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【 CASE REPORT 】

Antegrade Balloon Aortic Valvuloplasty for the Highly Frail Patient of Severe Aortic Stenosis Complicated with Transthyretin-type Cardiac Amyloidosis

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Abstract:
Transcatheter aortic valve implantation (TAVI) is widely accepted as the treatment for patient with severe aortic stenosis (AS) whose prognosis may be over one year; however, there is no consensus concerning extremely high-risk patients whose prognosis may not exceed one year. We herein report a highly frail patient with severe AS complicated with transthyretin-type cardiac amyloidosis who had a very poor prognosis. Given his condition, we treated him by percutaneous antegrade balloon aortic valvuloplasty (A-BAV) instead of TAVI. A-BAV may be a beneficial option for treating extremely high-risk severe AS patients, including those with cardiac amyloidosis.

Key words: antegrade balloon aortic valvuloplasty, cardiac amyloidosis, aortic stenosis

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Introduction

Elderly patients with severe aortic stenosis (AS) whose prognosis is expected to exceed one year are often treated with transcatheter aortic valve implantation (TAVI); however, there is no current consensus regarding the treatment of patients with severe AS whose prognosis may not be as lengthy.

Percutaneous balloon aortic valvuloplasty was first reported in 1986 (1). Although an immediate reduction in the transvalvular aortic gradient and early improvement of the symptomatic status were achieved, a poor long-term outcome and relatively high rate of complications have been shown (2, 3). However, transesophageal or intracardiac echocardiography-guided antegrade balloon aortic valvuloplasty (A-BAV) has been able to be performed safely without critical complications and may thus be effective for treating severe AS (4-6).

We herein report an extremely frail severe AS patient complicated with transthyretin (TTR)-type cardiac amyloidosis and discuss the treatment strategy for such extremely high-risk AS patients.

Case Report

An 86-year-old man was admitted to the previous hospital because of vertebral dislocation and spinal cord injury induced by a traffic accident. After laminoplasty operation, he managed to sit up by himself. However, during additional rehabilitation, he developed palpitation and dyspnea.

An electrocardiogram showed first-degree atrioventricular block, low voltage in the limb lead and a QS pattern on V1 to V2 (Fig. 1A). Transthoracic echocardiography (TTE) revealed severe AS [peak aortic jet velocity 4.36 m/s, mean aortic pressure gradient 42 mmHg, calculated aortic valve (AV) area 0.67 cm^2] with marked left ventricle (LV) concentric hypertrophy (maximum wall thickness 18 mm)

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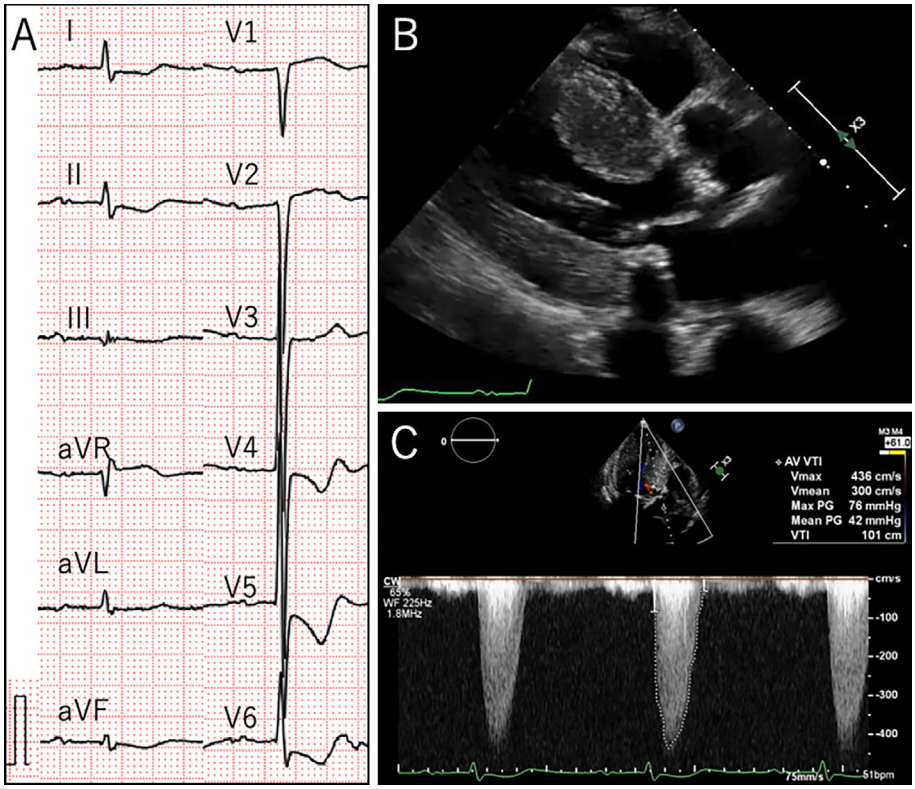

Figure 1. **(A) An electrocardiogram showing first-degree atrioventricular block, low potential in limb leads and QS pattern in V1 and V2 leads. (B) Transthoracic echocardiography left ventricular long-axis view and (C) continuous doppler on aortic valve showing marked left ventricle concentric hypertrophy (maximum wall thickness: 18 mm) with severe aortic stenosis [peak aortic jet velocity 4.36 m/s, mean aortic pressure gradient 42 mmHg, calculated aortic valve (AV) area 0.67 cm^2].**

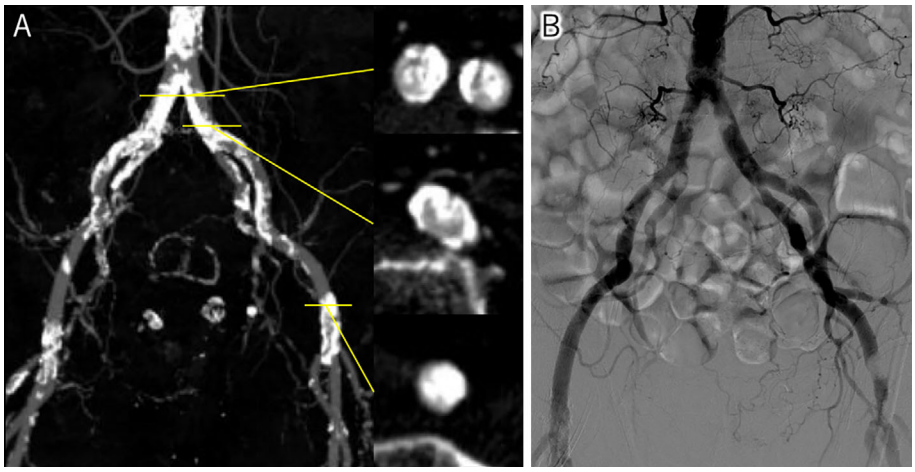

Figure 2. **(A) Enhanced computed tomography and (B) digital subtraction arteriography showing severe tandem calcification from the bilateral common iliac arteries to the common femoral arteries.**

(Fig. 1B, C). His rehabilitation could not progress because of his dyspnea and palpitation, so he was referred to our hospital.

TAVI was initially considered as a treatment option. However, he was unable to even stand up because of his spinal cord injury at that moment, and enhanced computed tomography and arteriography revealed severe tandem calcification in the bilateral common iliac arteries to common femoral arteries (Fig. 2). Because of his extreme frailty, with a clinical frailty scale (CFS) score of 7, the severe calcification and the large annulus area (566 mm^2), we decided to perform percutaneous A-BAV via the right femoral vein.

Transseptal puncture and subsequent procedures were performed under intracardiac echocardiography guidance. A balloon-tipped catheter was inverted from the left ventricle to the ascending aorta with great difficulty because of severe

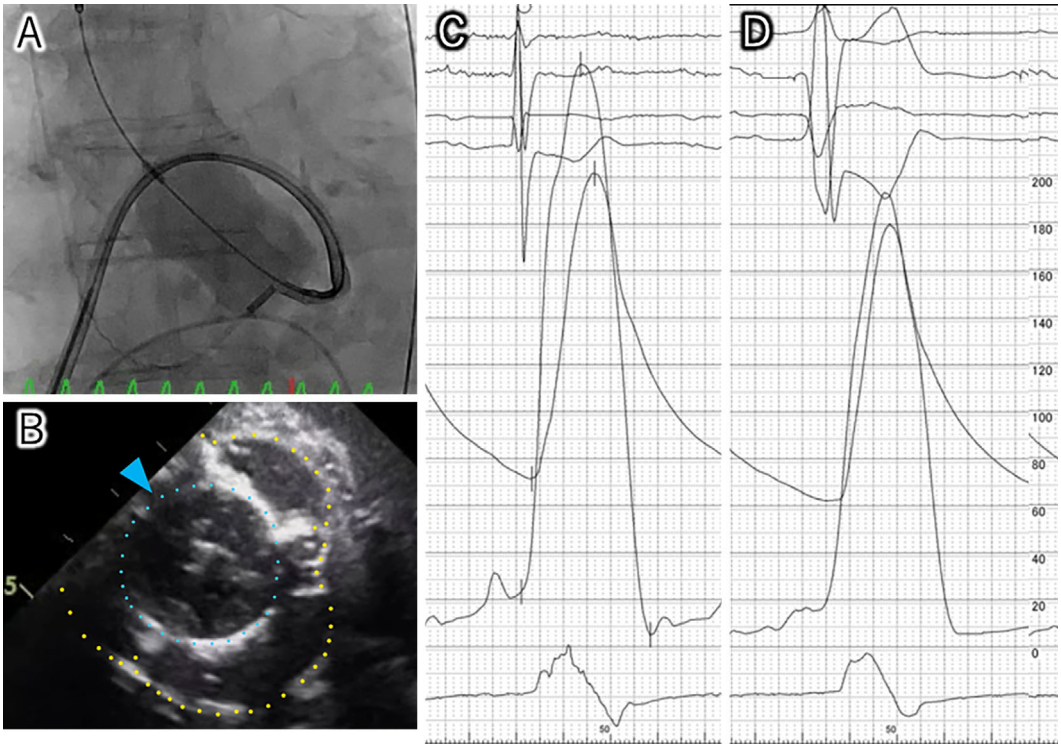

Figure 3. **(A) Cine image and (B) intracardiac echocardiography during inflation of the Inoue balloon catheter. Percutaneous antegrade balloon aortic valvuloplasty was performed using a 26-mm Inoue balloon under intracardiac echocardiography guide. The blue arrowhead and blue dotted line indicate the inflated Inoue balloon catheter. The yellow dotted line indicates the aortic valve (AV). (C) Polygraph recording before and (D) after valvuloplasty. The AV peak pressure gradient improved from 45 mmHg to 12 mmHg.**

concentric LV hypertrophy. A 26-mm Inoue balloon could not pass the AV at first, so pre-dilatation using an 18-mm conventional balloon was performed. The Inoue balloon then successfully crossed the AV. Valvuloplasty was started, adjusting the balloon size to 22 mm, and then the balloon was gradually enlarged 1 mm at a time. During the balloon inflation to 24 mm, temporary complete atrioventricular block occurred, and the operation was ended.

The AV peak pressure gradient and AV area measured by the catheter improved from 45 mmHg to 12 mmHg and from 0.59 cm^2 to 1.25 cm^2 respectively (Fig. 3). We performed a right ventricular endomyocardial biopsy because a preprocedural ^{99m}Tc-labeled pyrophosphate (PYP) scintigram had suggested coexisting transthyretin cardiac amyloidosis (Fig. 4A). The specimen showed positive Congo red staining, suggesting the existence of amyloid deposits, which further showed transthyretin (TTR)-positive amyloid deposition, leading to a definitive diagnosis of TTR-type cardiac amyloidosis (Fig. 4B, C).

Because TTR-type cardiac amyloidosis complicated with severe AS has been reported to present with a very poor prognosis (7) we decided to follow him strictly without additional invasive therapy, including TAVI or surgical AV replacement. His BNP level improved from 2,102 pg/mL to 624 pg/mL after the procedure. One month later, he was able to walk with a cane as a result of successful rehabilitation and was discharged. TTE after discharge showed moderate AS (peak aortic jet velocity 3.58 m/s, mean aortic pressure gradient 27 mmHg, calculated AV area 1.34 cm^2). He has been free from symptoms for more than nine months since the procedure.

Discussion

We herein report an elderly patient with severe AS and TTR cardiac amyloidosis. He was treated with A-BAV instead of TAVI based on his severe impairment of morbidity and advanced frailty (CFS score: 7) in addition to the fact that he was also complicated with TTR-type cardiac amyloidosis, meaning his prognosis was expected to be very poor.

In Japan, TAVI has emerged as an alternative option for the treatment of severe AS, especially in patients expected to show a high mortality during surgical procedures. However, TAVI is not recommended for extremely high-risk patients whose prognosis is expected to be less than one year. BAV, by contrast, has already been shown to be a good option as a bridge to AV replacement or TAVI, even for such extremely high-risk patients (8) however, because of the high AV restenosis rate within several months after the procedure (2, 3), it is not recommended for use in patients with severe AS who can be treated by initial surgical AV replacement or TAVI. If their frailty improves after the first BAV

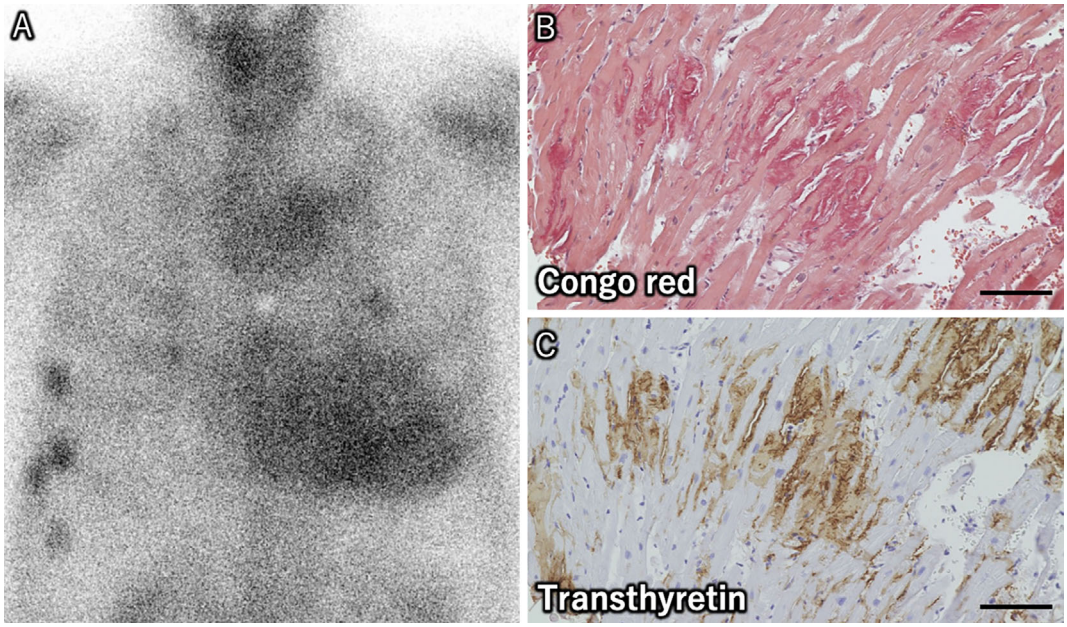

Figure 4. **(A) A ^{99m}Tc-labeled pyrophosphate scintigram was positive in the heart, suggesting coexisting transthyretin cardiac amyloidosis. (B) A histological myocardial biopsy slides stained with Congo red under brightfield light and (C) transthyretin-specific immunohistochemistry showing patchy transthyretin-type amyloid deposits. Scale=100 μm.**

procedure, patients can be treated by TAVI or surgical AVR. Otherwise, repeated BAV may be a treatment option for patients with AV restenosis.

Regarding the potential treatment options for severe AS in the present case, the cumulative 1-year mortality has been shown to be as high as 44.1% in patients with a CFS score ≥7 (9) In addition, TTR-type cardiac amyloidosis complicated with severe AS has been associated with a very poor prognosis (7) There was also great concern about using the trans-femoral approach site for TAVI because of the severe calcification present from the patient's bilateral common iliac arteries to common femoral arteries. Transesophageal or intracardiac echocardiography-guided A-BAV approaching through the femoral vein, by contrast, was expected to be able to be performed safely without critical complications and thus effective for severe AS, even in such an extremely high-risk patient (4-6). Compared with retrograde BAV, the transvenous approach with A-BAV might reduce the bleeding risk; in addition, our patient's annulus size was quite large at 566 mm^2, which was too large to use commercially available balloons for retrograde BAV. An antegrade transseptal approach is also expected to reduce the incidence rate of periprocedural cerebral and cerebellar infarctions, as large devices never cross the aortic arch during the procedure (10) Given the above, we selected A-BAV for treating the present case, providing him a great opportunity to achieve further rehabilitation.

According to a previous report, TTR-type cardiac amyloidosis occurs at a rate of 16% in elderly patients with severe calcific AS undergoing TAVI (11) and the 1-year all-cause mortality of patients with cardiac amyloidosis complicated by AS is reported to be as high as 56% (7) Of note, the presence of cardiac amyloidosis in elderly AS patients is associated with all-cause mortality after adjusting for potential comorbidities and confounders, including the Society of Thoracic Surgery predicted risk of mortality and aortic valve replacement (11).

The present case holds two important messages: First, A-BAV is a beneficial option for treating elderly patients with severe AS and extreme frailty. Second, TTR cardiac amyloidosis should be considered in patients with severe AS, especially among those exhibiting massive left ventricular hypertrophy and low voltage on an electrocardiogram, since it may improve the patient stratification and affect the treatment strategy.

The authors state that they have no Conflict of Interest (COI).

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