DOI: https://doi.org/10.2298/SARH160802064L
UDC: 616.132-007.271-089

CASE REPORT / ПРИКАЗ БОЛЕСНИКА

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

Aleksandar Lazarević[1,2], Toru Naganuma[1], Satoru Mitomo[1], Hiroyoshi Kawamoto[1], Tatsuya Nakao[1], Hisaaki Ishiguro[1], Sunao Nakamura[1]

[1]New Tokyo Hospital, Department of Cardiovascular Medicine, Matsudo, Japan;
[2]University of Banja Luka, Faculty of Medicine, Banja Luka, Republic of Srpska, Bosnia and Herzegovina

SUMMARY

Introduction Transcatheter aortic valve implantation is currently considered 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 woman with severe symptomatic aortic stenosis, body weight of 29 kg and body surface area of 1.1 m^2 underwent transcatheter aortic valve implantation via transapical access. Severe hypotension occurred before the 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 of applying 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 transcatheter aortic valve implantation 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; transapical approach; acute mitral regurgitation

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 (Figure 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 to 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 initiate a downward spiral of ischemia 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 paper, 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 of applying 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 woman with severe symptomatic aortic stenosis. Based on the frailty, the patient was considered unsuitable for conventional surgery. The patient's body weight was 29 kg, and body surface area 1.1 m^2. Due to very tortuous aorta and small

Примљено • Received: August 2, 2016
Ревизија • Revised: January 13, 2017
Прихваћено • Accepted: February 9, 2017
Online first: March 10, 2017

Correspondence to:
Sunao NAKAMURA
Interventional Cardiology Unit,
New Tokyo Hospital
1271 Wanagaya, Matsudo, Chiba, Japan
boss0606@pluto.plala.or.jp

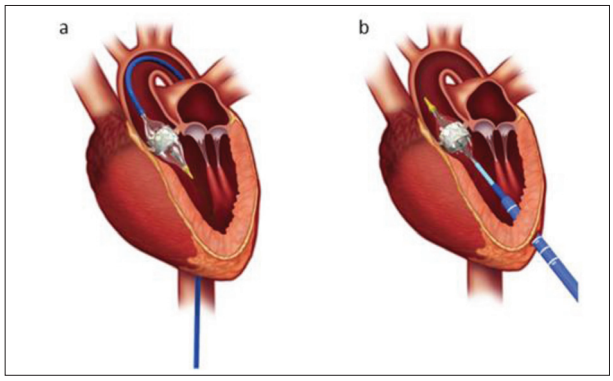

Figure 1. Schematic diagram of the delivery routes for transcatheter aortic valve implantation commonly employed for the balloon expandable valve; (a) the transfemoral (retrograde), and (b) the transapical (anterograde) route (courtesy of Edwards Lifesciences)

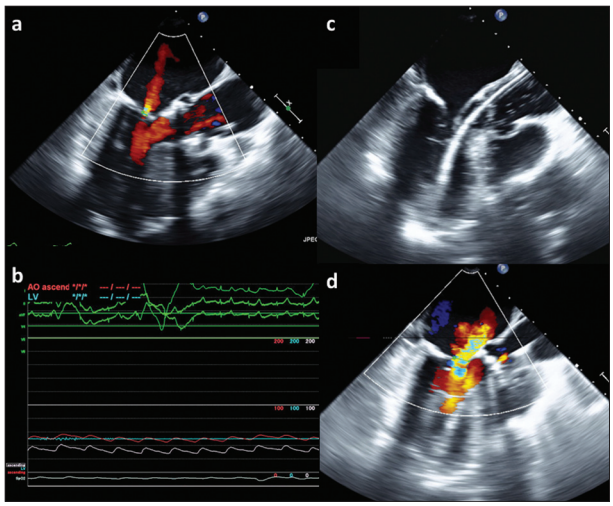

Figure 2. Severe hypotension and acute severe mitral regurgitation due to a distortion of the mitral apparatus by the stiff wire; transesophageal echocardiogram revealed (a) mild mitral regurgitation; (b) invasive pressure monitoring showed severe hypotension; (c) transesophageal echocardiogram: Lunderquist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

iliofemoral arteries, TAVI was performed by the transapical approach. The left coronary artery and the right coronary artery ostium heights were 13 mm and 16.5 mm, respectively. The left ventricular outflow tract diameter, sinus of Valsalva diameter, and sinotubular junction diameter were 15.9 × 23.3 mm, 29.2 × 29.6 × 31.9 mm, and 22.8 × 23.7 mm, respectively. The mean aortic gradient was 38.7 mmHg. The left ventricular ejection fraction was calculated to be 75% using a modified Simpson method. Indexed aortic valve area was 0.51 cm^2/m^2; mild mitral regurgitation (Figure 2a) and trace aortic regurgitation were recorded.

The TAVI procedure was performed under general anesthesia 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 left ventricle concentric hypertrophy, which was documented in fluoro, as well as

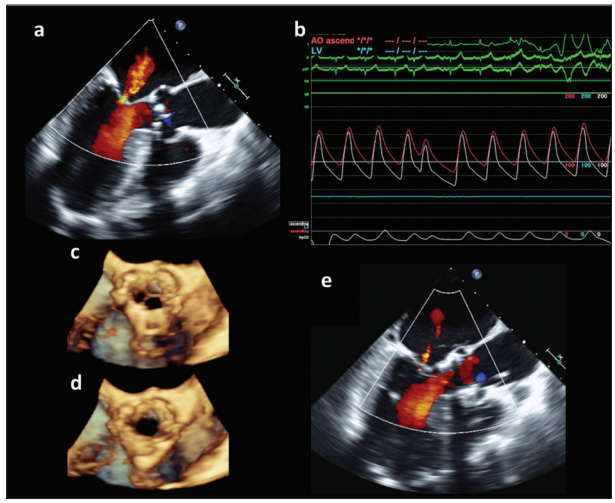

Figure 3. Successful management of the severe hypotension and deployment of the transcatheter stent-prosthetic aortic valve; transesophageal echocardiogram after wire removal revealed (a) mild mitral regurgitation; (b) invasive pressure monitoring showed recovery of blood pressure; 3D transesophageal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

in echo images. The wire was removed from the 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 Corporation, Tokyo, Japan), and exchanged for the Lunderquist Stiff Wire (Cook Medical, Bjaeverskov, Danemark). Immediately after, severe hypotension was recorded (37/22 mmHg) (Figure 2b), and patient became hemodynamically unstable. Continuous TEE monitoring revealed mitral apparatus distortion which lead to the retraction of the anterior mitral leaflet causing severe mitral regurgitation due to leaflet malcoaptation (Figure 2 c and d). This was successfully managed without mechanical support by removing the stiff wire (Figure 3 a and b). We recrossed the aortic valve using a softer wire (Amplatz Extra Stiff Wire, Cook Medical), which did not cause the mitral apparatus distortion. A 23 mm Sapien XT valve (Edwards Lifesciences Inc., Irvine, CA, USA) was successfully implanted following predilatation with a 20 mm balloon (Figure 3 c, d, and e).

DISCUSSION

We report a case with mitral apparatus distortion and hemodynamic deterioration due to severe mitral regurgitation 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 a 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, this

should alert the operator to the possibility. To avoid the subchordal passage, rewiring or the 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 left ventricular outflow tract 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 the valve position, valve shape, leaflet motion, and gradients following the 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 be useful to clarify the etiology of sudden hemodynamic deterioration. Furthermore, it provides invaluable information with regard to treatment of severe hypotension during transapical 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.

REFERENCES

1. Smith CR, Leon MB, Mack MJ, Miller DC, Moses JW, Svensson LG, et al. Transcatheter versus surgical aortic valve replacement in high-risk patients. N Engl J Med. 2011; 364(23):2187–98.
2. Leon MB, Smith CR, Mack MJ, Makkar RR, Svensson LG, Kodali SK, et al. Transcatheter or surgical aortic-valve replacement in intermediate-risk patients. N Engl J Med. 2016; 374(17):1609–20.
3. Masson JB, Kovac J, Schuler G, Ye J, Cheung A, Kapadia S, et al. Transcatheter aortic valve implantation: review of the nature, management, and avoidance of procedural complications. J Am Coll Cardiol Intv. 2009; 2(9):811–20.
4. Barbanti M, Yang TH, Rodes Cabau J, Tamburino C, Wood DA, Jilaihawi H, et al. Anatomical and procedural features associated with aortic root rupture during balloon-expandable transcatheter aortic valve replacement. Circulation. 2013; 128(3):244–53.
5. Kappetein AP, Head SJ, Genereux P, Piazza N, van Mieghem NM, Blackstone EH, et al. Updated standardized endpoint definitions for transcatheter aortic valve implantation: the Valve Academic Research Consortium-2 consensus document. J Thorac Cardiovasc Surg. 2013; 145(1):6–23.
6. Webb JG, Chandavimol M, Thompson CR, Ricci DR, Carere RG, Munt BI, et al. Percutaneous aortic valve implantation retrograde from the femoral artery. Circulation. 2006; 113(6):842–50.
7. Hahn RT, Little SH, Monaghan MJ, Kodali SK, Williams M, Leon MB, et al. Recommendations for comprehensive intraprocedural echocardiographic imaging during TAVR. J Am Coll Cardiol Img. 2015; 8(3):261–87.
8. Himbert D, Descoutures F, Al-Attar N, Iung B, Ducrocq G, Détaint D, et al. Results of transfemoral or transapical aortic valve implantation following a uniform assessment in high-risk patients with aortic stenosis. J Am Coll Cardiol. 2009; 54(4):303–11.
9. Hahn RT, Gillam LD, Little SH. Echocardiographic imaging of procedural complications during self-expandable transcatheter aortic valve replacement. J Am Coll Cardiol Img. 2015; 8(3):319–36.
10. Pasic M, Unbehaun A, Dreysse S, Drews T, Buz S, Kukucka M, et al. Transapical aortic valve implantation in 175 consecutive patients: excellent outcome in very high-risk patients. J Am Coll Cardiol. 2010; 56(10):813–20.
11. Ribeiro HB, Nombela-Franco L, Urena M, Mok M, Pasian S, Doyle D, et al. Coronary obstruction following transcatheter aortic valve implantation: a systematic review. J Am Coll Cardiol Intv. 2013; 6(5):452–61.
12. Stabile E, Sorropago G, Cioppa A, Cota L, Agrusta M, Lucchetti V, et al. Acute left main obstructions following TAVI. EuroIntervention. 2010; 6(1):100–5.

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

Александар Лазаревић[1,2], Тору Наганума[1], Сатору Митомо[1], Хиројоши Кавамото[1], Татсуја Накао[1], Хисаки Ишигуро[1], Сунао Накамура[1]

[1]Болница Новог Токија, Одељење за кардиоваскуларну медицину, Матсудо, Јапан;
[2]Универзитет у Бањој Луци, Медицински факултет, Бања Лука, Република Српска, Босна и Херцеговина

САЖЕТАК

Увод Транскатетерска 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 *kg* и површине тела 1,1 m^2, са тешком симптоматском аортном стенозом, подвргнута је транскатетерској уградњи вештачке аортне валвуле трансапикалним путем. Пре уградње валвуле јавила се акутна митрална регургитација и тешка хипотензија узрокована дисторзијом митралне вавлуле чврстом жицом. Ова компликација је одмах препозната ехокардиографским прегледом и решена једноставним повлачењем жице натраг и репозицијом жице, уместо применом механичке циркулаторне подршке. После поновног пласирања жице и предилатације стенотичне аортне валвуле успешно је транскатетерским путем након надувавања балона уграђена вештачка стент валвула пречника 23 *mm*.

Закључак Континуирано праћење болесника помоћу трансезофагусне ехокардиографије за време транскатетерске 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: транскатетерска уградња аортне валвуле; трансапикални приступ; акутна митрална регургитација