Journal of Cardiology Cases 19 (2019) 136–139

Contents lists available at ScienceDirect

Journal of Cardiology Cases

journal homepage: www.elsevier.com/locate/jccase

Case Report

Unexpected massive pleural effusion leading to discovery of left subclavian artery rupture during transcatheter aortic valve implantation

Hideyuki Kawashima (MD PhD)*, Yusuke Watanabe (MD PhD), Akihisa Kataoka (MD PhD), Ken Kozuma (MD PhD)

Department of Medicine, Teikyo University School of Medicine, Tokyo, Japan

ARTICLE INFO

Article history:
Received 6 October 2018
Received in revised form 23 November 2018
Accepted 6 December 2018

Keywords:
Transcatheter aortic valve implantation
Hemodynamic shock
Transesophageal echocardiography
Subclavian artery rupture
Intrapleural
Perforation
Covered stent

ABSTRACT

An 89-year-old woman underwent transcatheter aortic valve implantation (TAVI) for severe aortic valve stenosis, based on a logistic European System for Cardiac Operative Risk Evaluation of 59.6% and Society of Thoracic Surgeons risk score of 17.1%. The patient had multiple comorbidities including chronic kidney disease with creatinine clearance of 15 ml/min. We ruled out preprocedural contrast-enhanced computed tomography and coronary angiography to prevent exacerbation of renal dysfunction. Moreover, we concluded that a trans-subclavian approach was optimal, because the transfemoral approach was contraindicated due to severe lordosis, and the transapical approach was contraindicated due to severe chronic obstructive pulmonary disease and frailty. This report describes a massive pleural effusion that led to the discovery of subclavian artery rupture causing hemodynamic shock. Hemodynamic instability in this patient was caused by hypovolemic and obstructive shock, with a pleural perfusion caused by subclavian artery rupture. Monitoring via transesophageal echocardiography during the procedure enabled early discovery of the massive pleural effusion. Subsequent covered stent implantation stabilized the subclavian artery rupture, and the patient became hemodynamically stable. As subclavian artery rupture can occur during trans-subclavian TAVI, the presence of calcifications and tortuosity requires careful management.

<**Learning objective:** This is the first report of a massive pleural effusion that led to discovery of subclavian artery (SCA) rupture causing hemodynamic shock during trans-subclavian-transcatheter aortic implantation (TS-TAVI). Monitoring via transesophageal echocardiography enabled early discovery of the massive pleural effusion. As SCA rupture can occur during TS-TAVI, the presence of calcification and tortuosity requires careful management.>

Introduction

Patients selected for transcatheter aortic valve implantation (TAVI) often have various coexisting diseases and a poor access site. We report the case of an 89-year-old woman with critical symptomatic aortic stenosis, presenting with medically uncontrollable congestive heart failure. Preprocedural contrast-enhanced computed tomography was not performed due to renal dysfunction. Transfemoral TAVI could not be performed due to severe lordosis. Transapical TAVI was not suitable due to poor respiratory function and frailty. We concluded that trans-subclavian-TAVI was optimal, despite focal calcification and tortuosity according to echocardiographic findings.

Case report

An 89-year-old woman underwent TAVI for severe aortic valve stenosis. The patient had multiple comorbidities, including chronic kidney disease with creatinine clearance of 15 ml/min, and forced expiratory volume in 1 s of 0.9 l because of chronic obstructive pulmonary disease. A transthoracic echocardiogram showed a

* Corresponding author at: Department of Medicine, Teikyo University School of Medicine, 2-11-1 Kaga Itabashi-ku, Tokyo, 173-8606, Japan.
E-mail address: h.kawashima429@gmail.com (H. Kawashima).

https://doi.org/10.1016/j.jccase.2018.12.016
1878-5409/

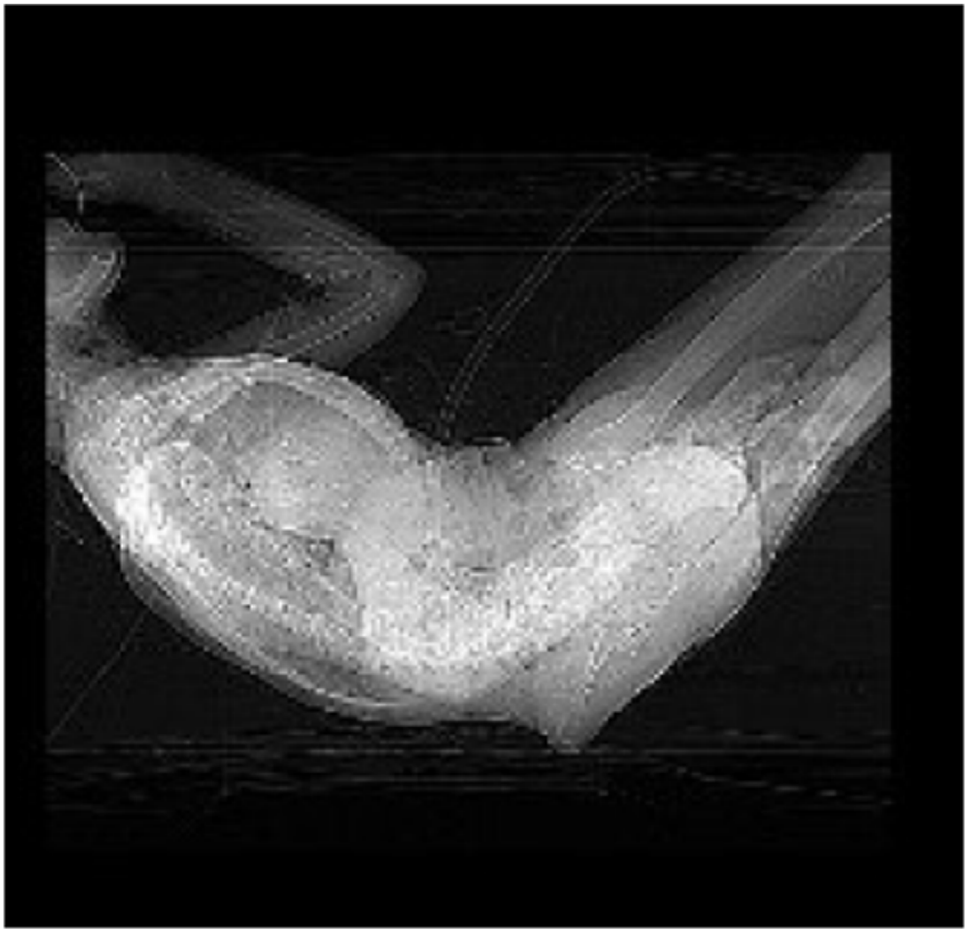

Fig. 1. Image showing severe lordosis in the patient.

severely calcified tricuspid aortic valve, with an aortic peak gradient of 58 mmHg, mean gradient of 32 mmHg, a valve area of 0.4 cm^2, an ejection fraction of 25%, mild aortic regurgitation, and mild mitral regurgitation. The patient had a logistic European System for Cardiac Operative Risk Evaluation of 59.6% and Society of Thoracic Surgeons risk score of 17.1%. Transfemoral TAVI was contraindicated because of severe lordosis (Fig. 1), and transapical TAVI was contraindicated due to severe chronic obstructive pulmonary disease and a frailty score of 7. Contrast-enhanced computed tomography (CT) and coronary angiography were not performed even with a small amount of contrast due to renal dysfunction [1]. Renal function declined even further before the TAVI procedure. Magnetic resonance angiography (MRA) without contrast agent could not be performed due to the increased difficulty in inserting the apparatus due to the severe lordosis. Echocardiographic findings revealed the minimum lumen diameter of the left subclavian artery (SCA) to be 3.8–5.5 mm, with prominent calcification of the vascular lumen. The heart team, including the cardiologists, cardiac surgeons, anesthesiologists, and paramedics, concluded that trans-subclavian (TS)-TAVI was the best treatment, despite focal calcification.

Left TS-TAVI was performed under general anesthesia with transesophageal echocardiography (TEE) guidance. A 5-Fr pacing catheter advanced from the right internal jugular vein was inserted through the right radial artery and a 4-Fr pigtail catheter was detained at the non-coronary cusp. A perpendicular view was identified with left anterior oblique 20° and caudal 25° on aortography. After surgical cutdown, a 14-Fr GORE DrySeal Sheath (W. L. Gore. & Associates, Flagstaff, AZ, USA) was inserted from the left SCA, guided by Amplatz Extra-Stiff Wire Guides (CookMedical, Bloomington, IN, USA). The aortic valve was crossed with a 0.035-in. straight guidewire supported by a 5-Fr Judkins-Right 4.0 diagnostic catheter. This was changed to an Extra-small Safari wire (Boston Scientific, Minneapolis, MN, USA). After predilation via a 16-mm balloon, an In-Line Sheath (Medtronic, Minneapolis, MN, USA) could not cross the left SCA due to calcification and tortuosity. Therefore, we utilized a Lunderquist Extra Stiff Wire (Cook Medical), and the sheath passed through. A 26-mm Medtronic CoreValve Evolut R (Medtronic) was expanded slowly and implanted. TEE demonstrated that the prosthetic valve was implanted in the correct position. However, the patient became hemodynamically unstable. We confirmed the cause by TEE immediately; left ventricular function and the level of mitral regurgitation were unchanged compared to pre-procedure assessments. Left main trunk flow was detected by the ultrasound pulse Doppler method, and trivial paravalvular aortic leakage was detected along with an absence of systolic anterior movement, left ventricular outflow tract obstruction, pericardial effusion, and aortic dissection. TEE in the trans-gastric view demonstrated a massive left pleural effusion that gradually increased in size (Fig. 2). Rupture of the proximal left SCA led to left intrapleural perforation, revealed angiographically (Fig. 3). An 8.0–80 mm Fluency stent (Bard Peripheral Vascular, Tempe, AZ, USA) was placed in the proximal left SCA, and the rupture was controlled. Left pleural puncture was performed, and the patient became hemodynamically stable. Finally, the left SCA was surgically

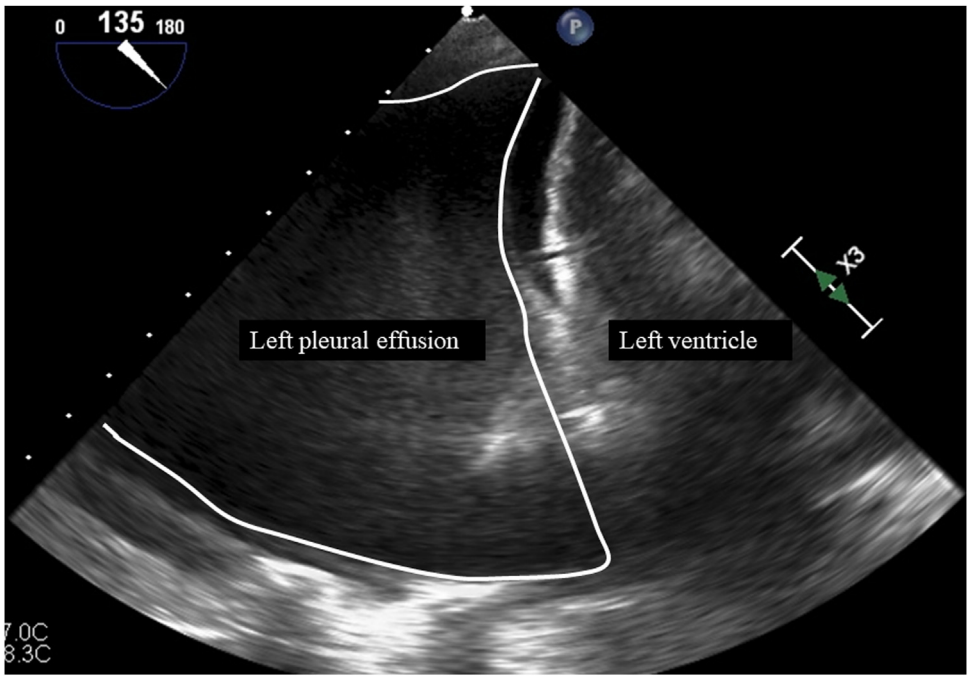

Fig. 2. Massive left pleural effusion detected by transesophageal echocardiography.

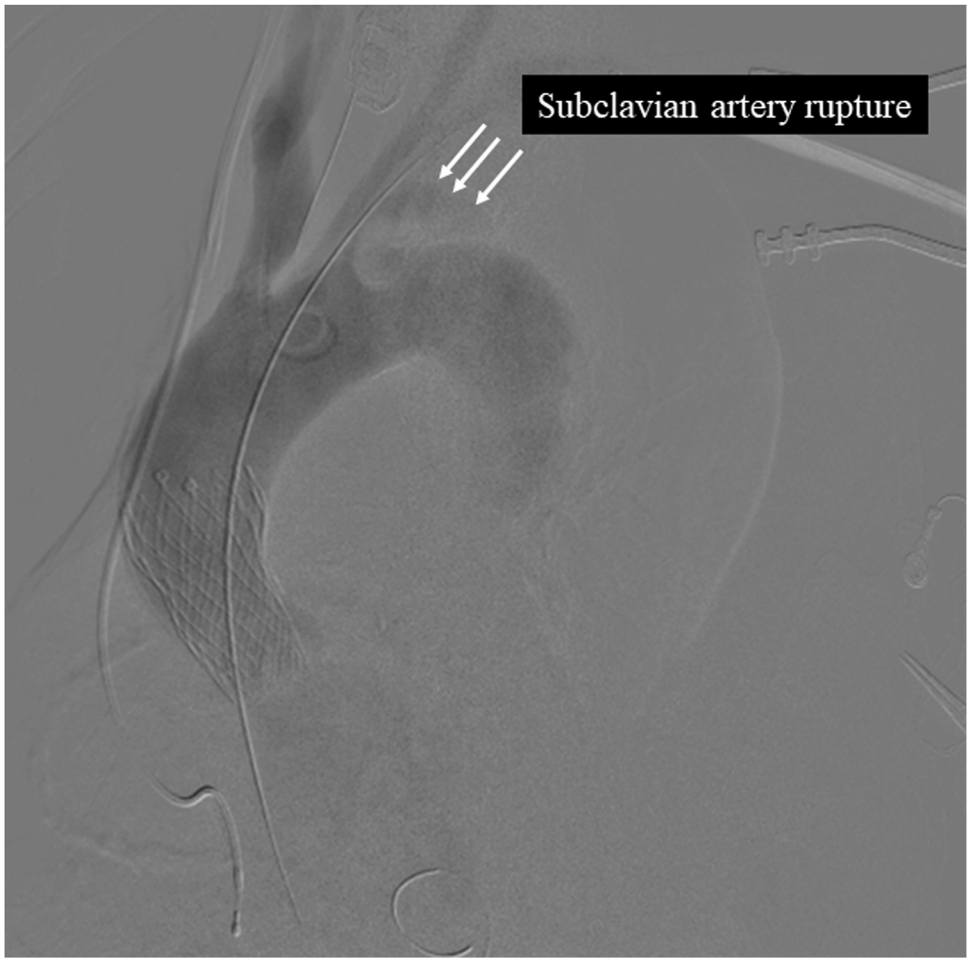

Fig. 3. Rupture of left subclavian artery *(white arrow)*.

sutured. The total procedure time from skin to skin was 101 min, and the total amount of contrast media used was 68 ml.

The patient was extubated immediately and transferred back to the intensive care unit. Stroke did not occur after the TAVI procedure, despite implantation in the proximal left SCA. Transthoracic echocardiography performed 1 week after TAVI showed trivial aortic regurgitation, a peak/mean transvalvular pressure gradient of 24/9 mmHg, a valve area of 1.8 cm^2, and an ejection fraction of 27%. The patient was transferred to a nearby hospital on the 13th day after the TAVI procedure.

Discussion

To our knowledge, this is the first report of a massive pleural effusion that led to discovery of SCA rupture causing hemodynamic shock. TAVI through the subclavian approach appeared feasible and safe, with excellent procedural success and low in-hospital complication rates [2]. However, in this case, left SCA rupture occurred due to catheter use, leading to left pleural effusion. We speculated that hemodynamic instability in this patient was caused by hypovolemic and obstructive shock caused by the massive pleural effusion. Monitoring via TEE during the procedure enabled early discovery of the massive pleural effusion. Many centers worldwide use angiography combined with TEE guidance to enhance the accuracy of intervention, assess the results, and identify potential complications [3,4]. We consider the evaluation of access site by multiple modalities to be important for the prevention of vascular complications. In the present case, contrast-enhanced CT and MRA could not be performed and therefore, vascular access was assessed by echocardiography which allowed for the detection of a prominent calcification in the vascular lumen of the left SCA. This finding is characteristic of an access artery at high risk for rupture. Contrast-enhanced CT with a small amount of contrast should have been performed in this case, or the access site could have been altered to the trans-apical or direct-aortic approach, despite the invasion for this patient.

Conclusion

As SCA rupture can occur during TS-TAVI, the presence of calcification and tortuosity requires careful management. To evaluate access site by multiple modalities is considered important to prevent vascular complications.

Conflict of interest statement

The authors declare no conflict of interest.

Acknowledgments

The data were presented at London Valves 2018.

All authors contributed to and approved the submitted manuscript.

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