

LETTER TO THE EDITOR

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Residual shunt in an infant following patent ductus arteriosus ligation detected via transesophageal echocardiography monitoring during pulmonary artery banding: a case report

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To the Editor,

Patent ductus arteriosus (PDA) often requires surgical intervention in neonates and infants. During PDA closure, transesophageal echocardiography (TEE) provides consecutive monitoring of ductal flow, allowing detection of a residual shunt and final confirmation of PDA closure [1–3]. However, no reports exist of a residual PDA shunt being detected during pulmonary artery banding (PAB) manipulation on intraoperative TEE monitoring. Here, we describe a low-weight infant in whom a residual shunt following PDA ligation was detected via TEE monitoring during subsequent PAB.

Case presentation

A 6-month-old girl (2.7 kg) diagnosed with PDA, ventricular septal defect, and accompanying pulmonary hypertension was scheduled for PDA ligation and PAB. Preoperative transthoracic echocardiography indicated the peak pressure gradient of a left-to-right PDA shunt as 14 mmHg. After induction of general anesthesia and tracheal intubation, a single-plane TEE probe (UST-52110S; Hitachi-Aloka Medical, Tokyo, Japan), connected to an ultrasound apparatus (Prosound F75; Hitachi-Aloka Medical), was inserted into the patient's esophagus. The tip of this probe was 6.0, 13.4, and 5.3 mm in width, length, and depth, respectively. Hemodynamics and ventilation conditions were unchanged following probe insertion and manipulation. Before surgery initiation, TEE demonstrated a left-to-right shunt through the PDA on color Doppler flow imaging. Surgery was initiated under midline sternotomy, and the PDA was ligated using silk thread. After PDA ligation, disappearance of the

PDA shunt flow was confirmed. Subsequently, when the surgeon was adjusting the diameter of band on the main pulmonary artery during PAB, TEE monitoring revealed a residual PDA shunt on color Doppler imaging. There was a discrete mosaic jet moving from the descending aorta toward the pulmonary artery (Fig. 1), suggesting incomplete PDA ligation. The surgeon consequently applied a hemoclip to the PDA, and the shunt was confirmed to have disappeared on TEE. The main pulmonary artery was finally strangulated using a 24-mm band, resulting in a peak pressure gradient of 41.9 mmHg at the PAB site when the systemic arterial pressure was 74/45 mmHg. With no residual PDA flow thereafter, the patient successfully underwent ventricular septal defect closure and pulmonary arterioplasty at the age of 17 months.

Discussion

To our knowledge, this is the first report describing a residual PDA shunt that was detected again with TEE during the PAB procedure after ductal flow had been confirmed to have ceased after PDA ligation. We believe that decreased pulmonary arterial pressure caused by PAB greatly increased the pressure gradient between the pulmonary artery and the descending aorta, which made the residual PDA shunt detectable in our case.

Hemodynamic compromise and/or airway obstruction can be caused by a TEE probe especially when observing blood flow around the pulmonary artery in pediatric patients [4, 5]. A thin single-plane TEE probe can reduce the risk of these complications while providing sufficient information to determine PDA shunt flow in pediatric patients, as noted in our case.

We suggest that, in surgery for PDA closure in combination with PAB, the existence of residual PDA

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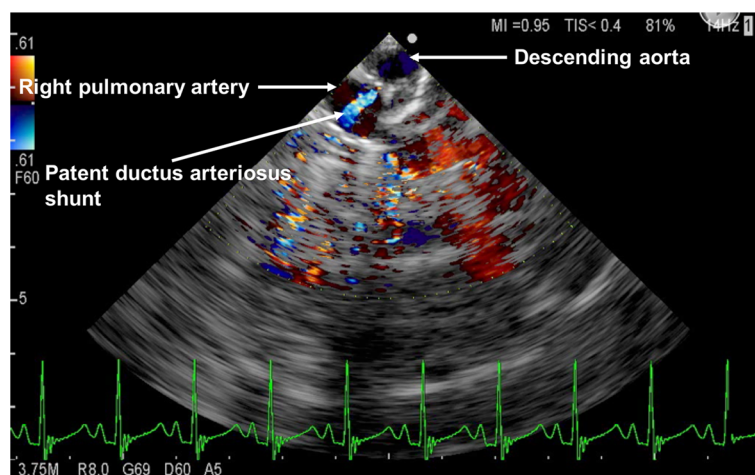


Fig. 1 Residual PDA shunt flow on color Doppler flow imaging. A mosaic jet moving from the descending aorta toward the pulmonary artery, indicating a residual PDA shunt, is seen

shunt flow should be evaluated again after the pulmonary artery pressure decreases with banding.

Abbreviations

PAB: Pulmonary artery banding; PDA: Patent ductus arteriosus; TEE: Transesophageal echocardiography

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Authors' contributions

TY and NA conducted the perioperative anesthetic management of the patient and wrote and revised the manuscript. YN wrote and revised the manuscript. All authors read and approved the final version of the manuscript.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Written informed consent was obtained from the patient's parents for the publication of this case report and accompanying images.

Competing interests

The authors declare that they have no competing interests.

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References

1. Wang KY, Hsieh KS, Yang MW, Lin CY, Kang L, Kuo SM. The use of transesophageal echocardiography to evaluate the effectiveness of patent ductus arteriosus ligation. *Echocardiography*. 1993;10:53–7.
2. Lavoie J, Javorski JJ, Donahue K, Sanders SP, Burke RP, Burrows FA. Detection of residual flow by transesophageal echocardiography during

video-assisted thoracoscopic patent ductus arteriosus interruption. *Anesth Analg*. 1995;80:1071–5.

3. Sorensen KE, Kristensen B, Hansen OK. Frequency of occurrence of residual ductal flow after surgical ligation by color-flow mapping. *Am J Cardiol*. 1991;67:653–4.
4. Ayres NA, Miller-Hance W, Fyfe DA, et al. Indications and guidelines for performance of transesophageal echocardiography in the patient with pediatric acquired or congenital heart disease: report from the task force of the pPediatric Council of the American Society of Echocardiography. *J Am Soc Echocardiogr*. 2005;18:91–8.
5. Hilberath JN, Oakes DA, Sherman SK, Bulwer BE, D'Ambra MN, Eltzschig HK. Safety of transesophageal echocardiography. *J Am Soc Echocardiogr*. 2010;23:1115–27.

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