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LETTER TO THE EDITOR

Dark blood aspiration from a right upper pulmonary vein vent catheter during cardiopulmonary bypass: a clue to partial anomalous pulmonary venous connection

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To the Editor:

Partial anomalous pulmonary venous connection (PAPVC) in adults is often detected incidentally, and right-sided PAPVC involving drainage of the right upper pulmonary vein (RUPV) into the superior vena cava (SVC) is a well-recognized anatomical variant [1]. Nevertheless, PAPVC may still be overlooked perioperatively when attention is focused on the main surgical pathology [2]. We report an intraoperative scenario during cardiopulmonary bypass (CPB) in which persistent aspiration of dark venous-appearing blood from a pulmonary venous left ventricular (LV) vent catheter suggested an anomalous venous pathway.

A 77-year-old man (167 cm, 72 kg) underwent elective total arch replacement for a distal aortic arch aneurysm. Preoperative transthoracic echocardiography demonstrated preserved left ventricular systolic function and mild right-sided chamber enlargement. Contrast-enhanced computed tomography (CT) showed the aortic pathology, and no abnormal pulmonary venous drainage was recognized on routine review. General anesthesia was induced with standard monitoring, including intraoperative transesophageal echocardiography (TEE).

After initiation of CPB with bicaval venous drainage, an LV vent catheter was inserted via the RUPV. Immediately after CPB was started, persistently dark venous-appearing blood was aspirated from the vent catheter. Repositioning of the catheter did not alter this finding. Continuous TEE performed by an anesthesiologist revealed no intracardiac shunt, and the catheter tip was not visualized in the left atrium or ventricle. Manual palpation by the surgeon suggested that the catheter was not in the left atrium. Because inadequate LV decompression could increase the risk of ventricular distension, cardioplegic arrest was instituted and an alternative LV vent was placed directly; the operation and weaning from CPB were uneventful.

Postoperative three-dimensional CT reconstruction demonstrated PAPVC, with the RUPV draining into the SVC, along with a sinus venosus-type atrial septal defect overlooked preoperatively. Based on the anatomy, it was presumed that the vent catheter inserted via the RUPV had entered the anomalous pulmonary venous channel, passed into the SVC and right atrium, and advanced toward the inferior vena cava, resulting in continuous aspiration of systemic venous blood (Fig. 1).

This case highlights a practical pitfall during CPB. When a vent catheter inserted via the RUPV yields persistent dark blood and its position cannot be confirmed in the left heart, an anomalous venous pathway, such as PAPVC, should be considered. For rapid troubleshooting, we propose a focused differential diagnosis including: (1) anomalous pulmonary venous drainage or other abnormal pulmonary-systemic venous communications; (2) catheter malposition into systemic venous structures; (3) physiological causes of unexpectedly low oxygen content; and (4) technical or sampling artifacts.

TEE is central to perioperative assessment, but its diagnostic yield depends on prior suspicion and targeted examination. In the absence of clinical cues, PAPVC and sinus venosus–type atrial septal defects may be difficult to detect intraoperatively. When abnormal vent drainage is observed,

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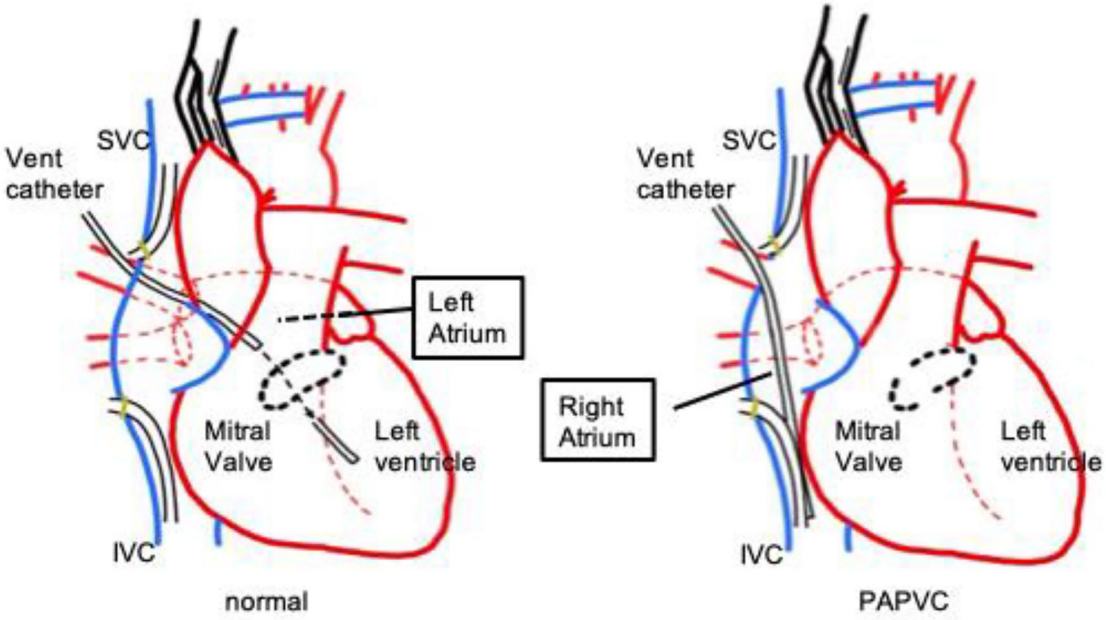

Fig. 1 Schematic representation of the partial anomalous pulmonary venous connection in the present case. The right upper pulmonary vein (RUPV) drains into the superior vena cava (SVC) instead of the left atrium. A vent catheter inserted via the RUPV is presumed to have advanced through the anomalous drainage pathway into the SVC and right atrium, and further into the inferior vena cava (IVC), resulting in persistent aspiration of systemic venous blood during cardiopulmonary bypass

TEE assessment should shift from routine confirmation to goal-directed troubleshooting, including careful interrogation of pulmonary venous inflow sites and the interatrial septum using bicaval views. And if available, fluoroscopic or radiographic imaging may help confirm the catheter course.

A limitation of this report is that the assessment of "venous-appearing" blood was subjective. Objective confirmation using blood gas analysis from the vent line compared with arterial and central venous samples would strengthen this inference. Nevertheless, anomalous pulmonary venous anatomy has been reported as a cause of failed vent insertion [3], and persistent aspiration of dark blood from a vent inserted via the RUPV may serve as an additional warning sign.

Recognizing this pattern may reduce repeated blind catheter manipulation, prompt earlier targeted imaging, and enhance situational awareness among anesthesiologists, surgeons, and perfusionists during CPB.

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Authors' contributions YO drafted the manuscript. DT was responsible for anesthesia management and assisted in manuscript preparation. NH supervised the writing process. All authors read and approved the final manuscript.

Data availability Data sharing is not applicable to this article as no datasets were generated or analyzed during the current report.

Declarations

Conflict of interest All authors declare that they have no conflicts of interest.

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