

## Pressure Wave Reflection After Successful Balloon Dilatation of Aortic Coarctation

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After successful surgical repair in patients with aortic coarctation, the early onset of cardiovascular diseases is an important subsequent complication and one of the causes is the enhanced aortic pressure wave reflection. Balloon angioplasty has become established as an effective alternative to surgery, but there have been no reports regarding pressure wave reflection after balloon dilatation in patients with aortic coarctation. A 29-year-old patient with aortic coarctation was admitted for angioplasty, which was performed successfully. Six months later, catheter examination demonstrated enhanced aortic pressure wave reflection, although there was no pressure difference. After balloon dilatation patients with aortic coarctation may be also at high risk for future cardiovascular diseases. (*Circ J* 2007; 71: 1821–1822)

**Key Words:** Aortic coarctation; Percutaneous transluminal angioplasty; Pressure wave reflection

**A**ortic coarctation is one of the most common congenital heart diseases and despite initial, apparently successful surgical repair, subsequent cardiovascular complications are frequent, one of which is early onset of cardiovascular disease (eg, hypertension, myocardial infarction, cardiac failure, and sudden death)<sup>1,2</sup>. We have reported that a possible cause of subsequent cardiovascular disease is enhanced aortic pressure wave reflection<sup>3</sup>. Balloon angioplasty is now established as an effective alternative to surgery<sup>4,5</sup> but there are no data about the risk of subsequent cardiovascular diseases afterward. To clarify this issue, we investigated the aortic pressure waveform before and after balloon angioplasty treatment for aortic coarctation.

### Case Report

A 29-year-old male patient was admitted for cardiac catheterization and angioplasty treatment for aortic coarctation. He was diagnosed as suffering from essential hypertension when 15 years old. Although treated with antihypertensive drugs, his systolic blood pressure (SBP) remained over 160 mmHg. From this medical history, we considered secondary hypertension, and used magnetic resonance imaging to demonstrate the aortic coarctation (Fig 1).

His right arm SBP was 159 mmHg, and that in his right leg was 99 mmHg. Cardiac catheterization showed a minimum aortic diameter of 4.3 mm, and the SBP gradient between the ascending and descending aorta was 44 mmHg. Balloon angioplasty was performed using a 16 mm×2 cm XXL balloon catheter (Boston Scientific), which was fully inflated until the narrowing disappeared. There were no significant complications. After the procedure, the pressure

difference between the ascending and descending aorta had reduced to 4 mmHg. Six months later, he was readmitted to evaluate the effectiveness of the intervention. Magnetic resonance imaging showed an extended aortic arch (Fig 2) and furthermore, cardiac catheterization proved no pressure difference between the ascending and descending aorta. However, we noticed an abnormality of his aortic pressure waveforms (Fig 2). The augmentation index (AI) of the ascending aortic pressure waveform had been reduced from 34.5% to 22.7% by the balloon angioplasty treatment, but the AI in the descending aorta (25.7%) was just lower than

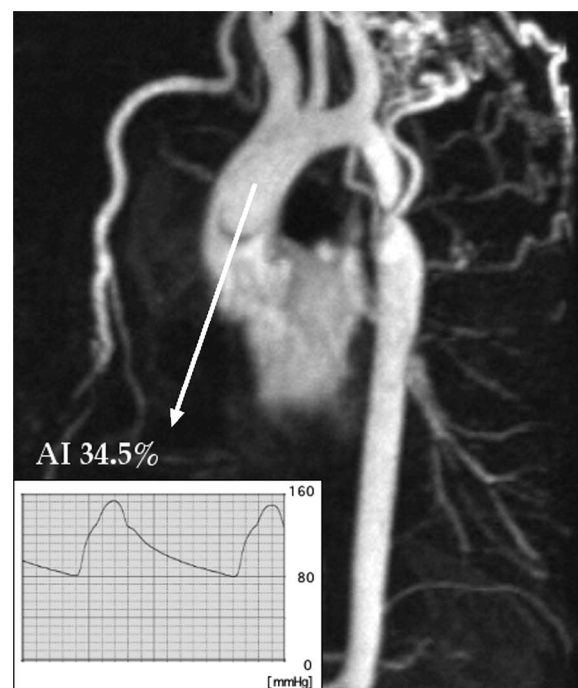


Fig 1. Magnetic resonance imaging and pressure waveform of aorta before balloon angioplasty treatment. AI, augmentation index.

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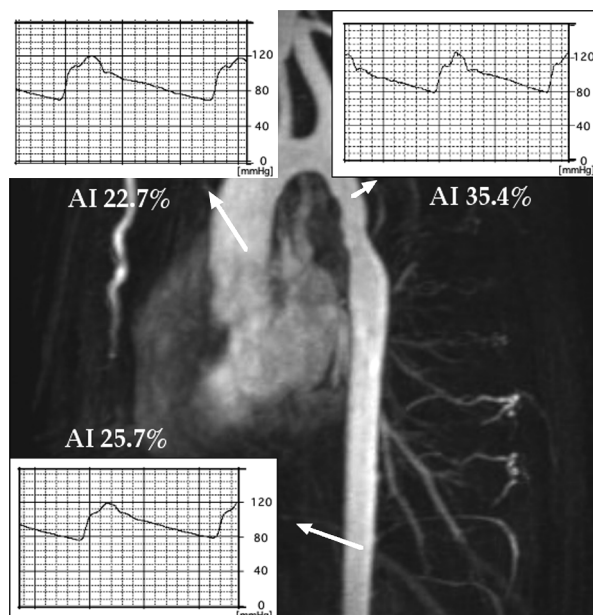


Fig2. Magnetic resonance imaging and pressure waveforms of aorta after balloon angioplasty treatment. In normal aorta, the augmentation index (AI) increases when the pressure sensor gets closer to the aortic bifurcation, which is a major reflection point. However, AI in the descending aorta was just lower than that in the aortic arch, which means that there was a strong reflection wave from the extended portion. Pressure waveforms recorded with a pressure sensor mounted catheter (Millar, SPC-464D; Millar Instruments).

that in the pre-coarctation position (35.4%) (Fig2). In a normal aorta, the AI gradually increases when the pressure sensor moves from ascending aorta to the aortic bifurcation,<sup>3</sup> so these data meant that there was a strong reflecting wave from the extended portion.

## Discussion

The aortic pressure waveform is composed of forward and backward (or reflected) pressure waves.<sup>6</sup> Aortic pressure augmentation by the reflected pressure wave is one of the most important risks for cardiovascular diseases,<sup>7</sup> and the degree of aortic pressure augmentation is evaluated by the AI. In the present study, balloon dilatation of the aortic coarctation reduced the aortic pressure augmentation, but we confirmed that pressure wave reflection continued to

occur in the extended portion after balloon dilatation of aortic coarctation, as with surgical repair.<sup>3</sup> Because wave reflections arise from any discontinuity in the elastic properties along the arterial tree in which there is a mismatch in impedance,<sup>8</sup> it seems reasonable that the reflected pressure wave arose from the enlarged portion. The reason why the aortic pressure augmentation was decreased by balloon dilatation may be because of a decrease in the mismatch in impedance. In other words, balloon dilatation of the aortic coarctation smoothed out the aorta and the change in the aortic shape may have reduced the pressure wave reflection.<sup>9</sup>

Balloon angioplasty is now widely performed to treat aortic coarctation and the results are comparable with those achieved during surgery.<sup>4,5</sup> However, information about future cardiovascular diseases prognoses has not yet been reported. Our results show that aortic pressure augmentation after balloon dilatation treatment resembles that after routine surgical intervention,<sup>3</sup> so we therefore conclude that patients remain at high risk of future cardiovascular diseases after aortic balloon dilatation. However, it is impossible to predict whether balloon dilatation or surgery provides a better prognosis judging from this case only. Further cases and longer-term follow-up are required to resolve these issues.

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