Survival of Severe Aortic Stenosis Complicated with Cardiogenic Shock by Emergent Transcatheter Aortic Valve Implantation and Intra-Aortic Balloon Pump

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Objective: To learn the management of severe aortic stenosis (AS) complicated by cardiogenic shock.

Case Presentation: The case was an 89-year-old female with a past medical history of diabetes and stroke. She presented to another hospital after a syncopal episode. While waiting for further evaluation, she suddenly became unresponsive, and the monitor showed asystole. She was immediately resuscitated, and transthoracic echocardiography showed severe AS. Therefore, she was transferred to our hospital for further management including transcatheter aortic valve implantation (TAVI). During echocardiography, the patient developed hypotension and diffuse ST-segment depression. Transthoracic echocardiography revealed severe mitral regurgitation with preserved ejection fraction. Emergent coronary angiography did not show significant stenosis, and the patient was considered to be in cardiogenic shock secondary to severe AS. Emergent TAVI was performed under intra-aortic balloon support. Post TAVI course was uneventful, and at 1-year follow-up, the patient was in stable condition. Echocardiography at 1 year showed normal prosthetic valve function and mild mitral regurgitation.

Conclusion: Favorable outcome of severe AS complicated with cardiogenic shock could be achieved with emergent TAVI and mechanical circulatory support. Further study is warranted to identify risk factors for acute decompensation of AS causing cardiogenic shock.

Keywords: aortic stenosis, intra-aortic balloon pump, transcatheter aortic valve implantation

Introduction

Transcatheter aortic valve implantation (TAVI) has been introduced to treat symptomatic, severe aortic stenosis (AS) patients at inoperable and high surgical risk for surgical aortic valve replacement, and since then it has been expanded to treat those at intermediate and low surgical risk with severe AS.¹⁾ Major trials have excluded patients with hemodynamic instability requiring inotrope or

mechanical circulatory support.²⁻⁷⁾ Therefore, details of individual outcomes of TAVI in these patients are scarce. We report a case of emergent TAVI under intra-aortic balloon pump and inotropic support in a patient who developed cardiogenic shock that resulted in a favorable outcome.

Case Report

The patient was an 89-year-old female with a past medical history of diabetes and stroke. She presented to another hospital with a chief complaint of syncope. While in the emergency department, she went into asystole requiring resuscitation. After successful resuscitation, echocardiography showed severe AS with max and mean gradient of 85 and 50 mmHg, respectively. Therefore, she was transferred to our hospital for further management

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Fig. 1 Use of guiding catheter to protect the left coronary artery after 70% expansion of the self-expandable valve

Fig. 2 No obstruction of both coronary artery after full expansion of the self-expandable valve

including TAVI. Heart team discussion at our center reached a consensus of TAVI over surgical aortic valve replacement mainly due to high surgical risk and advanced age.

The patient remained hemodynamically stable since admitted to our hospital; however, she suddenly became confused during transthoracic echocardiography. Her systolic blood pressure dropped into the 60 s, and an electrocardiogram demonstrated diffuse ST-segment depression. Therefore, she was transferred for emergent cardiac catheterization. A coronary angiogram did not show any significant epicardial coronary artery stenosis. Intra-aortic balloon pump and inotrope were started for hemodynamic support. Transthoracic echocardiography showed severe mitral regurgitation with preserved left ventricular function. She was considered to have developed cardiogenic shock secondary to severe AS and the decision was made to perform emergent transfemoral TAVI. Her STS score, Euroscore, and JapanSCORE were 43.7, 14, and 34.6%, respectively. Enhanced CT images for TAVI were obtained following coronary angiogram.

Evolut PRO (Medtronic, Minneapolis, MN, USA) 23 mm was selected based on CT measurement and in order to avoid rapid right ventricular pacing during valve deployment in a hemodynamically unstable patient. The height of the coronary ostium was 14.6 mm and 12.8 mm for the right and left coronary artery, respectively. We used the 20 mm Inoue balloon for pre-TAVI balloon aortic valvuloplasty without rapid pacing. Because there was a concern of acute left coronary artery occlusion after 80%

Fig. 3 Pressure gradient between the left ventricle and aorta, pre and post TAVI. TAVI: transcatheter aortic valve implantation

expansion of the Evolut PRO, a 6 French Judkins left catheter was engaged into the left coronary artery with the workhorse wire placed in the left anterior descending artery for coronary protection. After full expansion of the Evolut PRO, there was no obstruction of the coronary artery and the Judkins left catheter was cautiously removed without any disruption of the implanted valve (**Fig. 1, 2**). Pressure gradient improved significantly (**Fig. 3**). She was weaned off from intra-aortic balloon pump on day 2 and inotrope was discontinued on day 3. She was discharged home on day 26 post TAVI after rehabilitation at our institution. At 1-year follow-up, the

patient was ambulatory and echocardiography showed well-functioning transcatheter aortic valve with mild paravalvular and mitral regurgitation.

Discussion

Patients with cardiogenic shock preceding TAVI are one of the most challenging populations. From a large national TAVI registry of the United States, the incidence of TAVI performed in cardiogenic shock patients was 4.1% and the 30-day mortality was 19.1%.⁸⁾ According to Fraccaro et al., the 1-year mortality and heart failure readmission rate were 25.7% and 8.6%, respectively.⁹⁾

Cardiogenic shock with acutely decompensated AS portends a dismal prognosis; however, the lesson from our case is that prompt management with emergent TAVI and mechanical circulatory support is feasible and may result in a favorable outcome. We did not use extracorporeal membrane oxygenation as the patient did not develop cardio-pulmonary arrest. Our case was unique in that cardiogenic shock developed in the hospital and severe AS was already recognized, therefore led to swift management. The common causes of death in post emergent TAVI were multi-organ failure and sepsis, suggesting hemodynamic and infection management are the key for survival post TAVI.¹⁰⁾ As expected, the 1-year mortality rate was higher in TAVI preceded by cardiogenic shock compared with elective TAVI; however, the 30-day landmark analysis showed similar 1-year mortality suggesting that once the patient survives the early period, the prognosis is similar to that of elective TAVI.¹⁰⁾

We obtained enhanced CT prior to TAVI, but prior study suggested that 3D echocardiography measurement of aortic parameters demonstrated strong correlations with CT¹¹⁾ and could be an advantageous option for pre-TAVI workup because of contrast exposure avoidance. TAVI in this case was performed under general anesthesia but local anesthesia resulted in similar outcomes and both strategies are acceptable.¹²⁾

Our case suggested that emergent TAVI and intra-aortic balloon pump were useful in maintaining end-organ perfusion, therefore allowing early recovery from TAVI and preventing infectious complication.

Conclusion

A favorable outcome of severe AS complicated with cardiogenic shock could be achieved with emergent TAVI and mechanical circulatory support. Further study is

warranted to identify risk factors for acute decompensation of AS causing cardiogenic shock.

Author Contribution

The conception and design of the work: T. Kimura and T. Tobaru.

The acquisition and analysis of data of the work: T. Ando and T. Kimura.

The interpretation of data for the work, revising the work critically for important intellectual content: T. Ando, K. Hatori, T. Onishi, and T. Tobaru.

Final approval of the work: all authors.

Accountability for all aspects of the work: all authors.

Disclosure Statement

Dr. Tobaru is the proctor of TAVI for Edwards Life-sciences and Medtronic. All other authors have no disclosures.

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