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Abbreviations:

AD: aortic dissection
CT: computed tomography
CCU: cardiac care unit
PAD: pulmonary artery dissection
PDA: patent ductus arteriosus

Central Picture Legend

The pseudolumen of abdominal dissection was spiral down around the true lumen.

Central Message

We present a successful pediatric case with acute AD concomitant with PAD due to transcatheter PDA occlusion.
A 1 year and 10 months old girl was admitted to hospital because finding heart
murmur for 1 year, the echocardiography showed significantly hemodynamical
funnel-shaped patent ductus arteriosus (PDA) (3.4mm pulmonary end diameter,
6.6mm aortic end diameter), and otherwise normal intracardiac findings. The child
was electively posted for percutaneous transcatheter closure of PDA.

During the interventional surgery, a 6F pigtail catheter was sent into the right
femoral artery sheath. When reached the junction of descending aorta and abdominal
aorta, the surgeon felt upward resistance, angiography showed a dead end of
abdominal aorta under the diaphragm. After adjusted the position of the catheter, the
catheter was continued to be delivered toward the aortic arch. The followed
angiography showed that the descending aorta was a dead end close to the aortic arch.
Removed the catheter and guide wire. Bedside echocardiography showed a possible
main pulmonary artery hematoma. A contrast enhanced CT scan was urgently
performed and revealed aortic dissection of DeBakey type III (Stanford B), with
severe compression on the pulmonary trunk and left pulmonary artery (Fig 1). The
dissection was extended from the origin of the descending aorta to aortic hiatus of the
diaphragm. A pity should be noted that abdominal CT scan was not performed due to
the emergency.

Fortunately, the patient’s vital signs were stable, except for the disappearance of
the right dorsalis pedis artery pulse. Then the girl was transferred to cardiac care unit
(CCU) and emergent procedure was performed under deep hypothermic lower limb
circulatory arrest and low-flow antegrade cerebral perfusion.
The patient was supine, after induction of general anesthesia, a median sternotomy approach was chosen. During the operation, the heart was enlarged, the main pulmonary artery was bulged and dilated (Fig 2A). The cardiopulmonary bypass was established by ascending aortic cannulation and bicaval venous drainage. During cooling, the aortic arch and its branches were thoroughly mobilized and tourniquets were placed. When the temperature reached 26℃, the ducts arteriosus was double ligated by 7# silk sutures. When the bulged adventitial of pulmonary artery was incised, we found the pseudolumen was filled with blood. After sucking out the blood, a fistula was detected at the connection of ductus arteriosus and the bifurcation of the main pulmonary artery. The mobilization of the descending aorta was continued. When the flow of bypass decreased to 30-50ml/kg/min, two aortic cross-clamp were applied across the aortic arch distal to the origin of the left subclavian artery and descending aorta distal to the ductus arteriosus. Divided and excised the ducts tissue, the aortic dissection was found at the distal end of the ductus arteriosus (Fig 2B), 7-0 pledget-supported Prolene sutures were used to close the aortic dissection and aortic end of the ductus arteriosus by direct anastomosis with no additional patch. After excise of the dilated adventitial wall of the main pulmonary artery, the pulmonary artery end of the ductus arteriosus and the fistula of the pulmonary artery dissection were repaired with a fresh pericardial patch anchored with 6-0 prolene sutures. After rewarming, the heart beat resumed, and the case returned to CCU on mechanical ventilation after routine chest closure.

Postoperatively, inotropes were instituted intravenously for a short time and
nitroglycerin was used for blood pressure control. The pulse of the right dorsalis pedis artery recovered immediately. Fourteen hours later the child successfully weaned from the ventilator, and she left CCU on postoperative day 5. Three days after surgery, her serum D-Dimer leveled up to 2.570mg/L (0-0.243 mg/L) and oral aspirin was used for a month as an anticoagulant therapy until the level of D-Dimer was normal. On the postoperative day 12 echocardiography showed the PDA was closed with no residual shunt and no obvious abnormal signals were detected in the main pulmonary artery and aortic arch. Abdominal ultrasonography showed abdominal aortic dissection from celiac trunk to the bifurcation of the common iliac artery (the narrowest part of the true lumen was 0.26cm in diameter, and the widest part of the false lumen was 0.5cm) (Supplementary Fig 1). And the follow-up contrast enhanced CT confirmed the abdominal aortic dissection (Supplementary Fig 2). The patient was discharged from the hospital on day 18. The child was asymptomatic at 2-month follow-up and echocardiography showed a stable false lumen size. 8 months after surgery, the abdominal ultrasonography showed the true lumen was getting wider with stable blood flow velocity and the false lumen was getting narrower (Supplementary Fig 3, Supplemental Table 1). Our study was approved by the Shanxi Children’s Hospital of ethical committee (IRB-WZ-2023-001, 28/1/2023). Written informed consent was obtained from the parents of the patient for the publication of this case report.

Aortic and pulmonary artery dissection are rare pediatric diseases\(^1\)\(^2\) with high mortality and it is extremely rare for both aortic dissection (AD) and
pulmonary artery dissection (PAD) to occur in the same patient. As a common congenital heart disease, patent ductus arteriosus is usually treated by interventional therapy \[^3\]. Endovascular operation has the potential to damage the vascular wall. Iatrogenic injury can cause tearing between the intima and media of the aorta which leads to acute AD and PAD. However, successful treatment in children was rarely reported. We present a successful pediatric case with acute AD concomitant with PAD due to transcatheter patent ductus arteriosus occlusion.
Reference


Supplemental Table 1  Postoperative color doppler ultrasound results

<table>
<thead>
<tr>
<th>Postoperative follow-up time</th>
<th>diameter (cm)</th>
<th>the narrowest part of the true lumen</th>
<th>blood flow velocity (cm/s)</th>
<th>the widest part of the false lumen</th>
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<tr>
<td>5 weeks</td>
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<td>0.53</td>
<td>93.1</td>
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<td>7 weeks</td>
<td>0.23</td>
<td>0.53</td>
<td>148</td>
<td>98</td>
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<td>12 weeks</td>
<td>0.30</td>
<td>0.60</td>
<td>77.6</td>
<td>29.1</td>
</tr>
<tr>
<td>20 weeks</td>
<td>0.34</td>
<td>0.48</td>
<td>89.8</td>
<td>*</td>
</tr>
<tr>
<td>8 months</td>
<td>0.53</td>
<td>0.20</td>
<td>90</td>
<td>**</td>
</tr>
</tbody>
</table>

*: Low velocity blood flow detected in the false lumen
**: No obvious blood flow signal detected in the false lumen
Figure 1. Contrast enhanced computed tomography revealed aneurysmal dilatation (*) and the lumen of the pulmonary trunk and left pulmonary artery was significantly narrowed. The pseudolumen (white arrows) was spiral down around the true lumen (black arrows), the dissection was extended from the ductus arteriosus (white hollow arrow) to the descending aorta. (a, c, d: Axial view, b: Coronal view, e: Sagittal view, f: Three-dimensional reconstruction).

Figure 2A During the emergent surgery, the main pulmonary artery was aneurysmal dilatation (white arrows).

Figure 2B After excised the adventitial of main pulmonary artery (white arrow), a fistula (black arrow) at the connection of ductus arteriosus and pulmonary artery was found.

Supplementary Figure 1. Echocardiography showed abdominal aortic dissection on the 12th postoperative day. A floating intima was detected at the celiac trunk level (A, B). From celiac trunk to the bifurcation of the common iliac artery, part of the pseudolumen was larger than the true lumen (C, D).

Supplementary Figure 2. Postoperative CT images. PAD disappeared after operation (*), the ductus arteriosus (yellow star in F) was closed with no residual shunt. The pseudolumen (yellow arrows) of abdominal dissection was spiral down around the true lumen (black arrows).

Supplementary Figure 3. Echocardiography on the 8-month postoperatively. A, B: The diameter of true lumen increased compared with figure 4C, and the blood flow signals were not significant in the pseudolumen. C, D: At the the bifurcation of the
common iliac artery level, the pseudolumen was not obvious compared with figure 4D.