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Central venous catheter misplacement into an aberrant pulmonary vein: implications of a congenital variation

Rebecca Smart[1,*], Julieta Gegova[1], Andrew Wade[1] and Andrew Thrower[2]

[1]Department of Anaesthetics, Basingstoke and North Hampshire Hospital, Basingstoke, UK and [2]Department of Radiology, Basingstoke and North Hampshire Hospital, Basingstoke, UK

*Corresponding author. E-mail: rebecca.smart292@gmail.com

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Editor—Confirmation of the correct position of central venous catheters (CVC) is a major factor in patient safety. Recognising catheter misplacement and, most importantly, inadvertent arterial cannulation, is a crucial step in this process. However, rare congenital venous variations could pose significant difficulties in the interpretation of CVC position criteria, such as pressure waveform, blood gas analysis, and chest radiography.[1] We report an example of an aberrant pulmonary vein as an unexpected cause of CVC misplacement.

A 64-yr-old patient with no significant medical history required CVC replacement after abdominal surgery (patient provided written consent for publication). He was mechanically ventilated via tracheostomy, with an FiO_2 of 0.5. Although in atrial flutter, he was haemodynamically stable. Left internal jugular vein cannulation was performed under ultrasound guidance. Dark red blood was aspirated under low pressure and the guidewire was passed easily. The operator used ultrasonography to confirm guidewire entry into the internal jugular vein and its course up to the junction with the left subclavian vein before dilation and catheter insertion. We did not perform further ultrasonographic examination of the major thoracic veins or the heart, as there was no suspicion of guidewire misplacement at that time. Catheter tip position was not confirmed by intracardiac electrocardiography, as this technique is not established in our unit.

The transduced pressure waveform had a pulsatile triangular shape with a steep upslope, wide base, and no dicrotic notch. This resembled the 'cannon' waves observed when the right atrium contracts against a closed tricuspid valve. The mean pressure transduced from the distal lumen of the CVC was 12 mm Hg, implying that the CVC tip was positioned in a blood vessel with venous pressure characteristics.

The chest radiograph taken after the procedure revealed that the new CVC followed an unusual, straight course in the left mediastinum (Fig. 1). The image suggests catheter misplacement in the internal thoracic, pericardiophrenic, or accessory hemiazygos vein, or in a persistent left superior vena cava. Surprisingly, blood gas analysis of a sample from the CVC showed oxygenated blood with a P_{O_2} of 29 kPa. This ruled out catheter tip position in a vein and raised a suspicion of inadvertent arterial cannulation. However, the ultrasonographic findings of the guidewire reaching the junction of the left internal jugular vein with the left subclavian vein during insertion, and a mean pressure of 12 mm Hg transduced from

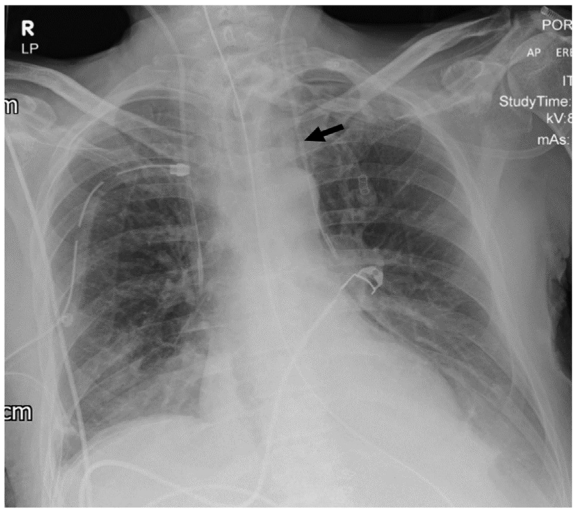

Fig 1. Chest radiograph showing the left internal jugular catheter projecting over the left mediastinum (arrow).

the CVC, suggested that arterial location of any part of the catheter was highly unlikely. Although the patient did not have an arterial line, his noninvasive systolic arterial pressure was measured regularly, ranging between 120 and 140 mm Hg during and after the procedure. He was able to communicate and there was no clinical reason to suspect an unrecognised episode of profound arterial hypotension.

It was felt that the potential risks of obstructing or damaging the blood vessel cannulated by the catheter would outweigh the benefit of confirming its position before its removal. Additionally, there were other options for central venous access for this patient. Further techniques for determining catheter location or repositioning, such as contrast fluoroscopy, were not considered. The CVC was removed without complications.

The conflicting findings surrounding this CVC misplacement suggested a possible pulmonary vein position of the line tip. Our retrospective search showed that the patient already had two recent contrast CT scans reported by two different radiologists. Both of them confirmed an incidental finding of an aberrant connection between the left superior pulmonary vein and the left brachiocephalic vein (the scan reconstruction is provided in the Supplementary material). Furthermore, a radiologist interpreted the chest radiograph as demonstrating the likely position of the line in this aberrant vein.

Partial anomalous pulmonary venous connection (PAPVC) is a congenital variation present in 0.04–0.7% of the population.[1–5] It is characterised by failure of one or more pulmonary veins to communicate with the left atrium. Instead, the pulmonary vein drains directly or indirectly into the right atrium. Described drainage sites include the superior vena cava, inferior vena cava, right atrium, brachiocephalic (innominate) vein, coronary sinus, and azygos vein[1,4,6] (see diagram in the Supplementary material). Variant pulmonary veins can be unilateral or bilateral. Right-sided origin is more prevalent and is found in 90% of the symptomatic cases.[2–4] PAPVC can be isolated or associated with other findings, such as atrial septal defect and persistent left superior vena cava.[2,5] It is diagnosed by contrast CT scan, cardiac MRI or transoesophageal echocardiography.[2,4]

If the aberrant venous return is <50% of total pulmonary venous flow, the condition is usually asymptomatic. If there is significant left-to-right shunt, this may manifest as right ventricular overload, increased pulmonary blood flow, increased pulmonary vascular resistance, pulmonary hypertension, and right heart failure.[4,7] Treatment options include pulmonary vasodilators, catheter embolisation, surgical repair, and lung or heart/lung transplant.[2,4,7]

Understanding the physiological implications of PAPVC in critically ill patients is of significant importance. Because of cardiorespiratory interactions, the left-to-right shunt might become obvious only when mechanical ventilation is discontinued,[8] and its effect on patients with hypoxaemia and hypotension could be more detrimental.[3] In severe cases, shunt reversal or pulmonary arteriovenous malformations can present with paradoxical embolism.[9]

Our literature search revealed several similar reports of accidental aberrant pulmonary vein cannulation during CVC insertion.[3,4,8,10] Interestingly, most cases were found after left internal jugular vein catheter insertion. Typical findings are unusual appearance of the catheter by chest radiography, oxygenated blood sample, and venous pressure waveform. Most investigators found that Po_2 in blood drawn from the misplaced catheters was higher than radial artery samples. This could be because of the right-to-left shunt in the left heart caused by drainage of Thebesian veins. Some authors have described a pulsatile venous waveform, similar to our observation. This was explained by wedging of the line tip, thus allowing for transducing of pulmonary artery pressure.[1,10]

PAPVC is an uncommon finding, which can be asymptomatic or undiagnosed. Awareness of this congenital variation would help clinicians to recognise and correctly manage unusual cases of CVC misplacement, and other challenging clinical situations related to this rare condition.

Declarations of interest

The authors declare that they have no conflicts of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.bja.2021.02.029.

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Postoperative quality of recovery measurements as endpoints in comparative anaesthesia studies: a systematic review

Maxime Léger[1,2,*], Maëva Campfort[1], Cléor Cayla[1], Sigismond Lasocki[1] and Emmanuel Rineau[1]

[1]Département d'Anesthésie Réanimation, Centre Hospitalier Universitaire d'Angers, Angers, France and [2]INSERM UMR 1246, SPHERE, Nantes University, Tours University, Nantes, France

*Corresponding author. E-mail: maxime.leger@chu-angers.fr, Twitter: @mxmleger

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Editor—Recovery after surgery and anaesthesia is a multidimensional process that carries stress, anxiety, pain, and even minor complications.[1] Clinical evaluation of perioperative intervention generally addresses only some morbidity parameters without looking at the overall recovery.[2] These evaluations should focus on what the patient experienced (i.e. patient-centred outcome measures) rather than on doctors' perceptions of success.[3] Several scales have been developed and validated to measure the quality of postoperative recovery (QoR) (e.g. the 9-item QoR,[4] QoR-40,[5] QoR-15,[6] ObsQoR-11 scores,[7] or even the postoperative quality of recovery scale[8]). In a recent international consensus, the SteP–COMPAC group has highlighted the value of these postoperative recovery scales for standardising outcomes in perioperative medicine.[9] Our objective was to evaluate the use of early QoR scales as an endpoint in comparative studies in the field of anaesthesia.

This systematic review was registered (PROSPERO registration number CRD42020211561). We searched MEDLINE via PubMed from January 1, 1900 to October 31, 2020 to identify all published comparative studies using a QoR scale as an endpoint (primary or secondary). We focused on the anaesthesia literature, and selected the 24 anaesthesiology journals with the highest impact factors. We applied different search terms addressing the QoR or the use of one of the most popular scales in the title or abstract. The complete search strategy and list of the selected anaesthesiology journals are presented in the Supplementary material. Inclusion criteria for considering an article were: comparative study using a scale to measure the QoR as an endpoint, and assessing an intervention in the field of anaesthesia. We focused on human studies involving adults (age >15 yr old). We did not include systematic reviews, meta-analyses, case reports, study protocols, editorials, or other comments. One reviewer (ML) screened the titles and abstracts to exclude ineligible articles. Three reviewers (ML, MC, and CC) extracted data independently from the full text of all potentially eligible articles. Another reviewer of the group cross-checked all extracted data. All discrepancies were resolved by the third reviewer, who did not participate in the initial collection or cross-checking. We focused on the endpoints, and reported the use of a scale to measure the early QoR, detailing data concerning the QoR scale. We detailed article information including authors, title, journal of publication, year of publication, study design, and the country in which the patients were included. We collected information concerning the study population, the type of surgical procedure, the type of anaesthesia, and the type of intervention studied. The list of included studies, list of excluded non-comparative studies, and the flow chart are detailed in the Supplementary material.

Of 339 screened records, 148 (43.7%) comparative studies were included. The median sample size was 89.5 (65.5–135.0), while the median age was 50.0 (42.4–56.4) yr and the median proportion of women was 63.7% (47.7–100.0%). The main characteristics of the included studies are presented in Supplementary material. Among the