

Fetal balloon aortic valvotomy: Celebrating first birthday

Sir,

We report a timely managed case of impending hypoplastic left heart syndrome (HLHS) due to critical aortic stenosis in a fetus. Fetal echocardiogram of a 25-year-old 2nd gravida during midgestation showed severe aortic stenosis. On followup, fetal heart assessment showed redistribution of flow, namely, flow reversal in the arch, left to right flow across the foramen ovale, mitral regurgitation, ventricular dysfunction, and endocardial fibroelastosis [Figure 1a-d]. The published data supports in-utero progression to HLHS in the presence of these features.^[1] Biventricular circulation is reported to be achieved in 43% of liveborn infants if fetal aortic valvotomy is performed.^[2] Informed consent was obtained for the fetal balloon aortic valvotomy. At 26 weeks of gestation, after an initial unsuccessful attempt because of unfavorable fetal position, the procedure was reattempted 1 week later involving a multidisciplinary team [Table 1]. General anesthesia was given to the mother. After obtaining an ideal fetal position, intramuscular injection of vecuronium and fentanyl was given to the fetus using a 21 G needle. Under ultrasound guidance, an 18 G Hawkins-Akins needle (Cook Medical Inc, Bloomington, Indiana, USA) was introduced through the maternal

abdomen, fetal thorax, and subsequently into the left ventricle. A 0.014 Galeo extrasupport wire (Biotronik AG, Ackerstrasse, Switzerland) was passed through the aortic valve and a 3.5 mm × 10 mm Hiryu balloon (Terumo Europe NV, Leuven, Belgium) was advanced over it. The balloon was inflated twice across the valve [Figure 2a-d]. There was transient bradycardia during the procedure that recovered with atropine injection into the fetal ventricle. Mild pericardial effusion developed following the procedure, which resolved spontaneously over the next 48 h. There were no maternal complications.

The serial ultrasound assessment showed improvement of ventricular function, aortic flow, disappearance of mitral regurgitation, and reversal of shunt across foramen ovale [Figure 3a-d]. The left ventricle and mitral annulus showed steady growth [Figure 4]. Baby was delivered by an elective cesarian section and underwent percutaneous balloon aortic valvotomy using a 5 × 20 mm Tyshak mini balloon (NuMED, Inc, Hopkinton, New York, USA). The gradient across the aortic valve dropped from 120 to 45 mmHg following the procedure. On followup, the child had normal growth and development. In the fourth month of life, the child needed a repeat balloon valvotomy using

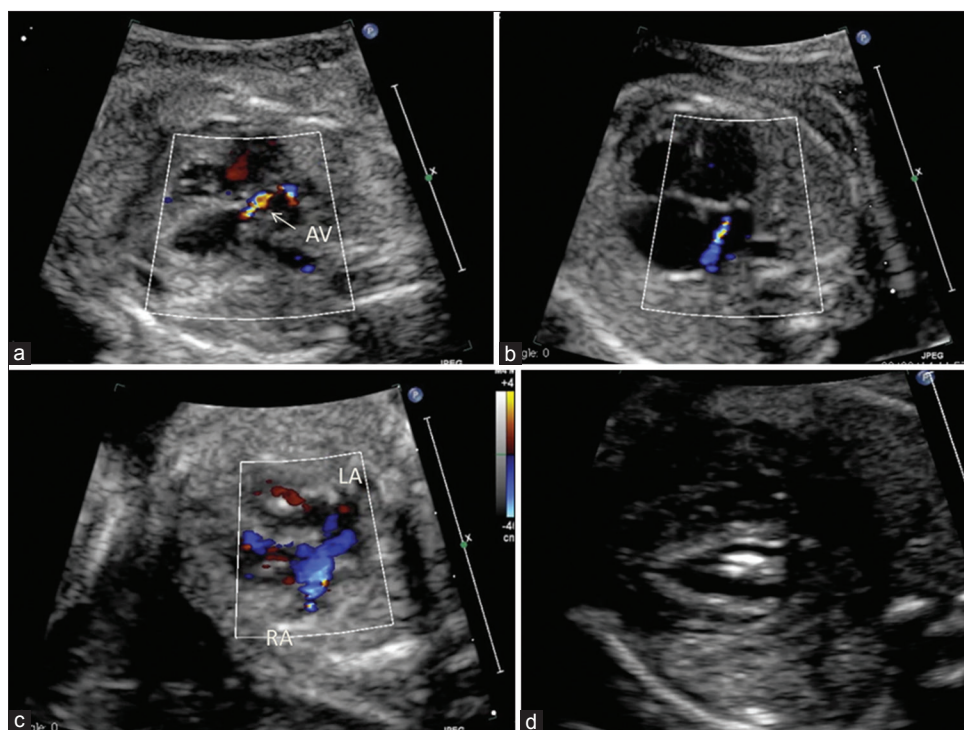


Figure 1: Fetal echocardiographic images prior to procedure. (a) Color Doppler image showing the stenotic aortic valve. (b) Four-chamber view revealing mitral regurgitation. (c) Foramen ovale shunting from left to right atrium. (d) Endocardial fibroelastosis of the left ventricle. AV: Aortic valve, LA: Left atrium, RA: Right atrium

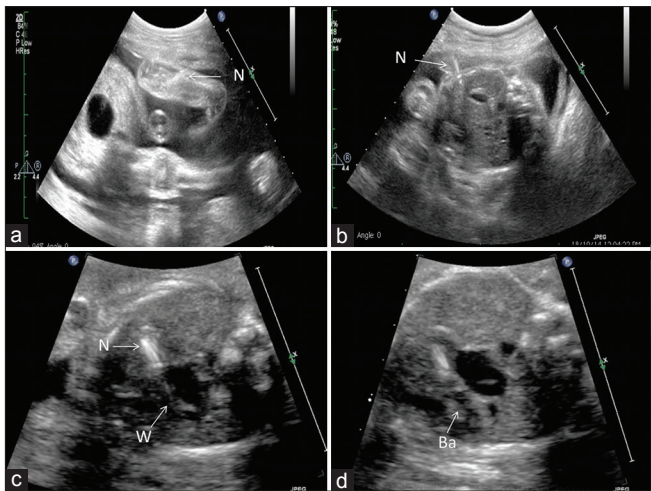


Figure 2: Fetal sonographic images during the procedure. (a) Intramuscular injection of anesthetic agent into the fetus. (b) Needle entry into the fetal thorax. (c) Needle alignment with the left ventricular outflow tract and wire across the aortic valve. (d) Inflated balloon across the aortic valve. AV: Aortic valve, Ba: Balloon, N: Needle, W: Wire

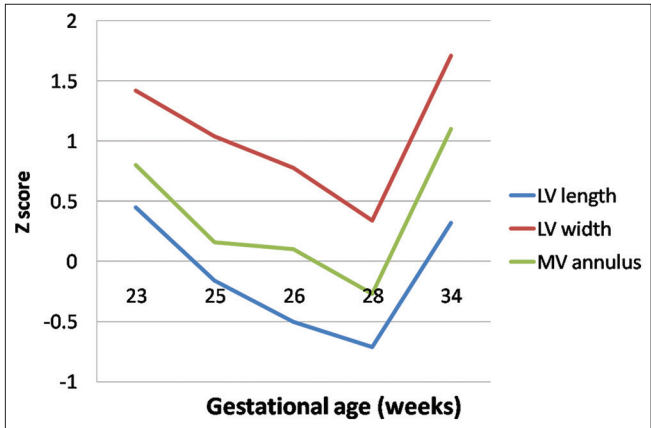


Figure 4: Graph showing steady growth in the left ventricular dimensions and mitral valve annulus following the balloon aortic valvotomy at 27 weeks gestation. LV: Left ventricle, MV: Mitral valve

7 × 20 mm Tyshak mini (NuMED, Inc, Hopkinon, New York, USA) balloon because of the suboptimal result obtained during neonatal period. At present, the child is 1 year old with normal growth and developmental milestones. There is mild residual aortic stenosis without regurgitation.

Although the world’s first fetal intervention for aortic stenosis was reported 24 years ago,^[3] there have been no reports of successful fetal balloon aortic valvotomy in India until now. Many social, cultural, and financial constraints play a role apart from identifying an ideal case. The success of fetal intervention depends on appropriate case selection, timing of intervention, organizing the team, selection of appropriate hardware, and experience in handling complications and postnatal management. Follow-up data of first 100 cases of

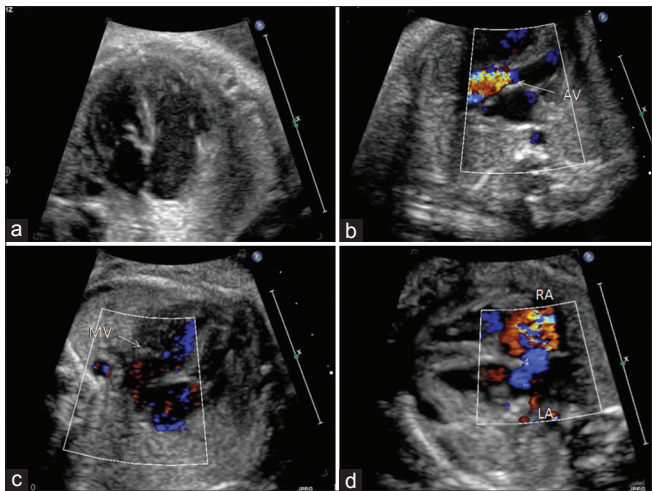


Figure 3: Fetal echocardiographic images 6 weeks following the procedure. (a) Four-chamber view showing resolution of endocardial fibroelastosis. (b) Color Doppler image revealing improved flow through the aortic valve. (c) Four-chamber view in systole showing absence of mitral regurgitation. (d) Foramen ovale shunting from right to left atrium. AV: Aortic valve, LA: Left atrium, MV: Mitral valve, RA: Right atrium

Table 1: Role of team members, hardware, and medications used during the procedure

Team	Role
Pediatric cardiologist	Procedure
Interventional radiologist	Imaging guidance
Obstetrician	Obstetric management
Anaesthesiologist	Maternal anaesthesia
Neonatologist	Fetal resuscitation
Equipment	Type
Needle for fetal anaesthesia	21 G spinal needle
Needle for the procedure	18 G Hawkins Akins needle
Guide wire to cross the valve	0.014 Galeo extra support wire
Balloon for aortic valvotomy	3.5x10 mm Hiryo balloon catheter
Procedure	Medications
Fetal anaesthesia	Fentanyl 10 µ/kg, Vecuronium 200 µ/kg
Maternal anaesthesia	General anaesthesia
Fetal Resuscitation	Atropine 20 µ/kg, Epinephrine 0.01 mg/kg

fetal aortic valvuloplasty revealed achievement of biventricular circulation in 43% of liveborn cases.^[2] However, the family has to be counseled that fetal intervention is never a standalone procedure. They usually need postnatal valvuloplasty as in our case. Up to 55% of those who achieved biventricular circulation also required additional cardiac surgeries during followup, such as aortic/mitral valve replacement, Ross-Konno procedure, or endocardial fibroelastosis resection.^[2]

Early detection of congenital heart defects in the fetus and timely referral to a tertiary care center may help achieve biventricular circulation, which has better survival and lesser morbidity compared to Norwood procedure.

Letters to Editor

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Conflicts of interest

There are no conflicts of interest.

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