Stent implantation of patent ductus arteriosus in a newborn baby

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INTRODUCTION

Duct-dependant circulation in a newborn baby presents as a life-threatening emergency. Neonates with pulmonary valve atresia or aortic valve atresia are born normal at birth. Their circulation is maintained through flow in patent ductus arteriosus (PDA). These patients can survive only if duct patency is reliably maintained for sometime before they can be taken up for staged cardiac surgical repair. We present a newborn baby who had tricuspid valve atresia, hypoplastic right ventricle with pulmonary valve atresia and was duct dependant. Baby was successfully managed with ductal stenting.

CASE REPORT

A male baby with birth weight of 3.6 Kg born at a peripheral hospital by normal delivery was noticed to have cyanosis twelve hours after birth. Saturation by pulse oximetry was 75%. General examination did not reveal any abnormality except post axial polydactyly in left hand. A grade II/VI systolic murmur was heard over left II intercostal space. Suspecting heart disease paediatrician got chest radiograph of baby which showed normal cardiac size with oligoemic lung fields. Echocardiography confirmed the diagnosis of duct dependant circulation with a PDA of 2 mm diameter.

To prevent closure of the duct, prostaglandin infusion was required but this was not available at the peripheral hospital hence within 24 hours of birth patient was shifted to tertiary care paediatric cardiac centre.

At our centre examination revealed deeply cyanosed baby with oxygen saturation <50% and feeble peripheral pulses. Precordium was quiet. Diagnosis of pulmonary and tricuspid valve atresia with hypoplastic right ventricle was confirmed by echocardiography. Faint flow of PDA could be observed with

duct size less than 1 mm. Prostaglandin E1 infusion was started immediately at the rate of 1 µg/Kg/min. Oxygen saturation improved to 88–92% within 3–4 minutes. Within 10 minutes of infusion the baby had an episode of apnoea which was aborted by providing ventilatory support with bag and mask. There were 4 apnoeic episodes in next 12 hours which were again controlled. Available options to keep the duct patent for few months before being taken up for staged cardiac surgery, were either to perform a surgical shunt or to do ductal stenting. Baby was taken up for ductal stenting for its obvious advantages.

The procedure was performed under general anaesthesia. Right femoral artery was catheterised and a 5 fr sheath was introduced by Scheldinger's technique. Angiography was performed in various views to define the length of the duct which was approximately 15 mm (Figure 1). A right coronary guiding catheter was placed in aorta with its mouth near the aortic end of the duct. The duct was not engaged with the catheter as this would have obstructed the flow into the duct. The duct was crossed with a 0.014 wire with its tip deep into right pulmonary artery. Prostaglandin infusion was now stopped so as to allow the duct to constrict. This constriction of duct prior to stent deployment is important for better opposition of stent in the wall of the duct. Coronary stent with diameter 3.5 mm and length of 20 mm, premounted on low-profile balloon dilation catheter was selected. While positioning the stent it was ensured that the length of the stent was longer than the duct so as to cover full length of duct including both ends adequately (Figure 2). Position of the stent was checked in various views by giving small injections of contrast by the side port of sheath.

Figure 1 Angiogram demonstrating PDA under effect of prostaglandin infusion and opacification of pulmonary arteries with contrast.

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After confirming the position stent was deployed by inflating the balloon at 18 atm pressures (Figure 3). Repeat angiography was performed after stent deployment to confirm the correct position of the stent (Figure 4). Ventilatory support was continued for 24 hours. Prophylactic antibiotic treatment with Cefotaxime and Amikacin was given for 72 hours. To prevent stent thrombosis, heparin infusion at dose of 25 units/Kg/hour was given for 24 hours followed by antiplatelet therapy with 3 mg/Kg/day of acetylsalicylic acid. Patient was discharged from hospital after 4 days with basal oxygen saturation 84–88%.

In future this patient will get single ventricle repair. Glenn shunt should be possible around 6 months of age and Fontan surgery at age of 3–4 years.

DISCUSSION

Duct dependant cardiac lesions like aortic valve atresia and pulmonary atresia usually present as an emergency. Their early recognition and timely management is important to save the life. Pulmonary atresia where blood flows from aorta to

Figure 2 Catheter at mouth of duct, over the wire stent mounted on balloon positioned in PDA.

Figure 3 Stent deployed in PDA, wire, and deflated balloon still in PDA.

pulmonary artery through the ductus become symptomatic once ductus arteriosus starts closing. Prostaglandin E1 infusion can keep the duct patent and should be started early in these patients at the slightest indication of impending ductal closure. This helps in keeping the duct patent for 48–72 hours which helps in transport of the patient to a specialised centre for definitive treatment. Prostaglandin may cause apnoea in these small babies hence ventilatory support should be kept ready.

Surgical aorto-pulmonary shunt (modified BT shunt) used to be an important first stage palliation in such cases. Pleural effusion, phrenic nerve palsy, congestive cardiac failure associated with increased pulmonary blood flow and stenosis because of kinking, thrombosis or narrowing at anastomotic site are all known complications associated with this surgery.¹ Stenting of the PDA is a better alternative to modified BT shunt as it eliminates problems associated with thoracotomy in neonatal period and long-term problems of scarring, which may cause major difficulty in future definitive surgery.² Initial results with ductal stenting were discouraging but with improvement in stents design and growing experience in proper positioning of stent the results are encouraging. Experience have shown that a low profile premounted coronary stent with diameter of 3.0 to 4.0 mm positioned in duct so as to cover complete length and both ends of the duct adequately can provide relief of cyanosis up to 3–4 months.³ Though an editorial described role of ductal stenting for restricted pulmonary blood flow in neonates to have a very limited role in clinical practice,⁴ several studies which compared ductal stenting with modified BT shunt (MBTS) showed that stenting is as effective as modified BT shunting in duct-dependant pulmonary circulation. Stent ensured an even distribution of the pulmonary blood flow and more balanced pulmonary vascular development than MBTS.^{5,6}

This patient was followed up for assessing the pulmonary blood flow as durability of coronary stents in ductus is limited by thrombosis and neo intimal proliferation.⁷ Recatheterisation after 3–6 months as recommended by Schneider et al⁸ can also be done but this depends more upon patients growth and oxygen saturations. This patient did very well, doubled birth weight at age of five months and had maintained oxygen saturation

Figure 4 Angiogram showing contrast flow in PDA after stent deployment.

around 80%. Stent can be redilated if required during follow-up catheterisation which is an added advantage of stenting over conventional shunt surgery. Surgery after PDA stenting is safe and low risk.⁹ A bidirectional Glenn shunt will be performed at age of six months in this patient as a step towards future single ventricle repair in form of Fontan shunt.

CONFLICTS OF INTEREST

None.

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