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Brief Report

Challenges for bilateral pulmonary artery stenting due to occluded femoral veins

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Abstract When the inferior caval vein is occluded or abnormal, jugular and hepatic veins provide alternative routes for interventions. For pulmonary artery stenting, transhepatic access may give a relatively straighter route than that from the jugular veins. We describe the challenges and strategies during transhepatic bilateral pulmonary artery stenting after arterial switch operation complicated by occluded inferior caval vein and congested hepatic veins.

Keywords: Transhepatic access; pulmonary artery stenosis; bilateral pulmonary artery stenting; occluded inferior caval vein; arterial switch operation

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Surgery and cardiac catheterisation including intervention in CHD involving femoral venous cannulation may result in their occlusion in some patients. Sometimes, anatomical abnormalities such as interrupted inferior caval vein may preclude femoral venous access for interventions. In such cases, interventions are usually performed using the subclavian or jugular veins. The transhepatic route is another alternative option, but may be challenging in patients with high central venous pressures and congested hepatic veins.[1,2] We describe a case of bilateral pulmonary artery stenting for branch pulmonary artery narrowing and associated right ventricular failure through two transhepatic sheaths.

Case report

A 17-year-old girl was diagnosed in the neonatal period with d-transposition of the great arteries with intact ventricular septum and narrowed branch pulmonary arteries. During the arterial switch operation on the 10th day of life, the branch pulmonary arteries were widened using extensive pericardial patches. She had a prolonged postoperative intensive care stay for 3 weeks. At the 1-year follow-up investigation, she was found to have significant bilateral branch pulmonary artery stenosis with elevated right ventricular systolic pressures. During cardiac catheterisation study attempts, the femoral veins could not be cannulated.

She presented 16 years later with Class-II effort dyspnoea, exertional palpitation, and easy fatiguability of 1-year duration. Clinical examination revealed elevated jugular venous pressure, cardiomegaly, widely split second heart sound, and loud ejection systolic murmur. Echocardiography showed severe bilateral branch pulmonary artery stenoses, suprasystemic right ventricular systolic pressures, severe right ventricular systolic dysfunction, and hepatic venous congestion. A computed tomogram confirmed severe stenosis of the distal main pulmonary artery and both branch pulmonary arteries, post-Lecompte anterior location of the pulmonary arteries, which seemed adherent to the sternum, as well as occluded and collateralised iliac and infrarenal inferior caval veins (Fig 1). The reimplanted coronaries were noted to be well away from the stenosed pulmonary artery branches.

Cardiac catheterisation and haemodynamic study were performed using the right internal jugular vein to assess the anatomy with a view to stenting. The right atrial mean pressure was 18 mmHg. The

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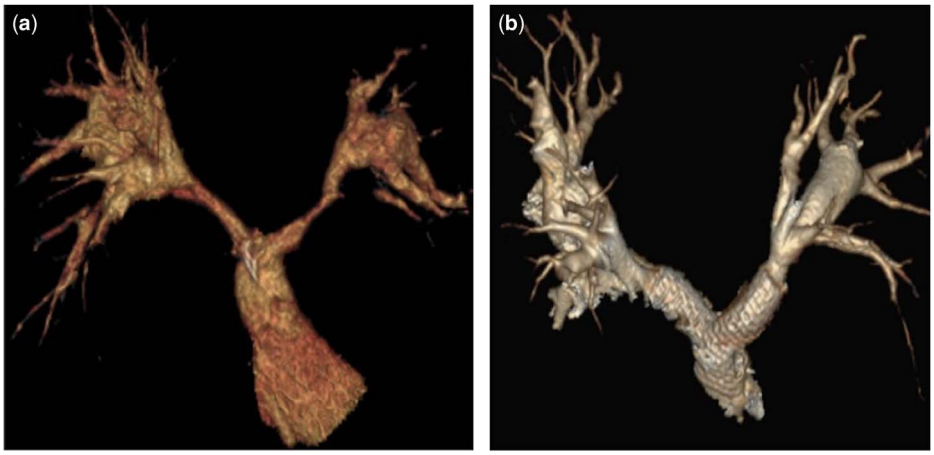

Figure 1.
*CT image before (**a**) and immediately after (**b**) bilateral pulmonary artery stenting.*

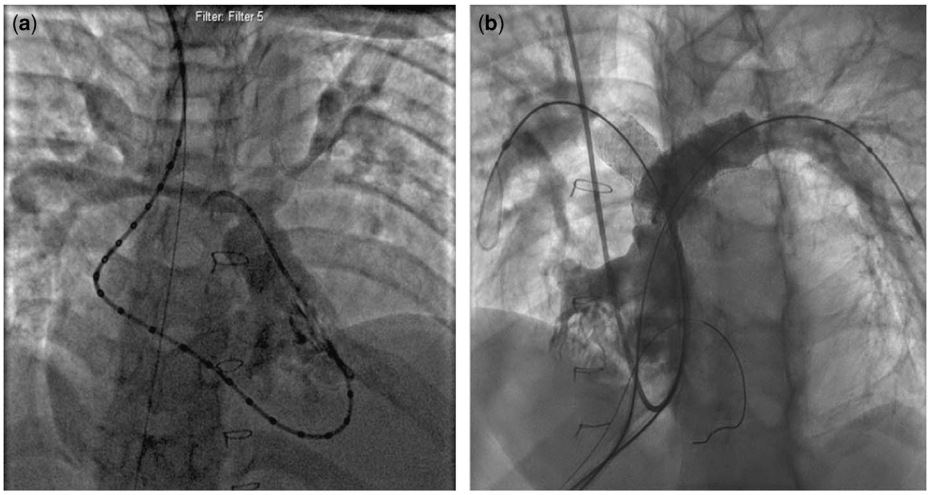

Figure 2.
*Angiography showed bilaterally diffuse long-segment pulmonary artery stenosis (**a**), improved after using simultaneous kissing stents (**b**).*

right ventricular systolic pressure was 164 mmHg against an aortic systolic pressure of 155 mmHg. The pressure gradient was 140 mmHg across the left pulmonary artery and 131 mmHg across the right pulmonary artery. Angiography showed complete occlusion of the infrarenal inferior caval vein. There was considerable difficulty in maintaining a stable catheter position in the pulmonary arteries. This precluded passage of long sheaths for stenting through the jugular access. Transhepatic venous access was considered as the only available option, but posed a risk for intraperitoneal bleeding because of markedly elevated right atrial pressures.

A catheter introduced through the jugular access into the right hepatic vein served as a guide for the transhepatic puncture along with additional guidance from ultrasound. Liver trauma was further reduced by inducing apnoea on the respirator. The hepatic vein was accessed through the mid-axillary line with a Chiba needle and a 5 Fr sheath was placed in the right atrium. Using two guidewires through the same sheath, the initial sheath was exchanged for two long, braided 7F Flexor (Cook Medical, Bloomington, Indiana, United States of America) introducer sheaths, which crossed the stenotic segments in both pulmonary arteries. Systemic heparinisation was performed using 5000 IU of heparin and activated clotting time was maintained above 250 s. After angiography, the long-segment narrowing on both pulmonary arteries were stented using two 10 mm × 40 cm Formula 535 stents (Cook Medical) deployed simultaneously and the balloons were inflated to 12 atmospheres (Fig 2). There was good flow across both the stents with a marked reduction in the right ventricular systolic pressure to 46 mmHg and gradients across both pulmonary arteries to 15 mmHg each. The tract in the hepatic parenchyma was occluded with 3 × 3 and 8 × 5 fibred 0.038″ embolisation

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coils (Cook Medical) delivered through the sheaths (Supplementary video 1). Heparin was reversed with protamine before complete withdrawal of the hepatic sheaths. Post-procedural monitoring with ultrasound scanning did not show any peritoneal bleeding. She was discharged after 4 days on aspirin.

Elective transhepatic recatheterisation performed 3 months later showed significant stent recoil and some in-stent restenosis. The right ventricular systolic pressure was 110 mmHg with gradients of 70 mmHg across both stents. Both the stents were again simultaneously redilated using 14 mm Atlas balloons (Bard Vascular, Tempe, Arizona, United States of America) to achieve optimal lumen diameter. After redilation, right ventricular systolic pressure reduced to 70 mmHg and the gradients across the stents were 30–35 mmHg. The hepatic parenchymal tract was again closed with fibred coils as before (Supplementary video 2). Aspirin was discontinued after 1 year. She remains asymptomatic 2 years after the procedure, with good effort tolerance.

Discussion

Occlusion of the femoral vein following previous catheterisations, central lines, venous thrombosis, infected groins, or congenital venous abnormalities may preclude transfemoral interventions. Jugular or subclavian veins may not allow a stable access to certain heart chambers. In such cases, the transhepatic approach is an alternative route, but contraindicated in individuals with active liver disease or peritonitis, abnormal clotting, or those with abnormally draining hepatic veins.[3–6] In spite of chronic right heart failure and congested hepatic veins, liver function tests and prothrombin time were normal in our patient. She developed bilateral femoral venous occlusion possibly because of prolonged postoperative central-line placements. The jugular venous route proved difficult to obtain stable catheter positions in both pulmonary arteries. The transhepatic approach provided a relatively straighter route. After a detailed literature review, our case was the first of its kind in positioning two simultaneous transhepatic sheaths, which enabled simultaneous stenting through a kissing technique.[5] Potential complications of this approach include significant intraperitoneal bleeding, which was minimised by inducing apnoea on the respirator, reversal of heparin with protamine during sheath removal, and obliteration of the hepatic parenchymal track with embolisation coils.[6] These measures ensured a safe redilatation of the stents in the same patient through two transhepatic sheaths. A single hepatic puncture site was used to insert both long sheaths as it reduced procedural time, reduced the bleeding risk from the congested hepatic veins, and facilitated the final track closure.

Conclusions

The transhepatic approach provides an alternative route for catheter interventions in selected patients. The shorter and straight route to intracardiac chambers might facilitate some interventions. Bleeding from the hepatic veins can be prevented by post-procedural reversal of the heparin effect and coil embolisation of the track.

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Conflicts of Interest

None.

Ethical Standards

The authors assert that all procedures contributing to this work comply with the ethical standards of Indian Council of Medical Research and with the Helsinki Declaration of 1975, as revised in 2008, and has been approved by the institutional committee of the Madras Medical Mission, Chennai, India.

Supplementary material

To view supplementary material for this article, please visit https://doi.org/10.1017/S1047951111700186X

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