Paravertebral Venous Access for Closure of a Collateral in a Pediatric Patient After Fontan Operation

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We report on a 16-year-old female patient with tricuspid atresia, ventricular and atrial septal defect, hypoplastic right ventricle, and pulmonary stenosis. A modified Blalock-Taussig shunt was placed within the first month of life, followed by a modified bilateral bidirectional Glenn anastomosis at 3 years and a total cavopulmonary anastomosis (TCPC) at 5 years of age. The azygous vein was ligated at the time of the Glenn procedure. The patient presented with new cyanosis (arterial oxygen saturations were 86% at rest and 76% at exercise) and a decrease in exercise capacity 11 years after TCPC. By cardiac catheterization, a significant right-to-left shunt across a collateral vessel could be detected, originating from the vertebral venous plexus and draining via the azygous system with a single opening to the pulmonary vein (Figure 1A and 1B). Repeated attempts were made at transcatheter closure through the small and tortuous feeding vessels connected to the jugular veins but were unsuccessful. Therefore, a combined surgical and transcatheter approach (hybrid procedure) was performed: After a median sternotomy, the left atrium was punctured and a long sheath was inserted into the pulmonary vein, which drained the collateral vessel. Because of the large diameter of the collateral, its distant orifice, and its tortuosity, however, it was not possible to advance an introducer sheath or a closure device into the collateral vessel. Therefore, a multidisciplinary interventional approach was applied. With the patient in prone position and under deep conscious sedation, a CT scan was performed (Siemens Somatom Definition AS, application of 80 mL Accupaque 350; flow, 2.5 mL/s; delay, 50 seconds; slice thickness, 5 mm, Erlangen, Germany) and identified a 4-mm paravertebral vein at the level of the 4th to 5th thoracic vertebra as a small feeding vessel. Under real-time CT guidance, this vessel was punctured using a 4F Micropuncture introducer set (Cook Medical Inc, Bloomington, Ind), and a 4F sheath (Cook Medical Inc) was placed by means of the Seldinger technique (Figure 2). The patient was then transferred to the catheterization laboratory. The sheath was exchanged for a 7F sheath and the collateral vessels were emobilized with the placement of 8 mm and 12 mm Amplatzer vascular plugs (AGA Medical, Golden Valley, Minn) far from the entrance to the pulmonary vein (Figure 1C). Because of the position of the sheath and devices, a postclosure venogram could not be performed, but an increase in the arterial saturation to 96% confirmed closure of the collateral vein. Finally, the puncture site was closed by means of Angio Seal 8F (St Jude Medical GmbH, Eschborn, Germany).

The vertebral-azygous-hemiazygous pathway may show significantly enlarged collateral vessels in patients after corrective surgery of congenital heart disease, especially in those with modified Glenn or TCPC/Fontan operations or with obstructions or thrombosis of the superior caval vein.1,2 The collateral pathways may also include connections to the pulmonary veins via the bronchial vein system with development of a significant right-to-left shunt.3 Because the azygous vein is typically ligated at its junction with the superior vena cava at the time of a bidirectional Glenn procedure, it can be difficult to access and close venous collaterals causing right-to-left shunting when they originate from the cervical vertebral venous system and drain through the posterior azygous. Clinically significant cyanosis may occur in these patients, depending on the quantity of this shunt, and interventional closure can be indicated.1 With connection to the paravertebral veins, the vessels are often located extremely posterior, making retrograde access from the pulmonary veins by either transseptal or direct hybrid access via the left atrium and placement of a sheath or closure device extremely difficult. CT visualization of the azygous or hemazygous veins and their collateral vessels makes CT-guided access through the paravertebral veins technically possible.4 This implies an alternative approach and improves the position for transcatheter closure of these collateral vessels. Despite the immediate vicinity to the pleura, the access to the paravertebral veins was possible with great precision under real-time CT-based navigation in our patient. Thus, this approach may be appropriate when access to the paravertebral veins seems mandatory.4

Disclosures
None.

References

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Figure 1. A, Angiogram (anterior-posterior projection with injection into the collateral vessel after retrograde access via the pulmonary veins) showing the inflow (or feeding vessels) to the collateral vessel from the azygous and vertebral veins. B, This lateral projection shows only 1 connection of the collateral vessel to the pulmonary veins and the diameter at the entrance to the left atrium (LA) of 11 mm, after injection into the collateral vessel from the paravertebral access. C, Lateral projection without contrast medium: 2 Amplatzer vascular plugs in situ. One occluder was placed in the inflow to the collateral; 1 was placed in the collateral itself. Access of the sheath through the vertebral vein is documented.
Figure 2. A, CT scan of the initial paravertebral approach (patient in prone position), with the needle passing through the paravertebral space. B, Puncture of the paravertebral vein with a needle on the right side. C, Introduction of a guide wire (asterisk) into the vertebral vein. D, Insertion of a 4F introducer sheath over the wire into the paravertebral vein and application of contrast medium (hash mark) to verify correct position of the sheath.
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