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## Case Report / Приказ случаја

Aleksandar Lazarević<sup>1,2</sup>, Toru Naganuma<sup>1</sup>, Satoru Mitomo<sup>1</sup>, Hiroyoshi Kawamoto<sup>1</sup>,  
Tatsuya Nakao<sup>1</sup>, Hisaaki Ishiguro<sup>1</sup>, Sunao Nakamura<sup>1,†</sup>

### Transapical transcatheter aortic valve implantation in a patient with small body weight complicated by severe hypotension: an enigma successfully solved by echocardiography

Транскатетерска имплантација аортне валвуле трансапикалним приступом  
код болеснице са малом телесном масом и тешком хипотензијом:  
загонетка решена ехокардиографским прегледом

<sup>1</sup> Department of Cardiovascular Medicine, New Tokyo Hospital, Matsudo, Japan;

<sup>2</sup> University of Banja Luka, Faculty of Medicine, Banja Luka, Republic of Srpska, Bosnia and Herzegovina

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† **Correspondence to:**

Sunao Nakamura

Director of Interventional Cardiology Unit, New Tokyo Hospital

1271 Wanagaya, Matsudo, Chiba, Japan

E-mail: boss0606@pluto.plala.or.jp

## Transapical transcatheter aortic valve implantation in a patient with small body weight complicated by severe hypotension: an enigma successfully solved by echocardiography

Транскаатетерска имплантација аортне валвуле трансапикалним приступом код болеснице са малом телесном масом и тешком хипотензијом: загонетка решена ехокардиографским прегледом

### SUMMARY

**Introduction** Transcatheter aortic valve implantation is currently considered as an alternative treatment for older patients with severe aortic valve stenosis and increased surgical risk, but can be associated with multiple life-threatening complications.

**Case Outline** An 83-year-old lady with severe symptomatic aortic stenosis, body weight 29 kg and body surface area 1.1 m<sup>2</sup> underwent transcatheter aortic valve implantation via transapical access. Severe hypotension occurred before valve implantation, due to temporary distortion of the mitral valve apparatus by stiff wire leading to acute mitral regurgitation. This complication was immediately recognized by continuous transesophageal echocardiography and managed by simple wire retrieval instead to apply mechanical circulatory support. After rewiring and predilatation of the stenotic aortic valve a 23 mm balloon-expandable transcatheter stent-prosthetic valve was successfully implanted.

**Conclusion** This case demonstrates that continuous imaging during TAVI is key to rapid diagnosis of life-threatening complications, associated with the procedure, especially during the early learning curve in transapical approach.

**Keywords:** transcatheter aortic valve implantation; trans-apical approach; acute mitral regurgitation

### САЖЕТАК

**Увод** Транскаатетерска уградња аортне валвуле представља алтернативно лечење старијих болесника са тешком стенозом аортне валвуле и високим хируршким ризиком, а може бити праћена бројним компликацијама.

**Приказ болесника** Болесница стара 83 године, тешка 29 кг и површине тела 1,1 m<sup>2</sup>, са тешком симптоматском аортном стенозом је подвргнута транскаатетерској уградњи вештачке аортне валвуле трансапикалним путем. Пре уградње валвуле јавила се акутна митрална регургитација и тешка хипотензија узрокована дисторзијом митралне валвуле чврстом жицом. Ова компликација је одмах препозната ехокардиографским прегледом и решена једноставним повлачењем жице натраг и репозицијом жице, уместо примене механичке циркулаторне подршке. Након поновног пласирања жице и предилатације стенотичне аортне валвуле успешно је транскаатетерским путем након надувавања балона уграђена вештачка стент валвула пречника 23 mm.

**Закључак** Континуирано праћење болесника помоћу трансезофагусне ехокардиографије за време транскаатетерске уградње аортне валвуле представља кључ за брзу дијагнозу компликација које могу да се јаве у току ове процедуре, посебно у раној фази криве учења трансапикалног приступа.

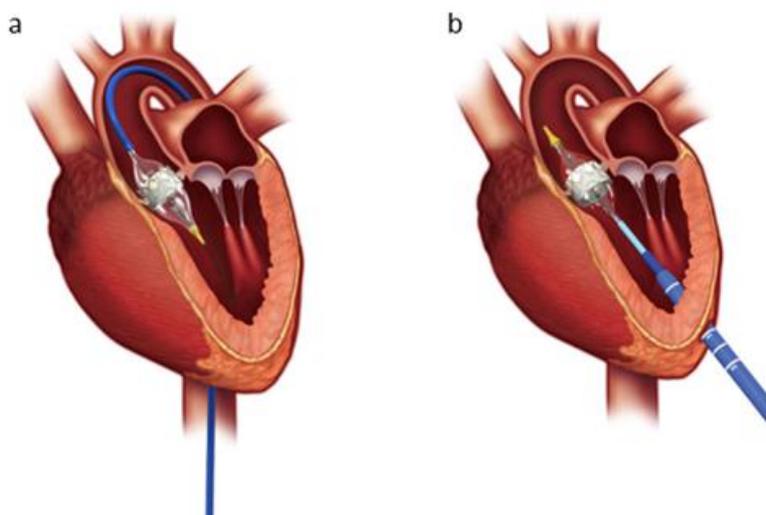
**Кључне речи:** транскаатетерска уградња аортне валвуле; трансапикални приступ; акутна митрална регургитација

### INTRODUCTION

Transcatheter aortic valve implantation (TAVI) has now become the standard of care for the high and intermediate risk elderly patients with symptomatic severe aortic stenosis [1, 2]. Two routes of delivery for TAVI are commonly employed for the balloon expandable valve, the transfemoral and the transapical route (Fig. 1 a and b). In patients in whom a transfemoral approach is not feasible, a subclavian, direct aortic (all three approaches represent retrograde delivery) or transapical approach (anterograde delivery) can be utilized.

A mortality benefit has been shown for TAVI compared with conservative treatment in patients deemed inoperable, and the procedure was proven to be at least non-inferior to surgical aortic valve replacement in high and intermediate risk patients [1, 2].

Acute hypotension during TAVI is a complication mainly due by aortic/annular rupture, landing zone trauma, ventricular perforation, cardiac tamponade, severe aortic or mitral regurgitation or ventricular dysfunction due to coronary occlusion [3,4,5]. Whatever the cause, hypotension might



**Figure 1.** Schematic diagram of the delivery routes for TAVI commonly employed for the balloon expandable valve. The transfemoral (retrograde) (a) and the transapical (anterograde) route (b). (Images courtesy of Edwards Lifesciences).

initiate a downward spiral of ischaemia and myocardial dysfunction, leading to shock [3]. Accurate positioning and deployment of the transcatheter heart valve (THV) may be complicated by marked septal hypertrophy because of prominent angulation of the left ventricular outflow tract diameter and difficulty on maintaining coaxial alignment of the guidewire, sheath, and valve delivery catheter [6]. This

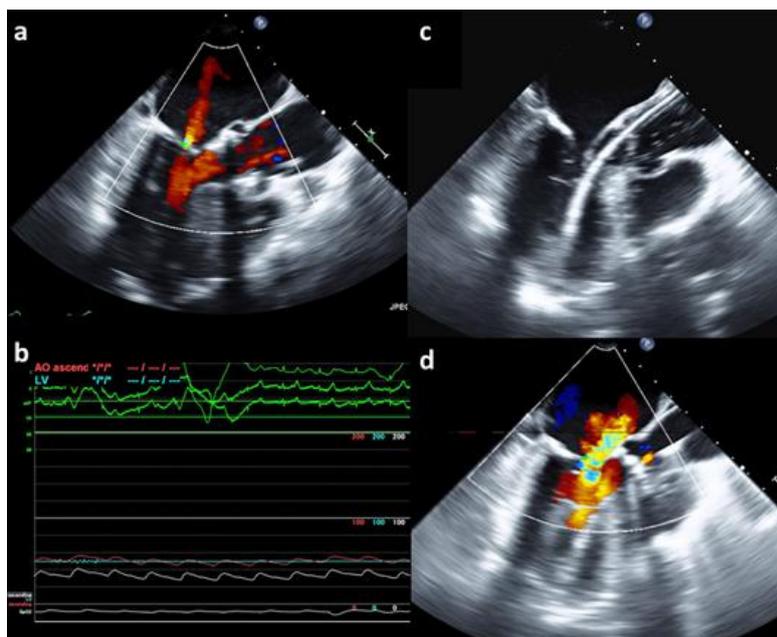
may be particularly apparent during the transapical approach when the apical cannula position is fixed.

In this manuscript, we present a case of acute hemodynamic deterioration during transapical TAVI, due to temporary distortion of the mitral valve apparatus by stiff wire leading to acute mitral regurgitation and hypotension, which was immediately recognized by transesophageal echocardiography (TEE) and managed by simple wire retrieval instead to apply mechanical circulatory support. Continuous imaging is key to rapid diagnosis of life-threatening complications, associated with the procedure.

### CASE REPORT

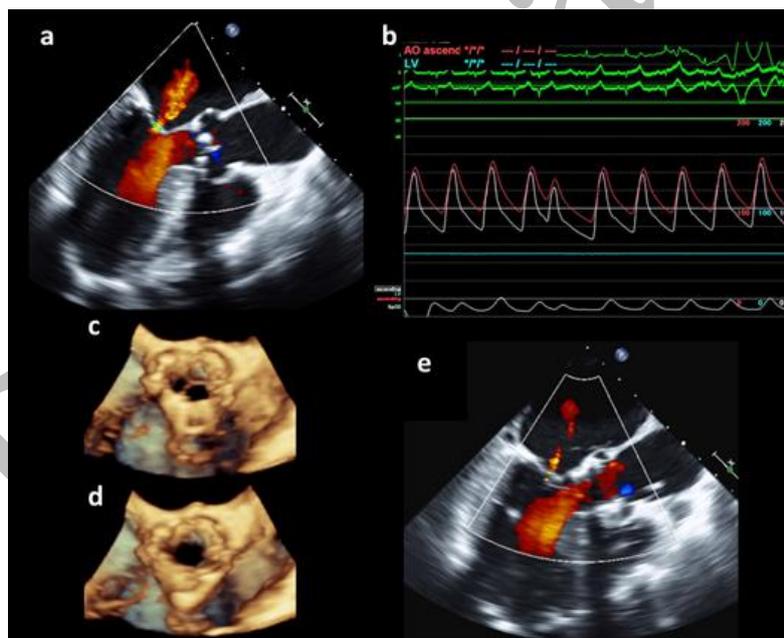
We report a case of a frail 83-year-old lady with severe symptomatic aortic stenosis. Based on the frailty the patient was considered nonsuitable for conventional surgery. Body weight was 29 kg, body surface area 1.1 m<sup>2</sup>. Due to very tortuous aorta and small iliofemoral arteries, TAVI was performed by transapical approach. Left coronary artery, right coronary artery ostium height were 13.0 mm and 16.5 mm, respectively. Left ventricular outflow tract diameter, sinus of Valsalva diameter, sinotubular junction diameter were 15.9×23.3 mm, 29.2×29.6×31.9 mm and 22.8×23.7 mm, respectively. Mean aortic gradient was 38.7 mmHg. Left ventricular ejection fraction was calculated to be 75% using a modified Simpson method. Indexed aortic valve area was 0.51 cm<sup>2</sup>/m<sup>2</sup>, mild mitral regurgitation (Fig. 2a) and trace aortic regurgitation were recorded.

The TAVI procedure was performed under general anaesthesia and continuous TEE guidance in the hybrid operating room. An anterior left mini-thoracotomy was performed to obtain access to the apex of the left ventricle. After the puncture of the apex, a guide wire was malpositioned into the left atrium due to narrow left ventricular outflow tract diameter and severe LV concentric hypertrophy,



**Figure 2.** Severe hypotension and acute severe mitral regurgitation due to a distortion of the mitral apparatus by the stiff wire. Transesophageal echocardiogram revealed (a) mild mitral regurgitation; (b) invasive pressure monitoring showed severe hypotension; (c) transesophageal echocardiogram: Lunderquist stiff wire is poorly positioned in left ventricle and causing tethering of the anterior mitral leaflet; (d) transesophageal echocardiogram: significant mitral regurgitation due to malpositioned stiff wire in left ventricle.

mm Hg) (Fig. 2b), and patient became hemodynamic unstable. Continuous TEE monitoring revealed mitral apparatus distortion what lead to retraction of the anterior mitral leaflet causing severe mitral regurgitation due to leaflet malcoaptation (Fig. 2c and 2d). This was successfully managed without



**Figure 3.** Successful management of the severe hypotension and deployment of the transcatheter stent-prosthetic aortic valve. Transesophageal echocardiogram after wire removal revealed (a) mild mitral regurgitation; (b) invasive pressure monitoring showed recovery of blood pressure; 3D Transesophageal echocardiogram revealed normal valve function in diastole (c) and systole (d); 2D transoesophageal echocardiogram revealed only mild mitral regurgitation after the balloon-expandable transcatheter stent-prosthetic aortic valve implantation (e).

which was documented in fluoro, as well as in echo images. Wire was removed from left atrium and was difficult to replace through the narrow aortic valve. Second puncture was attempted in order to redirect the wire across the aortic valve. After the second puncture, 7 Fr 25 cm sheet was placed, and 4 Fr Judkins catheter was advanced with Radifocus wire (Terumo, Japan), and exchanged for the stiff wire Lunderquist (Cook Medical, Bjaeverskov, Dane-mark). Immediately after, severe hypotension was recorded (37/22

mechanical support by removing the stiff wire (Figure 3a and 3b). We recrossed aortic valve using a softer wire (Amplatz extra stiff wire, Cook Medical, Bjaever-skov, Danemark), which did not cause mitral apparatus distortion. A 23 mm Sapien XT valve (Edwards Lifesciences Inc., Irvine Cali-fornia) was successfully implanted following predilatation with 20mm balloon (Figure 3c, 3d and 3e).

## DISCUSSION

We report a case with mitral apparatus distortion and hemodynamic deterioration due to severe mitral regurgitation that was detected by TEE during transapical TAVI. Continuous imaging is key to rapid diagnosis of life-threatening complications, associated with the procedure. A wire can be passed underneath a mitral chordae utilizing the antegrade apical approach [6,7]. Sliding forward a wire or catheter over the wire might result in temporary distortion of the mitral valve apparatus, leading to acute mitral regurgitation [3]. If resistance to catheter advancement is noticed or transient mitral regurgitation is assessed by TEE that should alert the operator to this possibility. To avoid subchordal passage, rewiring or use of a balloon flotation catheter might be considered.

It is critically important to have communication between the echocardiographer and other TAVI team members about the qualitative features of the left ventricular outflow tract and septal geometry [7]. Accurate positioning and deployment of the THV may be complicated by marked septal hypertrophy because of prominent angulation of the LVOT and difficulty on maintaining coaxial alignment of the guidewire, sheath, and valve delivery catheter. This may be particularly apparent during the transapical approach when the apical cannula position is fixed. In addition, a hyperdynamic hypertrophied septum may cause the THV to be superiorly displaced during balloon inflation or unsheathing of the valve [3].

During the immediate implantation period echocardiographic imaging is essential even though precise valve placement can be performed with fluoroscopic imaging alone [8, 9]. Echocardiographic imaging provides rapid and accurate assessment of valve position, valve shape, leaflet motion and gradients following THV deployment. Color Doppler imaging provides prompt and precise feedback to the operator about the presence, location and severity of aortic regurgitation, as well as coronary patency and mitral valve function [7, 9, 10]. Left ventricular dysfunction or aortic root catastrophe can be assessed within seconds as potential etiologies in this setting of hemodynamic compromise [11, 12].

The presented case report showed the importance of continuous TEE monitoring during the TAVI procedure. TEE seems to be useful to clarify the etiology of the sudden hemodynamic deterioration and furthermore provides invaluable information with regard to treatment of severe hypotension during trans-apical TAVI by simple wire retrieval instead of applying mechanical circulatory support. TEE with general anesthesia remains to be an important option especially during the early experience with transapical or transfemoral TAVI.

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