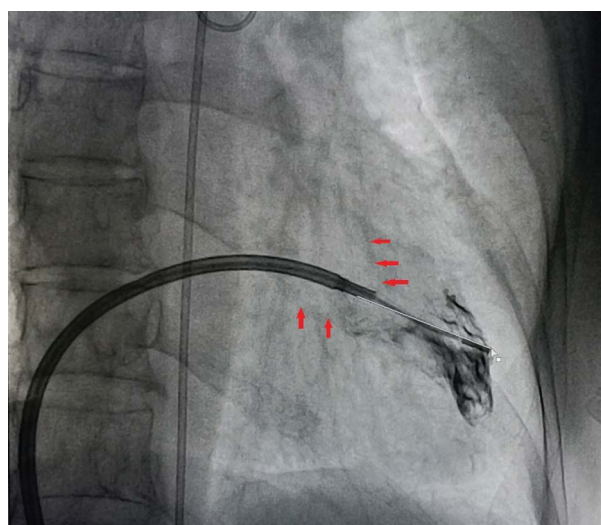


Figure 2. Accura balloon misaligned with apico-mitral axis (white line – apico-mitral axis; red arrow indicating position of mitral valve)

the septum was dilated. An Accura balloon (Vascular Concepts, UK) was sized to 25 mm based on Hung’s formula. Preprocedure left atrial (LA) pressure was 35/22 mm Hg (mean = 25 mm Hg) (Figure 1A). Initially, the Accura balloon was entering into the left lower pulmonary vein, but the mitral valve was later crossed smoothly. To recheck its position, contrast was injected through the balloon (Figure 2). The balloon was inflated in its distal part and pulled back to anchor it at the mitral valve and inflated further to achieve its full dilatation (Figure 3A). The mitral valve was dilated. The balloon was deflated and pushed into the left ventricle (Figure 3B, 4A). Postprocedural LA pressure shot up to 74/11 mm Hg (mean = 29 mm Hg) showing a giant cardiovascular wave of 72 mm Hg in pressure tracing and a new loud apical systolic murmur was audible, indicating

acute severe MR (Figure 1B). As the patient was haemodynamically unstable, she was transferred to cardiac surgery for immediate mitral valve replacement. During surgery, a chordae rupture of the postero-medial papillary muscle attaching to the posterior mitral leaflet was confirmed. Both commissures were fused. The chordae attached to the anterior papillary muscle were shortened, thickened, and calcified, while the ruptured one was also shortened. Both mitral leaflets were noted to be thickened and calcified, especially around commissures. It was noted that our balloon before dilatation was not aligned with the apico-mitral axis (Figure 4B) and was in fact facing away from it (Figure 4A) indicating that it was trapped in the chordo-papillary complex which led to the complication. This was realised when the balloon was pushed into the left ventricle after mitral valve dilatation and it was noted that it was aligning with the apico-mitral axis, but it had already caused complications in the form of acute MR.

Discussion

The development of acute severe MR requiring surgery is one of the most dreaded complications of PTMC. It can result in pulmonary oedema and even death [3]. The pathophysiological mechanisms are rupture of the papillary muscles, chordae tendinae, mild leaflet prolapse, tearing of the leaflet, over-splitting of the commissure, and rarely annular dehiscence [4, 5]. Herrmann et al. [4] found that rupture of the chordae tendinae was the most common cause because of the balloon catheter straying among the chordae tendinae while crossing the catheter in the left ventricle and subsequent inflation, and the stretching of severely diseased subvalvular structures during balloon dilatation, resulting in rupture.

In our case, the balloon was appropriately sized, which ruled out any over-splitting of the commissures. Subvalvular

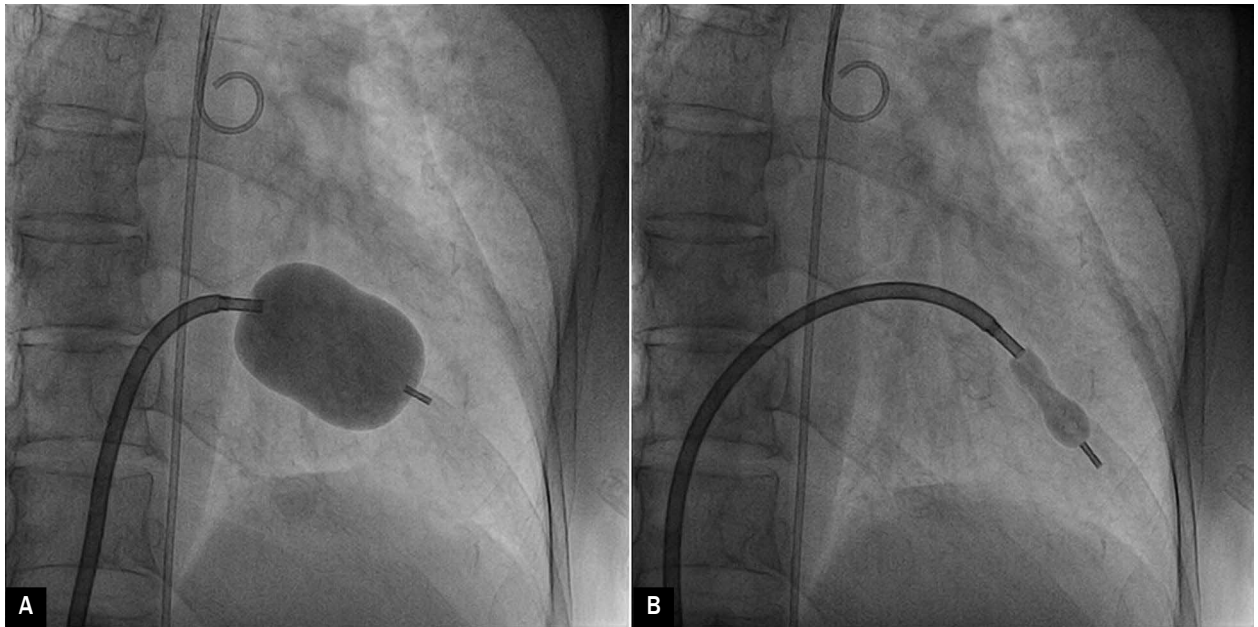


Figure 3A. Accura balloon catheter during full dilatation across the mitral valve; **B.** Balloon being pushed into left ventricle during deflation

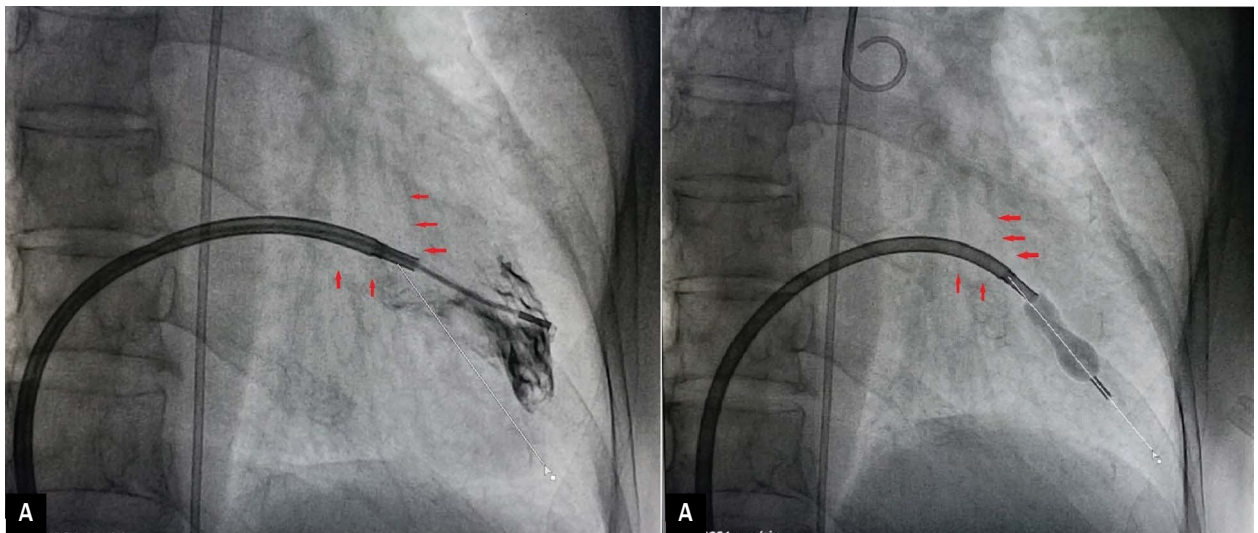


Figure 4. Position of Accura balloon in relation to apico-mitral axis (white line – apico-mitral axis; co-axial alignment – **A**); misalignment with the axis (**B**; red arrow indicating position of mitral valve)

structure involvement can be identified by an accordion manoeuvre, balloon impasse, and an unusual sequence of inflation. Echocardiography in our case ruled out any severe involvement, as the score was 8/16 (M_2, C_2, T_2, S_2). We observed that if the balloon was aligning with the apico-mitral axis, it was free from any subvalvular structure. Initially, the balloon was deviating from the proposed axis, and shifted laterally (Figure 3B). Therefore during the PTMC, every effort should be made to keep the balloon aligned to the apico-mitral axis to prevent MR. If it is found not to

be aligned, a routine 0.035" guidewire may be pushed through the balloon to free it from underlying chordae or it should be re-introduced. Also, once the mitral valve has been crossed, the free movement of the partially inflated distal balloon in the left ventricle should be ascertained to avoid disastrous consequences. Inflation should be avoided until the balloon is aligned with the apico-mitral axis *i.e.* orifice-apex axis. Sometimes, the balloon may point more vertically and may still deviate away from the apico-mitral axis. This is a harbinger of the fact that the balloon has

strayed among the chordae. In this circumstance, the distal balloon should be inflated larger to prevent it from getting retracted back to atrium and making sure that it stays in the ventricle. The balloon should be carefully pulled back to assume a more horizontal orientation. Once satisfactory alignment with the apico-mitral axis has been ensured, it should be pushed towards the apex and an accordion manoeuvre should be performed. Next, the usual sequence of inflation should be carried out to achieve proper dilatation of the mitral valve.

In this case, it appears that deviation of the balloon catheter away from the apico-mitral axis could be another sign of the presence of severe valvular and/or subvalvular lesions. The ejection force of the Accura balloon catheter during the further balloon inflation in lieu of severe valvular or subvalvular lesions may result in a detrimental plucking

of the mitral chordae tendinae. Since the chordal rupture usually occurs instantaneously, it is very difficult to document the process of how the balloon catheter severs the chordae tendinae.

In conclusion, a misaligned Accura balloon catheter along the axis between the mitral orifice and the left ventricular apex during balloon inflation may pluck the chordae tendinae and cause acute severe MR, especially in the presence of severe valvular and subvalvular disease. Awareness of this potential for string-plucking [6] should alert one to abort the balloon inflation process, and to reassess the dilatation strategy.

Conflict(s) of interest

The authors declare no conflict of interest.

Streszczenie

Rozwój ostrej ciężkiej niedomykalności zastawki mitralnej (MR) wymagającej leczenia chirurgicznego jest jednym z najpoważniejszych powikłań przezskórnej komisurotomii mitralnej. W niniejszej pracy przedstawiono przypadek 29-letniej kobiety z ciężką reumatyczną stenozą zastawki mitralnej, u której zwężoną zastawkę poszerzono za pomocą balonu Accura. Po przejściu przez zastawkę mitralną i wejściu do lewej komory cewnik balonowy odchylił się od osi koniuszkowo-mitralnej. Wypełniono dystalną część cewnika i poszerzono zastawkę mitralną stosowaną zwykle techniką. U chorej rozwinęła się ciężka MR. Odchylenie cewnika od osi koniuszkowo-mitralnej spowodowało zerwanie struny ścięgniastej tylnoprzyszrodkowego mięśnia brodawkowego, co stwierdzono w czasie zabiegu chirurgicznego. Autorzy konkludują, że nieprawidłowe ustawienie cewnika balonowego Accura w trakcie napełniania balonu może spowodować zerwanie struny ścięgniastej i doprowadzić do ostrej ciężkiej MR, a tym samym ujawnić wadę podzastawkową.

Słowa kluczowe: ciężka niedomykalność mitralna, balon Accura, oś koniuszkowo-mitralna, pęknięcie struny ścięgniastej

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