Cardiology in the Young

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Fluoroscopy-free, echocardiography-guided hybrid stenting of native aortic coarctation in a 920-grams premature infant

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Brief Report

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Abstract

Therapeutic options are limited for the management of extremely low-birth-weight infants with critical aortic coarctation despite high doses of prostaglandin infusion. We report successful hybrid, fluoroscopy-free, echocardiography-guided primary stenting of native aortic coarctation in a 920-grams premature infant.

Therapeutic options are limited for the management of extremely low-birth-weight infants with critical aortic coarctation despite high doses of prostaglandin infusion. Based on a few successful reports, primary stenting has emerged as a promising bridging therapy to further surgical repair in extremely low-birth-weight infants with critical coarctation. We herein report successful fluoroscopy-free primary stenting of native coarctation in a 920-grams extremely low-birth-weight infant.

Case description

A premature infant (born at 28 weeks of gestation, birth weight: 850-grams) was intubated at day-1 because of infant respiratory distress syndrome and remained ventilator-dependent. She developed severe isolated coarctation. Prostaglandin-1 (10 ng/kg/hr) infusion was started and allowed restoration of systemic perfusion. Prostaglandin-1 doses were then gradually increased because of progressive deterioration of her clinical condition with decrease of systemic perfusion and progressive left ventricular dysfunction. At 3 weeks of life, she presented with cardiogenic shock, critical coarctation, and a patent ductus arteriosus despite high doses of prostaglandin-1 infusion (50 ng/kg/day). Transthoracic echocardiography confirmed severely impaired left ventricular function and severe coarctation with a posterior shelf and an increased Doppler velocity at 3 m/s with a diastolic tail, despite a left-to-right shunting patent ductus arteriosus. The transverse aortic arch diameter was measured at 3.5 mm and aortic isthmus at 1.2 mm diameter on a 4.5 mm length. The left subclavian artery originated immediately upstream the coarcted aortic isthmus (Fig 1, Movie1). After multidisciplinary team discussion, the patient was declined for conventional surgical repair due to extremely low body weight and hybrid management was planned under general anaesthesia at day-of-life 21, procedural weight 920 grams.

The procedure was guided by transthoracic echocardiography only, i.e. fluoroscopy-free, without angiography, although it was performed in the catheterisation laboratory to keep fluoroscopy immediately available as a bailout option if needed. After right carotid surgical cut-down, vascular access was gained by direct puncture using a 24-Gauge needle and a 0.014' coronary wire, and the first 2 cm of a 4-French short introducer were cautiously inserted. An infusion of 4 IU/kg/h of intravenous heparin was administered. Stent dimensions were determined according to transthoracic echocardiography measurements. The 0.014' coronary wire was placed in descending aorta and a 3.5 x 10 mm pre-mounted drug-eluting coronary stent (Optimax, Hexacath, Rueil-Malmaison, France) was advanced into the 4-French introducer and positioned using transthoracic echocardiography landmarks, over the full length of the isthmus, immediately below the origin of the left subclavian artery, until just beyond the coarctation. The stent was deployed using an indeflator at 16 atmosphere bridging the stent to a diameter of 3.75 mm. On transthoracic echocardiography, the stent appeared well apposed with a peak velocity of 1.5 m/s in the descending aorta and the left subclavian artery origin remained free (Fig 2, Movie2). The sheath was removed with the purse string closed, and the baby was transferred back to the neonatal ICU with a low dose of IV heparin (4 IU/kg/h) during 2 days. She did not receive antiplatelet treatment to avoid the risk of cerebral haemorrhage in that context of severe prematurity. Early follow-up was uneventful with normalised left ventricular systolic function at day-1 transthoracic echocardiography, unchanged weekly

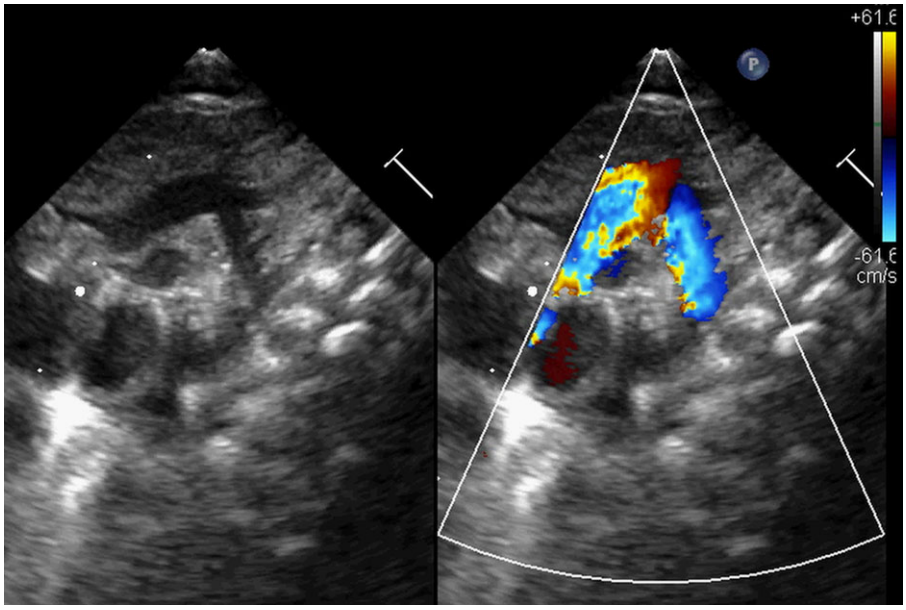

Figure 1. Movie 1: pre-procedural echocardiography showing critical aortic coarctation.

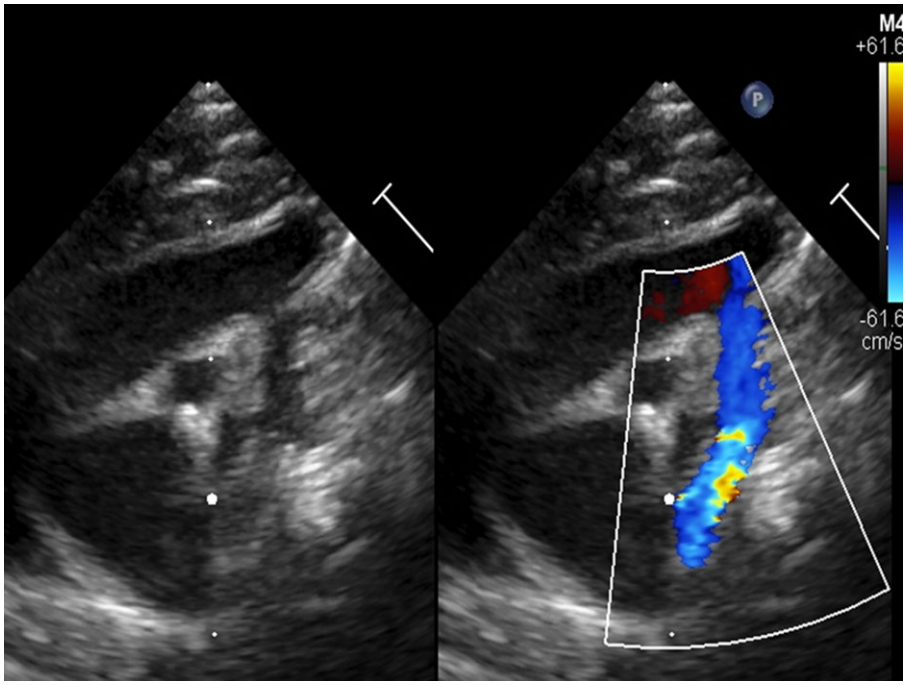

Figure 2. Movie 2: post-procedural echocardiography showing a well apposed coronary stent with coarctation relief.

ultrasound controls, clinical improvement, and de-escalation of respiratory support with extubation at day 8. However, the patient died 5 weeks after the procedure from severe prematurity-related brain injury due to periventricular leukomalacia and intraventricular haemorrhage grade 3.

Discussion

Although there are reports of early surgical repair of coarctation between 1000 and 2500-grams, prematurity, younger age, and smaller body weight are at increased risk for adverse outcomes and reinterventions.[1] Percutaneous balloon angioplasty of critical coarctation has been offered to ELBW infants,[2] but it carries a high risk of aortic wall injury, recoarctation, and need for reintervention. Primary stenting of coarctation has emerged as an efficient alternative.

In previous reports of balloon dilation and/or primary stenting of coarctation in extremely low-birth-weight infants, vascular access varied including umbilical artery,[2] femoral artery,[3,4] axillary artery, and femoral or carotid artery surgical cut-down. Umbilical artery access was no longer available in our patient. Although feasible,[3,4] femoral artery access carries a high risk of arterial spasm and femoral artery occlusion in extremely low-birth-weight infants, with 5/5 patients (gestational age: 29 weeks [27–32], procedural weight: 1200-grams [680–1380]) having occlusion of the femoral artery used for intervention in a recent series.[3] In our case, we preferred surgical cut-down of the right common carotid artery as neonatal cardiac interventions via percutaneous common

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carotid artery access have been shown to be effective and safe, with no acute change in cerebral perfusion.[5]

We performed a fluoroscopy-free intervention, without angiography and with transthoracic echocardiography guidance only as we thought that the benefit–risk balance was in favour of avoiding the potential risks associated with both irradiation and contrast injection in this very preterm infant, although small aortic wall dissection or aneurysm may be missed by transthoracic echocardiography only. Although radiation reduction protocols according to the ALARA concept aim to provide the lowest possible radiation dose, increased radiosensitivity of young children, higher heart rates, smaller cardiovascular structures, and smaller body size remain specific challenges often resulting in relatively high radiation doses to the patient and the possibility to further develop radiation-related sequelae, including increased standardised incidence ratios for all-cancer, leukaemia, lymphoma, and solid cancers compared with the general population.[6] The use of contrast agent in extremely low-birth-weight infants may cause renal failure or iodine-induced hypothyroidism that has been occasionally reported in extremely low-birth-weight infant after transcatheter patent ductus arteriosus closure.

Our patient had a drug-eluting stent to provide long palliation until her elective surgery, according to previous reports demonstrating (a) less luminal loss and lower unplanned reinterventions with drug-eluting stent as compared with bare metal stent[7] and (b) low serum sirolimus levels in neonates.[8] Promising preliminary results have been reported with stents capable of being implanted at infant vessel diameters and achieving adult size while maintaining structural integrity, i.e. (a) the Minima stent, a cobalt-chromium, balloon expandable stent delivered via a 4-French sheath, with stent diameters ranging from 4 to 22 mm[9] and (b) the breakable Osypka BabyStent, a cobalt-chromium, balloon-expandable stent delivered via a 4-French sheath, with stent diameter adjustable from 6 to 12 mm by balloon dilatation, and easily breakable by further dilation that opens predefined joints enabling unrestricted growth.[10]

Conclusion

Our case illustrates the feasibility of fluoroscopy-free, echocardiography-guided only primary stenting of critical native coarctation in extremely low-birth-weight infants as a bridge to further surgical repair.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/S104795112300094X.

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Conflicts of interest. None.

Ethical standards. The authors assert that all procedures contributing to this work comply with the Helsinki Declaration of 1975, as revised in 2008.

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