MKH Tong 湯嘉恆
YP Siu 蕭睿邦
YY Ng 吳玉容
TH Kwan 關子凱
TC Au 區德璋

Misplacement of a right internal jugular vein haemodialysis catheter into the mediastinum

右頸內靜脈血液透析導管錯誤置入縱隔的案例

A 69-year-old woman with end-stage renal failure discontinued continuous ambulatory peritoneal dialysis and commenced temporary haemodialysis because of resistant peritonitis. Right internal jugular vein haemodialysis catheter placement was performed. The cuffed, tunnelled haemodialysis catheter was inserted using the modified Seldinger technique. When haemodialysis was initiated the following day, blood could not be aspirated from the catheter and the patient complained of central chest pain during the aspiration. Subsequent venography and computed tomography scan of the thorax showed that the catheter was placed extraluminally into the posterior mediastinum. The importance of a chest radiograph after placement of a central venous catheter is highlighted by this case report. Subtle deviations in catheter position from normal should alert the physician to the possibility of catheter misplacement and lead to further investigation.

本文報告一名69歲患有末期腎功能衰竭的女病人，她由於持續腹膜炎而停止接受持續可攜帶式腹膜透析，臨時改為接受血液透析。醫護人員採用經改良的 Seldinger 穿刺技術，在患者右頸的內靜脈插入一條密封中空的血液透析導管。翌日開始進行血液透析時發現導管無法導引血液流出，病者亦在導引血液時感到胸部中央痛楚。醫護人員隨即採用靜脈造影術和電腦斷層照相術掃描胸腔，發現導管被錯誤置入後縱隔。個案顯示在中心靜脈進行置管後，進行胸部放射造影程序的重要性。即使導管僅僅略為偏離正常位置，醫護人員也應留意錯置導管的可能，並作進一步檢查。

Key words:
Catheterization;
Kidney failure, chronic;
Mediastinum;
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關鍵詞：
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Division of Nephrology, Department of Medicine, Tuen Mun Hospital, Tuen Mun, Hong Kong
MKH Tong, MRCP, FHKAM (Medicine)
YP Siu, MRCP, FHKAM (Medicine)
YY Ng, MB, ChB, MRCP
TH Kwan, FRCP, FHKAM (Medicine)
TC Au, FRCP, FHKAM (Medicine)

Correspondence to: Dr MKH Tong (e-mail: khmtong@netvigator.com)

Introduction

Cannulation of central veins and placement of catheters for temporary haemodialysis is a common procedure in the management of patients with end-stage renal failure. The right internal jugular (RIJ) vein is the site of choice for central venous catheter placement, being associated with the lowest complication rate.[1] This procedure can be associated with a variety of malpositions of the catheter and rarely, can lead to significant morbidity and even mortality, if this is not recognised and corrected early. We report a case with a rare complication associated with the insertion of a Permcath haemodialysis catheter for temporary haemodialysis. The catheter was erroneously inserted extravascularly into the mediastinum as demonstrated by subsequent venography and computed tomography (CT) scanning. A brief review of the literature on reported malposition of central venous catheters is also presented.

Case report

A 69-year-old woman with end-stage renal disease secondary to gouty nephropathy presented for further management at Tuen Mun Hospital. She had been on continuous ambulatory peritoneal dialysis since August 1999. During the subsequent 3 years, she had experienced three episodes of peritonitis, all of which had responded to intra-peritoneal antibiotic therapy. In June 2002, she was admitted for a further episode of *Escherichia coli* peritonitis, which was resistant to antibiotics therapy and required removal of the Tenckhoff peritoneal dialysis catheter. She was given haemodialysis with a temporary RIJ

haemodialysis catheter. After 4 weeks of haemodialysis, operation for the re-insertion of a new Tenckhoff catheter failed because of extensive intra-abdominal adhesions. The temporary haemodialysis catheter was removed, to be replaced 2 days later by a cuffed Quinton Permcath catheter (Kendall Company, Mansfield, US), also in the RIJ vein.

For the placement of the Permcath catheter, the RIJ vein was punctured using the blind anatomical landmark technique. The introducing needle was inserted at 1 cm below the previous RIJ insertion site, and the guidewire was then introduced. Although the operator did notice some mild resistance while inserting the guidewire to an approximate depth of the tip of the introducing needle, this was overcome and the guidewire was advanced further without significant difficulty. The Permcath was then positioned using the manufacturer's kit, by the modified Seldinger technique. A total of 5 to 10 mL of blood was aspirated and injected with ease via a 10 mL syringe at both the arterial and venous ports after placement. Chest radiography was completed after the procedure to confirm the position of the catheter (Fig 1).

Haemodialysis was scheduled for the patient via this new catheter the following day. However, at this time, blood could not be aspirated from either port of the catheter. On aspiration and on injection of saline through the catheter, the patient complained of associated central retrosternal pain and discomfort. A central venogram via the Permcath was immediately performed. The contrast injected via the catheter remained localised in the peri-catheter tissue (Fig 2a). A subsequent plain axial CT scan of the thorax showed that the catheter was placed outside the vascular lumen, along its course from the lower neck to the posterior mediastinum (Fig 2b). There was a decrease in haemoglobin level of 10 g/L noted in comparison with the haemoglobin level before the catheterization procedure. The Permcath was removed and a new one inserted uneventfully, with real-time ultrasound guidance 1 week later. Repeated venography showed that the RIJ vein was scarred as a result of previous trauma.

Discussion

The Quinton Permcath has been widely used as temporary vascular assess for haemodialysis. It has a median functioning duration of approximately 100 days[2] and is considered relatively safe. Most reported complications have occurred during cannulation of the left internal jugular vein or the subclavian veins. This case report documents a potentially lethal complication during placement of a Permcath in the RIJ vein using the anatomical landmark method. The catheter was inadvertently positioned in the upper mediastinum.

Fig 2a. Central venogram showing the localisation of contrast media in the peri-catheter tissue

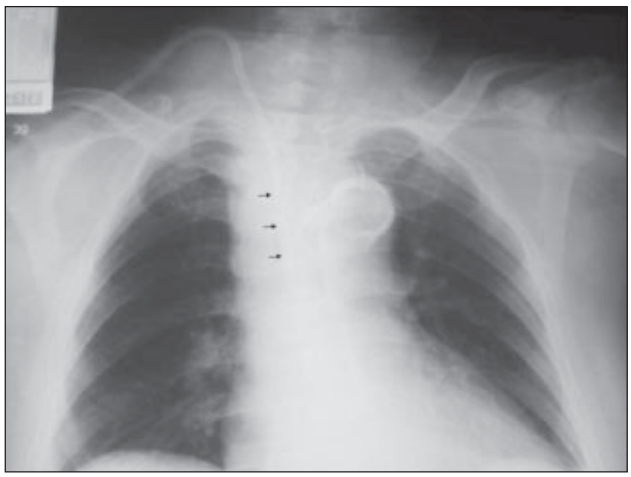

Fig 1. Chest radiograph showing the position of the misplaced catheter (arrow), medial to the superior vena cava

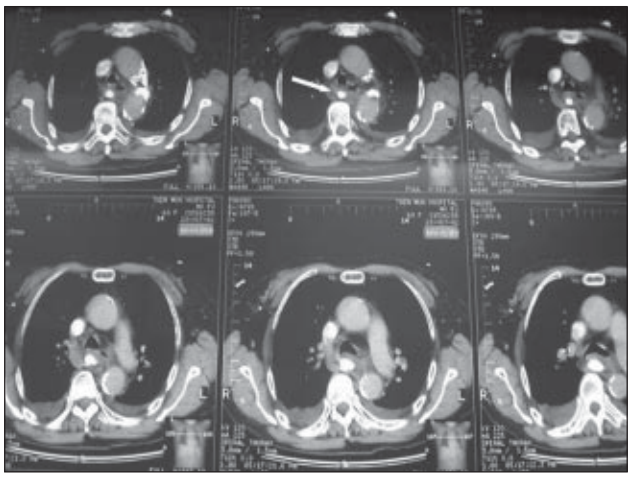

Fig 2b. Computed tomography scan of the thorax showing the position of the catheter (arrow) outside the superior vena cava lumen in the mediastinum

Complications of catheter placement can be broadly divided into two groups:

(1) malposition of the catheter; and
(2) complications relating to perforation and/or injury of nearby blood vessels and structures.

Catheter malposition during cannulation of the subclavian or internal jugular veins is not common, occurring in only 2% of cases.[3] There are five major systems comprising the collateral venous network of the thorax, namely the paravertebral, azygos-hemiazygos, internal mammary, lateral thoracic, and jugular venous systems. Given the anatomy of the venous drainage system and possible variations, the most common locations for malposition of venous catheters while attempting to cannulate the internal jugular vein include the internal mammary vein and the pericardiophrenic vein. Cannulating the left internal jugular vein has a higher chance of malposition because the left brachiocephalic vein has a more transverse lie, thus making the catheter more prone to angulation. There has also been a case reported of inadvertent placement of a jugular venous catheter into the left superior intercostal vein.[4]

Accidental puncture and perforation of blood vessels or injury to nearby structures usually results in a more catastrophic outcome and is not uncommon. In one study, carotid artery puncture occurred in 8.3% of patients undergoing internal jugular vein cannulation.[5] Schummer et al[6] reported a case similar to our patient with unrecognised stenosis of the superior vena cava (SVC). Perforation occurred in the SVC after catheterization of the left internal jugular vein with a haemodialysis catheter. Extravascular positioning of the catheter was unrecognised and the patient subsequently died of complications. Similarly, Murray et al[7] reported a case fatality following SVC perforation. A subsequent autopsy found extension of the catheter into the pericardial sac with associated haemopericardium and tamponade.

Other significant complications reported usually involve cannulation of the subclavian vein, with the formation of a haemothorax, haemomediastinum,[8] and thoracic duct injury.[9] Stewart et al[10] reported a rare fatal incident during the cannulation of the internal jugular vein for the placement of a haemodialysis catheter. This resulted in the formation of a large retropharyngeal haematoma, which in turn compressed the carotid artery, already narrowed by atherosclerosis, leading to massive cerebral hemispheric infarction and death. Delayed phrenic nerve injury and elevation of the hemidiaphragm has been reported to occur up to 3 months after internal jugular vein haemodialysis catheter placement.[11] The delayed manifestation observed indicates that the injury is unlikely to be the result of direct nerve trauma from the cannulation needle, local anaesthetic infiltration of the nerve, or subsequent haematoma formation. Mir and Serdaroglu[11] have suggested that it was due to the close proximity of the phrenic nerve to both the catheter and the cannulated vein, and that an inflammation reaction related to the catheter may have caused the nerve damage.

The complication rate associated with placement of a jugular venous catheter using the anatomical landmark method is operator dependent. In this case, the operator was very experienced in this procedure, illustrating that unexpected complications occur using the blind technique, even in experienced hands. Using the real-time ultrasound-guided technique for puncturing and cannulating the internal jugular vein has proven to be useful. Farrell and Gellens[12] have shown that under ultrasound guidance, the jugular vein could be entered on the first attempt in 83.3% of patients compared with 35.9% when using the anatomical landmark method. The success rate for the catheterization procedure was 96.7% with the use of ultrasound compared with 82% when ultrasound was not used.

A post-procedural chest radiograph is generally considered essential in identifying malposition of the catheter. On posterior-anterior or anterior-posterior views, the internal mammary vein will be located more laterally, the pericardiophrenic vein will follow the left cardiac border, and the superior intercostal vein will follow the aortic knob and frequently reveal an aortic nipple. On lateral chest films, the internal mammary vein will lie in the anterior mediastinum, the pericardiophrenic vein in the middle mediastinum, while the superior intercostal vein will occupy the posterior mediastinal position. Gladwin et al[13] recruited a total of 107 consecutive patients for a study of internal jugular catheter insertion. They performed routine post-procedure chest radiographs in all subjects. Radiographs confirmed one pneumothorax and malposition of 15 catheter tips (nine in the right atrium and six in the right axillary vein). As a result, the authors suggested that chest radiographs should be performed in all patients after jugular vein cannulation to ensure correct catheter positioning. Fluoroscopic guidance during the placement of intravenous haemodialysis catheter can assess the position of the catheter, any vascular abnormalities or stenosis and therefore prevent misplacement. However, this facility may not be readily available for every procedure. Fluoroscopy-guided placement of catheters is usually reserved for cases where difficulties are expected.

In this case, retrospective review of the chest radiograph after catheter placement, did show the catheter was more medial than usual, possibly suggesting mediastinal placement, but the change was subtle. We would recommend routine chest radiography to be completed after all internal jugular or subclavian vein cannulation and catheter placement procedures. Careful interpretation of radiographs obtained is necessary to identify subtle abnormalities suggestive of complications, such as extraluminal or other malposition. In cases where complications are suspected, lateral radiography should also be performed. It is our view that the scarring and stenosis of the internal jugular vein (the same site had been cannulated repeatedly before) also contributed to misplacement of the catheter in this case. Particular vigilance is indicated when placing a catheter into a vein that has been catheterized previously.

In conclusion, cannulation of the internal jugular vein should be guided by ultrasound whenever possible, especially in obese patients and patients who have undergone previous cannulation at the same site. At our institution, ultrasound localisation central venous catheterization using an ultrasound device (Siterite; Dymax Corporation, Pittsburgh, US) is now employed. The ability to aspirate a small amount of blood from the catheter lumen after placement of the catheter does not necessarily confirm an in-situ catheter. In the case reported here, it is possible that the blood was aspirated from a local haematoma formed after perforation of the internal jugular vein. Free venous outflow must be carefully checked after catheter insertion; it should be tested using a syringe of at least 20 mL in volume, and the aspiration of blood should be without resistance. We would also recommend that following placement of any central venous catheter, a chest radiograph be completed. If there are radiographic findings of note or any difficulty encountered during the insertion of the catheter, a CT scan of the thorax or venography should be performed to assess the position of the catheter.

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