Antegrade balloon valvuloplasty for critical aortic stenosis in a premature neonate weighing 1100 g

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Experiences with invasive cardiac catheterization in low birth weight infants are few. In our clinic, we performed balloon aortic valvuloplasty by antegrade approach in a neonate weighing 1100 g with critical aortic stenosis, patent ductus arteriosus and atrial septal defect. The right femoral vein was accessed with a 4 Fr sheath, and a catheter was placed into the left ventricle from the atrial septal defect along the guidewire for coronary catheter. The aortic valve was passed with guidewire, and the guidewire was placed into the right arteria carotis. After proper placement, the balloon was inflated at 6 atm using an indeflator device until indentation disappeared. After the procedure, the mean pressure gradient over the stenotic aortic valve was measured as 18 mmHg, mild-moderate aortic insufficiency was noticed, and left ventricle contraction was better. To the best of our knowledge, this is the lowest weight infant in the literature to undergo successful antegrade balloon aortic valvuloplasty.

Key words: aortic balloon valvuloplasty, very low birth weight, invasive cardiac catheterization.

The frequency of cardiac catheterizations applied to low birth weight infants has increased due to the increased chance of survival in recent years. Although these patients are at risk for severe complications due to the coexisting pathologies, gradually increasing success and lower complication rates are being reported with the developments in cardiac catheterization techniques[1]. Herein, we aimed to present our experience with antegrade balloon aortic valvuloplasty (AV) in a premature newborn weighing 1100 g.

Case Report

A 1100 g premature baby born at 31 weeks' gestation underwent echocardiographic examination at six days of age. Echocardiography revealed a critical aortic stenosis, bicuspid aortic valve, patent ductus arteriosus (PDA), severe dilation of the left ventricle (LV), and a small atrial septal defect (ASD). Left ventricular ejection fraction (LVEF) was 34%, and flow gradient of the aortic valve was 40 mmHg. Aortic annulus was measured as 4 mm; however, a very weak anterograde flow was observed on the aortic valve with color Doppler ultrasonography. Aortic arch flow was provided from the PDA retrogradely. As surgical repair could not be performed because of the low birth weight, it was decided to perform balloon AV. After the right femoral vein was accessed with a 2.5 cm (0.021 inch, Sentia®) Seldinger needle, a 4 Fr dilator and sheath (0.021 inch, 7.5 cm) were placed. A cobra catheter (4 Fr-Terumo Glidecath®) inserted from the sheath was placed into the LV from the right atrium to the left atrium and mitral valve by ASD along the 0.014 inch x 182 cm guidewire for coronary catheter (Boston Scientific, ChoICE® floppy). The aortic valve was passed with guidewire, and the guidewire was placed into the right arteria carotis. The cobra catheter was removed, and a 4 mm x 20 mm coronary balloon (Boston Scientific, Monorail® Maverick®, PTA dilatation catheter) was moved along the guidewire. After proper placement had been achieved, the balloon was inflated at 6 atm using an Indeflator device (Simeks, 30 atm-20 ml) until indentation disappeared (Fig. 1). After this procedure, the

cobra catheter was moved along the coronary guidewire into the ascending aorta, and then pressures were measured from the ascending aorta and LV. Mean pressures of the ascending aorta and LV were 27 mmHg and 45 mmHg, respectively. After contrast injection to the LV, a mild stenosis and a mild-moderate aortic insufficiency were noticed, and LV contraction was better (Fig. 2). Echocardiography performed on the same day, after the procedure, revealed a mild aortic insufficiency and aortic arch, and branches were filled by anterograde flow from the aortic valve. Two weeks after the procedure, a chest tube was inserted due to pneumothorax, and necrotizing enterocolitis (NEC) developed in the same week. The aortic arch was filling anterogradely during this time, and LVEF was within normal ranges. Three weeks after the procedure, LVEF was 72% on ECHO. Pneumothorax and NEC improved in the fourth week; however, the patient died due to sepsis.

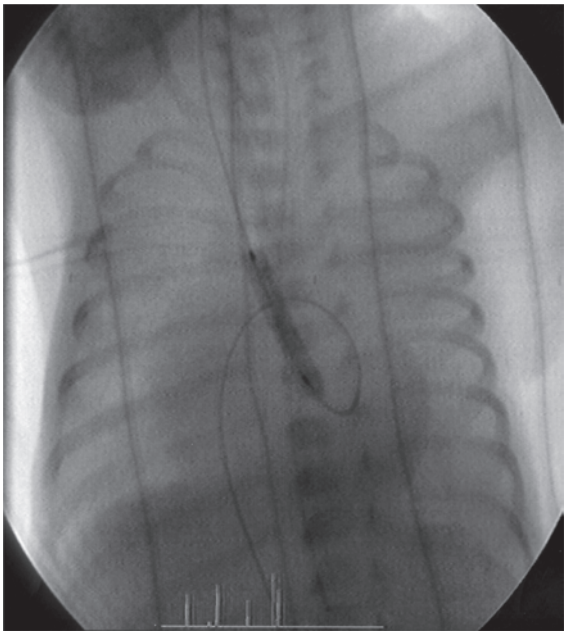

Fig. 1. Indentation is seen to disappear in balloon aortic valvuloplasty performed through antegrade route.

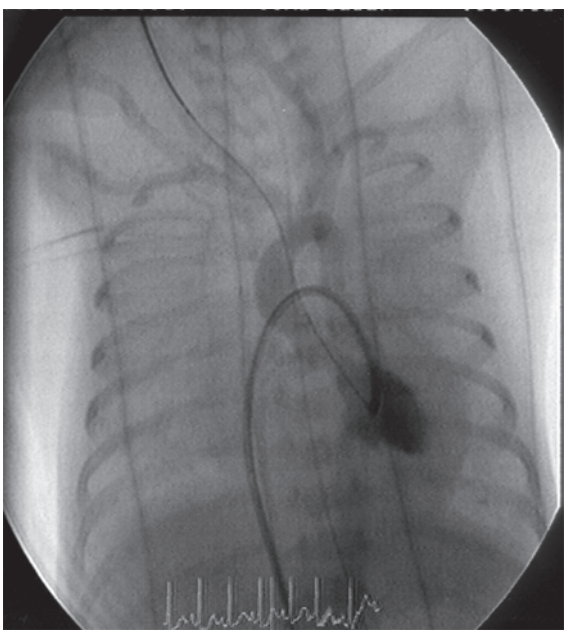

Fig. 2. Antegrade flow from the aortic valve is seen on anteroposterior angiographic images after the procedure.

Discussion

Aortic, umbilical, carotid, antegrade, and transapical routes have been used for balloon AV in newborns[2-6]. The aortic route may be preferred in infants whose body weights are a little greater; however, alternative routes are preferred in low birth weight infants, as the likelihood of femoral and iliac artery injury is high despite using the smallest sheaths. In patients with a proper body weight, the transapical route may be tried with hybrid method if hemodynamic status does not allow open heart surgery[3]. The umbilical route may be preferred in the early period in which umbilical venous access is suitable. The aortic occlusion time was reported to be shorter when the antegrade approach was preferred for balloon AV[7]. However, the success rate of the antegrade route is low if LV volume is insufficient[8]. We preferred the antegrade route as surgical treatment could not be performed due to the patient's low birth weight, and using the aortic route carries a high complication risk in the iliofemoral artery. In addition, our experiences with low birth weight infants with severe valvular stenosis show that the retrograde approach is not possible or would take too long.

Transapical AV through the hybrid method was reported to be successfully performed in a newborn weighing 890 g[3]. Koestenberger et al.[4] also reported a successful transcarotid AV in a 1100 g newborn. Fagan et al.[8] tried to perform AV through the antegrade route in a 1600 g newborn; however, they removed the catheter and abandoned the antegrade approach, as acute

bradycardia and hypotension developed when the catheter passed to the LV. They instead performed transcarotid balloon AV.

Although invasive cardiac catheterization-related complications are expected to be high in low birth weight infants, in recent years, complications rates were reported to be similar to those in older babies[9]. A proper balloon/aortic annulus diameter is of importance to prevent the development of aortic insufficiency. This ratio was 1 in our patient, and severe aortic insufficiency did not develop after the procedure. Sutton et al.[9] reported that none of the patients developed severe aortic insufficiency; however, trivial insufficiency was observed in all of four infants weighing less than 1500 g. They reported that two of the four patients died, and LV functions did not improve after the procedure in these two patients.

Materials used in interventional procedures in low birth weight newborns, such as introducer, wire, needle, and catheter, should be chosen carefully to minimize catheterization-related complications. We preferred the Seldinger needle 21 Ga X 2.5 cm (0.021 inch) and guidewires (0.014 inch) in our patient. Coronary balloons and guidewires can be used successfully in very low birth weight babies.

In conclusion, antegrade transcatheter balloon AV may be used to prolong survival of low birth weight infants with valvular aortic stenosis despite the high operative risk and poor prognosis. To the best of our knowledge, this is the lowest weight patient in the literature to undergo transvenous AV. Therefore, transvenous-antegrade AV, which is a less invasive method compared to others, can be preferred as an alternative to transarterial, transapical and transcarotid AV in low birth weight newborns. The major advantages of this technique compared to the other approaches are protection of the arterial vessels and its less invasive nature.

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