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Case Report

Confusing radiographic appearance of a central venous split-tip hemodialysis catheter

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ABSTRACT

Long-term cuffed hemodialysis catheters are being increasingly used in the management of patients with chronic kidney disease. These tunneled catheters are available in different types and characteristics. Patients undergo imaging, primarily chest radiographs to confirm the position of the catheter tip. It is essential to be aware of the normal imaging appearances of these catheters as they may simulate pathological appearance due to the shape of their tips. This knowledge will help avoid misdiagnosis and unnecessary medical interventions.

Introduction

Long-term cuffed hemodialysis catheters are being increasingly used in the management of patients with chronic kidney disease (CKD). These tunneled catheters are available in various types. Patients undergo imaging, primarily chest radiographs to confirm the position of the catheter tip. It is essential to be aware of the normal imaging appearances of these catheters as they may simulate pathological appearance due to the shape of their tips.

Case presentation

A 17-year-old patient with history of end-stage renal disease secondary to biopsy proven C3 glomerulonephritis presented to the clinic for renal transplant evaluation. He was initially being managed on steroids which were stopped due to development of bacterial pneumonia. He was then placed on mycophenolate mofetil which was also stopped due to severe gastrointestinal symptoms and intolerance. Due to his progression of symptoms, he underwent placement of long-term hemodialysis catheter. He had successful placement of placement of a 14.5 F 19 cm cuff to tip *Equistream* tunneled permanent dialysis catheter, through his right internal jugular vein access. The tip was placed in right atrium (Fig. 1). On his subsequent follow-up visits, chest x-ray was ordered to check for the location of the catheter as he was experiencing minimal discomfort in the chest. Chest x-ray revealed a right subclavian double lumen dialysis catheter with its tip terminating at the cavoatrial junction. There was a suspicion of partial discontinuity of the distal tip of the catheter (Fig. 2). Further evaluation was performed by fluoroscopic

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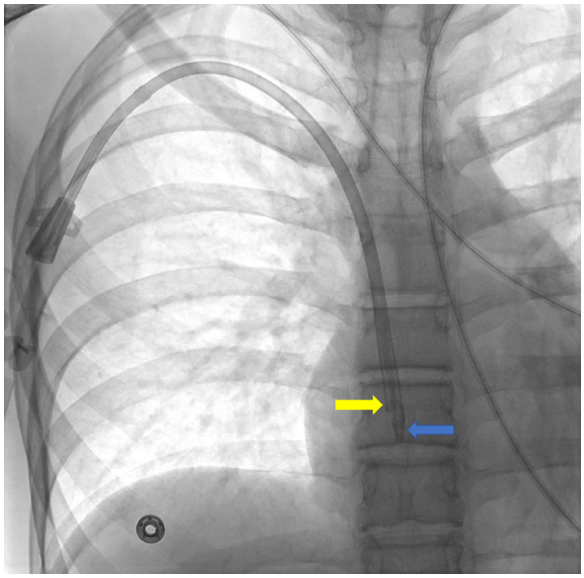

Fig. 1 – 17-year-old patient post placement of Equistream hemodialysis catheter. A spot fluoroscopic image shows subclavian vein placement of the double lumen hemodialysis catheter (shorter arterial limb (yellow arrow) and longer venous limb (blue arrow) with tip in the right atrium (Color version available online.).

examination. Fluoroscopy showed malalignment of the distal segment of the medial catheter (longer) that was seen most displaced when the patient was turned toward the right side, suggesting the distal fragment (still attached) was anterior in location. There was no larger amount of flip-flop movement seen on fluoroscopy (Fig. 3, supplementary DICOM). Fluoroscopy corroborated the suspicion of possible fracture of the distal tip of the catheter. Due to the potential risk of embolization of the catheter fragment, the patient underwent removal of the fractured catheter and had it replaced with another permanent dialysis catheter. However, on examination of the catheter, it was found to be intact with no evidence of a fracture. The appearance of fracture on chest x-ray was due to morphology and the unique design of the catheter (*Equistream*) as it has an unusual oblique shelf-like shape of its tip (Fig. 4,5). This obliquity led to the false projection of the tip and as such was labelled as being malaligned.

Discussion

According to Centers for Disease Control and Prevention, 15% of the adults in United States are estimated to have CKD and 1 in 2 adults in the age ranging from 30-64 years are expected to develop CKD [1]. The continuous increase in patients with CKD also leads to increase in requiring the dialysis access. In the year 2014, 662,000 people were living on chronic dialysis or with a kidney transplant [1]. The crucial thing in such patients is to maintain patency of vascular access for the provision of hemodialysis. The ideal vascular access should provide high flow rates, have long life and be free of complications. Arterio-venous (AV) fistulas come close to being ideal and should always be preferred as the first line mode of dialysis [2]. However, AV fistulas creation is difficult in patients with advanced age, diabetes mellitus, peripheral arterial disease as well as due to late referral for creation of fistula [3]. In addition, a bridge mode of vascular access is also required while waiting for the fistula tract to mature.

Split tip catheter

Equistream catheter is a type of long-term hemodialysis catheter. It has a unique split tip. The catheter shaft has 2 separate lumens and 2 separate free-floating tips (venous tip is distal to the arterial tip) [4]. The Split-tip design facilitates

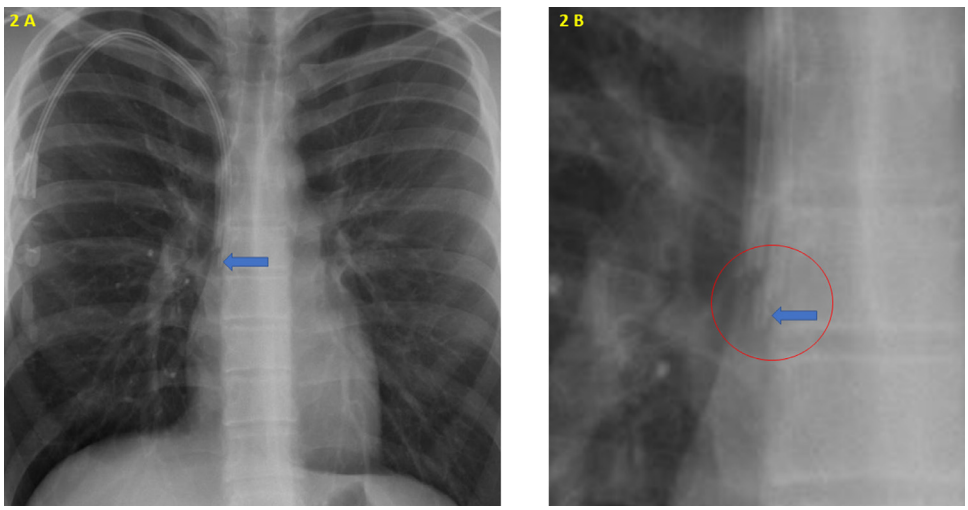

Fig. 2 – Follow-up chest radiograph. Chest radiograph (A) shows suspicion of discontinuity of the distal tip (arrow) of the distal catheter. A magnified view (B) of the same radiograph shows the discontinuity and malalignment clearly.

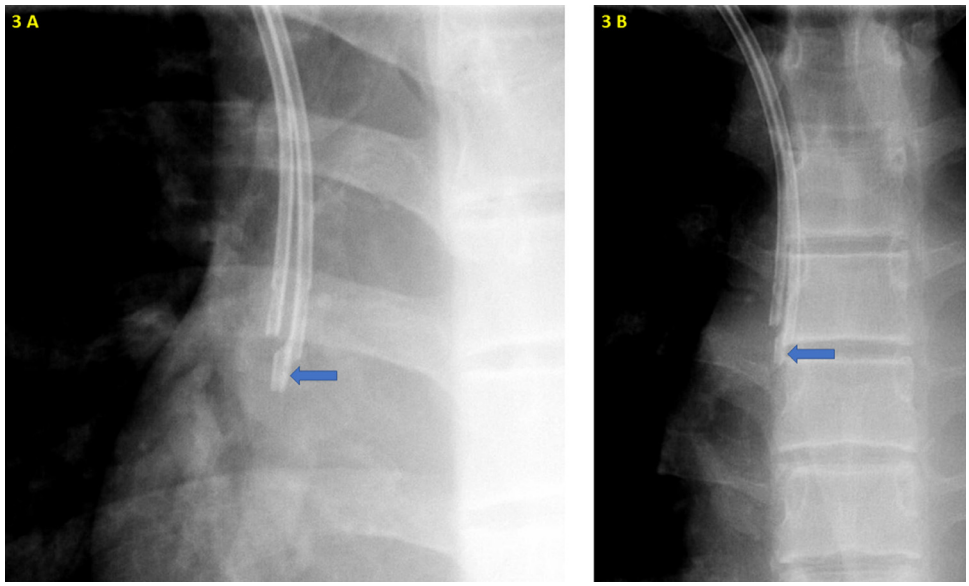

Fig. 3 – Follow-up tube check under fluoroscopy. A spot fluoroscopic image in oblique (A) and frontal (B) projection shows malaligned tip (arrow) of the longer catheter of the double lumen hemodialysis catheter.

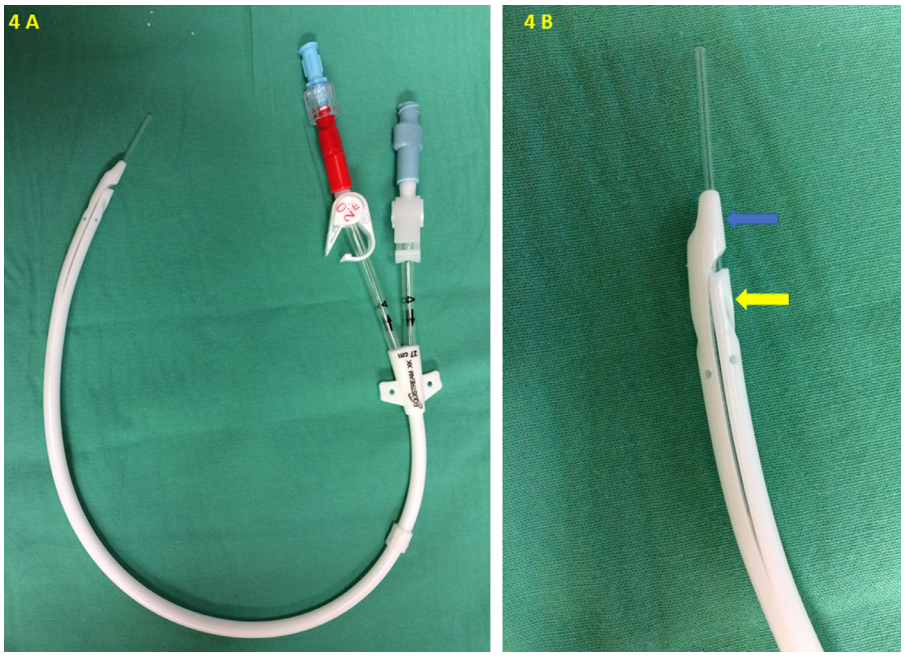

Fig. 4 – Equistream hemodialysis double lumen catheter with guided catheter in place. Equistream tunneled hemodialysis cuffed catheter (A) is a double lumen catheter with 2 limbs; longer (blue arrow) and shorter (yellow arrow). The longer limb is the venous and the shorter is for arterial flow. Magnified view (B) of the distal end of the catheter (Color version available online.).

placement of venous and arterial tips at the same anatomic location. The unique morphology and design of the tip may lead to erroneous interpretation of tip fracture or malalignment on imaging, as seen in our case. This is likely secondary to false projection of the shelf like tip simulating a fracture.

Other catheter-related complications

The "Fistula First Catheter Last Workgroup Coalition" pushes to decrease the use of long-term tunneled cuffed catheters to

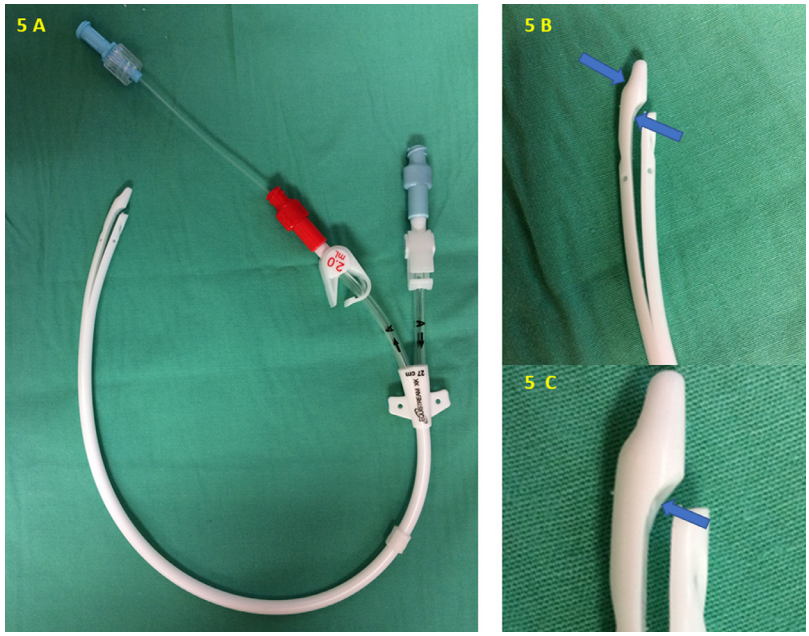

Fig. 5 – Equistream hemodialysis double lumen catheter after removal of guided catheter. Equistream tunneled hemodialysis cuffed catheter (A) shows shelf-like projection of the distal (longer) catheter (arrows). Magnified (B and C) views of the distal end of the catheter.

less than 10% and to use AV fistula as a primary mode of dialysis access [5]. According to National Kidney Foundation's Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines, the primary use of long-term hemodialysis catheter should be discouraged due to number of complications [6]. Despite all these factors, the use of cuffed central venous catheters is on the rise. Tunneled hemodialysis catheters are inserted via central veins, primarily the right internal jugular vein. Other less favorite sites include left internal jugular vein, subclavian, and femoral veins [7]. However, central venous access can have multiple complications primarily including thrombosis, stenosis, and infection. Catheter-related bacteremia is a potential serious complication [2,8]. Fibrin sheath formation at the catheter tip is a well-known complication that frequently needs fluoroscopic imaging to check for patency of the central venous access. The other mechanical complications that may be encountered are catheter tip migration or fracture [9]. These catheters are often placed without using fluoroscopy and there may be a risk of malposition. These patients are likely to undergo chest radiographs to confirm the position of the catheter tip. Also, in patients who have had the catheter placed for a long time but are having issues while withdrawing blood from the catheter, also undergo imaging as a first line approach to confirm the position of the catheter tip.

Images of type of catheter used

It is essential to be aware of the normal imaging appearances of these newly available catheters or else it may lead to misinterpretation and unnecessary intervention as in our case. This may be avoided by routinely *incorporating the images of the catheter being used and placing them as a media file* in patient's chart.

Conclusion

The use of tunneled hemodialysis catheter is going to increase due to ever increasing patients with CKD. Majority of these patients will have some sort of vascular access to maintain dialysis. Tunneled hemodialysis catheters are routinely used and vary in their design. It is pertinent to be aware of the normal imaging profile of the catheter being used and thus avoid misinterpretation and unwarranted intervention.

Ethical statement

All procedures were in accordance with ethical standards for human experimentation and the Helsinki Declaration.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.radcr.2018.12.014.

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