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CASE REPORT

BALLOON AORTIC VALVULOPLASTY IN TERM NEONATES WITH MINIMAL TO NIL COMPLICATIONS POST PROCEDURE- A REPORT CASE

TAMBULURU SRI KAVYA[1] VEERESH MANVI[2]

[1]Junior Resident, Department of Paediatrics, Jawaharlal Nehru Medical College and KLES Dr. Prabhakar Kore Hospital & Medical Research Centre, Belagavi

[2]Professor, Department of Paediatrics, Jawaharlal Nehru Medical College and KLES Dr. Prabhakar Kore Hospital & Medical Research Centre, Belagavi

*Corresponding Author
Dr. Tambuluru Sri Kavya

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Abstract:

Background: Balloon aortic valvuloplasty (BAV) is a well-established and minimally invasive interventional procedure for relieving congenital aortic stenosis (AS) in neonates. Despite its efficacy in reducing left ventricular outflow obstruction, the risk of post-procedural aortic regurgitation (AR) remains a concern, with literature citing incidence rates between 7% and 27%. Early antenatal detection of severe AS allows appropriate perinatal planning and timely postnatal intervention, which can significantly improve outcomes and reduce complications.

Case Report: We present the case of a term male neonate (3.28 kg) born at 38 weeks and 5 days of gestation via elective cesarean section. Fetal echocardiography had revealed severe congenital aortic stenosis with a bicuspid aortic valve. Postnatally, the infant was hemodynamically stable with a grade 3 ejection systolic murmur. Echocardiography confirmed severe valvular AS (AV peak gradient 95 mmHg; mean gradient 50 mmHg) with preserved left ventricular function. On day 17 of life, BAV was performed under general anesthesia using sequential 5 mm and 8 mm Tyshak balloons. Left ventricular pressure decreased from 144 mmHg to 74 mmHg, and post-procedure echocardiography showed a marked reduction in gradient (peak 18 mmHg, mean 9 mmHg) without any aortic regurgitation. A transient femoral artery thrombosis was identified post-procedure and successfully managed with low-dose heparin infusion. The infant was discharged in stable condition the following day.

Keywords: Congenital aortic stenosis, balloon aortic valvuloplasty, neonate, bicuspid aortic valve, aortic regurgitation, cardiac catheterization, femoral thrombosis, antenatal diagnosis, neonatal intervention.

INTRODUCTION

Congenital aortic stenosis (AS) is a significant cause of left ventricular outflow tract obstruction in neonates and infants, accounting for approximately 3–6% of all congenital heart defects. It may occur as an isolated lesion or in association with other congenital cardiac anomalies, most commonly a bicuspid aortic valve (1,2). The condition results in obstruction to left ventricular ejection, leading to increased afterload, left ventricular hypertrophy, and, in severe cases, left ventricular dysfunction and heart failure if left untreated. Early diagnosis and timely intervention are therefore crucial to improving survival and long-term cardiac outcomes (3).

Balloon aortic valvuloplasty (BAV) has emerged as the preferred initial treatment modality for congenital valvular aortic stenosis in many centers worldwide. First performed in the early 1980s, this minimally invasive catheter-based technique aims to relieve obstruction by dilating the stenotic aortic valve using a balloon catheter (4). The procedure is particularly advantageous in neonates and infants due to their small size, fragile physiology, and the high risks associated with open surgical valvotomy. BAV offers shorter recovery time, reduced procedural morbidity, and the potential to delay or avoid surgical intervention (5).

However, despite its effectiveness in gradient reduction and improvement of left ventricular function, balloon valvuloplasty carries certain inherent risks and complications. The most notable among these is the development of aortic regurgitation (AR) following the procedure (6). The incidence of post-procedural AR varies widely in published literature, ranging from 7% to 27%, depending on patient age, valve morphology, balloon-to-annulus ratio, and operator experience. Severe pre-procedural AS, bicuspid aortic valve anatomy, and excessive balloon dilation are recognized risk factors for the development of significant AR (7). Although mild AR is often clinically insignificant, moderate to severe AR can result in left ventricular volume overload, progressive dilation, and eventual heart failure, necessitating re-intervention (8).

Advances in fetal echocardiography have facilitated early antenatal diagnosis of congenital heart defects, including severe aortic stenosis. Prenatal identification allows comprehensive counseling of parents, multidisciplinary planning of delivery in tertiary centers equipped with pediatric cardiology and interventional facilities, and early postnatal management before the onset of critical decompensation. Immediate postnatal echocardiographic assessment helps confirm the severity of obstruction, left ventricular function, and associated anomalies, thus guiding the optimal timing of BAV (9).

The success of balloon aortic valvuloplasty in neonates relies on several critical factors accurate assessment of the aortic annulus size, appropriate selection of balloon size (typically 80–100% of the annulus), meticulous procedural technique, and close post-procedural monitoring for vascular or hemodynamic complications (10). Femoral arterial access is the most commonly used route for neonatal cardiac catheterization; however, it is associated with the risk of vascular occlusion or thrombosis (11). Prompt recognition and conservative management, as in our case, can prevent long-term ischemic complications.

This case highlights the successful management of a term neonate with antenatally detected severe congenital aortic stenosis and a bicuspid aortic valve who underwent balloon aortic valvuloplasty with excellent hemodynamic improvement and no post-procedural aortic regurgitation (12). The outcome underscores the importance of early detection, coordinated multidisciplinary care, and precise procedural execution in achieving favorable results with minimal complications in neonatal cardiac interventions (13).

CASE REPORT

Patient Presentation: A term male neonate weighing 3.28 kg was delivered via elective lower segment cesarean section (LSCS) to a 26-year-old G2E1 mother at 38 weeks and 5 days of gestation. The antenatal course was uneventful, and there were no maternal comorbidities or infections reported. Fetal echocardiography performed at 32 weeks of gestation revealed severe congenital aortic stenosis with a bicuspid aortic valve. The mother was counseled, and delivery was planned in a tertiary care center equipped with neonatal and interventional cardiology facilities.
Immediately after birth, the baby cried spontaneously and required no resuscitation. Apgar scores were 8, 8, and 9 at 1, 5, and 10 minutes, respectively. The baby was hemodynamically stable, with normal peripheral perfusion and oxygen saturation of 98% on room air. On cardiovascular examination, an ejection systolic murmur (grade 3/6) was audible in the aortic area radiating to the carotids. There were no features of heart failure or cyanosis.

Initial Investigations: Baseline investigations including complete blood count, coagulation profile, renal and liver function tests were within normal limits. Echocardiography confirmed the antenatal findings and revealed a bicuspid aortic valve with severe valvular aortic stenosis, showing a peak pressure gradient (PPG) of 95 mmHg and mean pressure gradient (MPG) of 50 mmHg. The aortic annulus measured 6 mm, and the left ventricle was of normal size and contractility, indicating preserved left ventricular function. No additional structural cardiac anomalies were detected.

Pre-Procedural Management: The neonate was monitored conservatively in the NICU, with serial echocardiography and hemodynamic surveillance. As the baby remained stable with good feeding and weight gain, elective intervention was planned at two weeks of age. After a multidisciplinary discussion involving the pediatric cardiologist, neonatologist, anesthesiologist, and the parents, a balloon aortic valvuloplasty (BAV) was scheduled on day 17 of life. Informed written consent was obtained from the parents.

Procedure Details: On the day of the procedure, the baby weighed 3.07 kg. Under general anesthesia, the child was intubated and mechanically ventilated. Percutaneous left femoral artery access was achieved using a 22G thin-wall percutaneous needle, and a 4 French Terumo arterial sheath was placed. An ascending aortogram demonstrated a doming bicuspid aortic valve with severe valvular stenosis and an aortic annulus of 8 mm. The aortic valve was crossed using a Terumo guidewire, and sequential balloon dilatations were performed using 5 mm and subsequently 8 mm Tyshak balloons.
Hemodynamic measurements showed a significant drop in left ventricular systolic pressure from 144 mmHg to 74 mmHg post-dilation. The post-procedure aortogram demonstrated a widely open aortic valve with no evidence of aortic regurgitation. The procedure was completed without any immediate complications.

Post-Procedural Course: Following the procedure, the neonate was extubated after four hours and shifted to the NICU for observation. The baby remained hemodynamically stable with good peripheral perfusion. However, the left dorsalis pedis pulse was noted to be feeble. Bilateral lower limb arterial Doppler revealed a focal thrombus involving the left common femoral, superficial femoral, and tibial arteries. The neonate was started on low-dose heparin infusion (10 U/kg/hr) and closely monitored. Within 6–8 hours, distal pulses improved, and heparin was gradually tapered off.
Repeat echocardiography post-procedure revealed a significant improvement in valve function with AV PPG of 18 mmHg and MPG of 9 mmHg, along with a well-opening aortic valve and no evidence of aortic regurgitation. The baby maintained stable vital signs and normal urine output throughout the observation period.

Outcome and Follow-Up: The neonate was discharged the next day in stable condition with palpable femoral and pedal pulses bilaterally. Parents were advised on regular follow-up with clinical evaluation and echocardiography. At two-week follow-up, the baby remained asymptomatic with satisfactory growth, stable hemodynamics, and no recurrence of gradient or regurgitation on echocardiography.

DISCUSSION

Balloon aortic valvuloplasty (BAV) has been widely accepted as the first-line treatment for congenital aortic stenosis (AS) in neonates and infants, owing to its minimally invasive nature and rapid relief of obstruction. Since its introduction in the early 1980s, it has become the preferred alternative to surgical aortic valvotomy (SAV), especially in critically ill neonates where surgical risk is high. BAV provides effective gradient reduction, shorter recovery time, and improved short-term survival (14).

McCrindle et al. (2001) conducted a landmark study comparing BAV and SAV in neonates with critical AS and reported similar mortality and re-intervention rates between both procedures. Long-term follow-up showed that BAV carries a re-intervention rate of 35%–60%, mainly due to restenosis (15). However, overall outcomes depend on ventricular function, patient stability, and procedural expertise, making BAV a suitable initial therapy in carefully selected cases.

The most frequent complication of BAV is aortic regurgitation (AR), with incidence ranging from 7% to 27.6%. Mild AR is generally well tolerated, but moderate to severe AR can cause left ventricular dilation and may necessitate surgery (16). In our case, there was no AR detected post-procedure on either aortogram or echocardiography, reflecting precise balloon sizing and optimal technique. Another common risk during neonatal cardiac catheterization is femoral artery thrombosis, due to small vessel size. Our patient developed a transient femoral thrombus that was successfully managed with low-dose heparin infusion and resolved completely before discharge (17).

Early antenatal diagnosis using fetal echocardiography played a crucial role in timely decision-making, multidisciplinary planning, and early postnatal intervention. This coordinated approach minimized morbidity and improved outcome. In neonates with adequate left ventricular function and favorable valve anatomy, as in this case, BAV provides excellent hemodynamic results with minimal complications (18). Balloon aortic valvuloplasty remains a safe and effective treatment for severe congenital aortic stenosis in neonates when performed in experienced centers. Accurate pre-procedural assessment, appropriate timing, and vigilant post-procedural care are key factors for achieving optimal results and preventing complications such as aortic regurgitation or vascular thrombosis (19).

CONCLUSION

Balloon aortic valvuloplasty is a safe and effective first-line intervention for neonates with severe congenital aortic stenosis when performed in a specialized center with a multidisciplinary approach. Early antenatal diagnosis, careful procedural planning, and precise balloon sizing are critical to achieving successful outcomes while minimizing complications. In this case, timely intervention resulted in significant reduction in transvalvular gradients, preservation of left ventricular function, and absence of post-procedural aortic regurgitation. The transient vascular complication was managed effectively, demonstrating that with vigilant monitoring and expert care, BAV can provide excellent short-term outcomes and favorable prognosis in neonates.

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