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Case Report

A case report of embolized umbilical venous catheter retrieval from the heart via femoral access in 660 g premature neonate

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ABSTRACT

An extremely premature infant born at a gestational age 24 5/7 and birth weight of 637 g was found to have retained a distal segment of an umbilical venous catheter (UVC) on chest radiograph after removal of the UVC. The catheter was retrieved by interventional radiology on day 10 of life when the baby weighed 660 g. To our knowledge, this is the smallest baby reported to have successfully retrieved catheter percutaneously via femoral access.

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Introduction

Umbilical venous catheters (UVC) are widely used for central venous access in premature and critically ill term neonates. Catheter breakage and embolization is one of the challenging complications of this commonly performed procedure. Previous case reports have documented successful retrieval of embolized UVC catheter in extremely low birth weight infants transcutaneously in ≥ 800 g babies [1–5]. In this case report we describe a case of transcutaneous retrieval of an embolized UVC catheter from the right cardiac atrium in a 660 g baby.

Case report

An extremely premature infant born at gestational age (GA) 24 5/7 weeks and birth weight of 637 g was transferred to our facility due to requiring a higher level of care. The infant had a UVC placed at the birth hospital before transfer. The UVC was discontinued on the day of life 5th as per our unit protocol after obtaining peripherally inserted central catheter (PICC) access. On follow-up radiograph, we coincidentally discovered a retained UVC catheter segment of around 1.5 cm in the abdomen. On review of radiographs of the baby prior to and at

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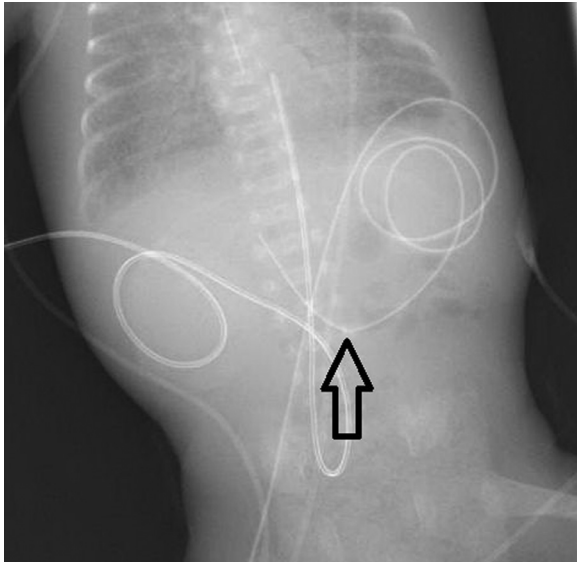


Fig. 1 – Umbilical catheter crack prior to its removal. Arrow pointing to catheter fracture.

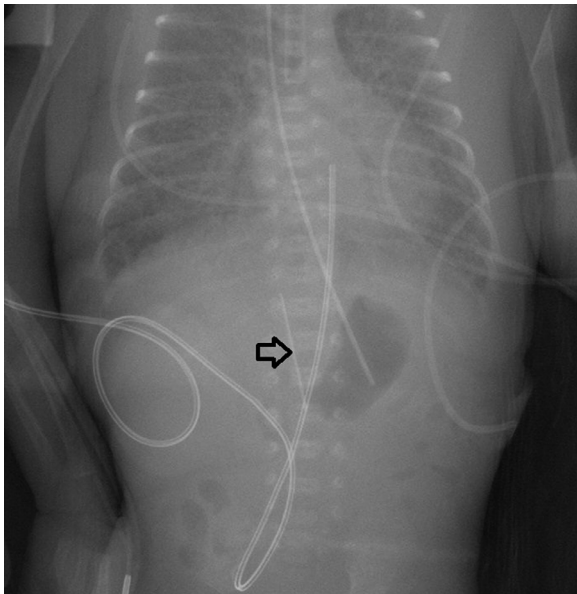


Fig. 2 – Initial radiograph: Infradiaphragmatic retained catheter fragment after UVC removal. Arrow is pointing to catheter fragment.

the time of transfer, a catheter fracture was noted in the lumen of the UVC just below the surface of the umbilical cord (Fig. 1).

The catheter fragment was initially noted on the radiograph to be over the liver in the infradiaphragmatic umbilical vein area (Fig. 2). After discussing the risks and benefits with parents, the infant underwent emergent surgical exploration for removal of the catheter at the bedside. During the procedure, the umbilical vein was identified as close to

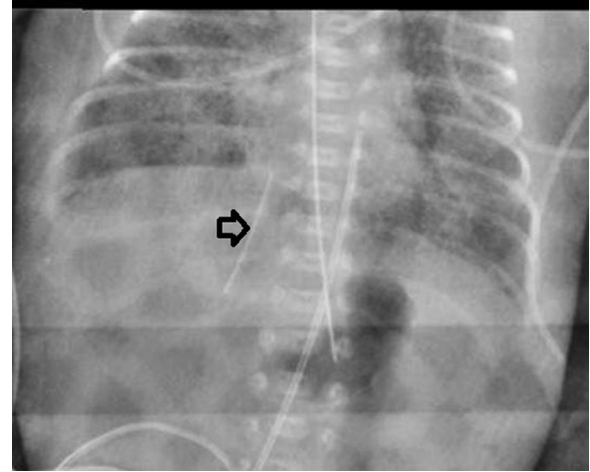


Fig. 3 – Preoperative radiograph demonstrating the migration of the catheter further through the umbilical vein and behind the liver. Arrow is pointing to catheter fragment.

the liver as could be surgically controlled, and the vein was clamped in an attempt to entrap the embolized catheter. No catheter was palpated. The vein was partially opened transversely then longitudinally revealing no intraluminal catheter. The vein was then tied off with 2-0 silk. Intraoperative radiograph demonstrated the migration of the catheter further through the umbilical vein and behind the liver (Fig. 3). The umbilical vein course was further followed after exploratory laparotomy to the liver. Bleeding was encountered from the liver parenchyma during exploration, and surgery was aborted after controlling bleeding.

The catheter continued to migrate into inferior vena cava (IVC) to the right atrium (Fig. 4) and ultimately through the tricuspid valve into the right ventricle (Fig. 5). The baby remained ventilated but clinically stable during this period. Cardiovascular surgery and interventional cardiology were both consulted, but the patient was deemed too small for any further intervention. Anticoagulants were not considered due to the risk of intraventricular hemorrhage outweighing any benefits of therapy.

On the day of life 10th, an intervention radiology consultation was ordered. Due to continued risks of serious complications with being segment now located in the heart, the Neonatal Intensive Care team discussed the intervention radiology plan with the parents. The procedure was performed in the Interventional Radiology procedure room with management involving pediatric anesthesia after the parents' consent.

The baby's right groin was prepped and draped. Using ultrasound guidance and sterile technique, 4 Fr access was obtained in the right common femoral vein. Subsequently, under fluoroscopic guidance, a 4F Kumpe (KMP) catheter was advanced up to the IVC junction. Subsequently, a 2.2 Fr microsnare was introduced via KMP catheter (Fig. 6), and after multiple attempts under fluoroscopic guidance, the retained

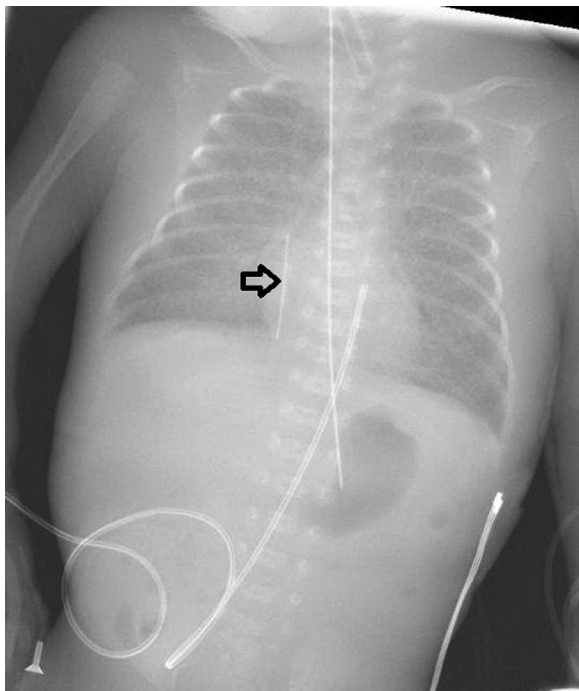


Fig. 4 – Postoperative radiograph: The catheter continued to migrate into inferior vena cava (IVC) to the right atrium and could not be retrieved through an open approach. Arrow is pointing to catheter fragment.

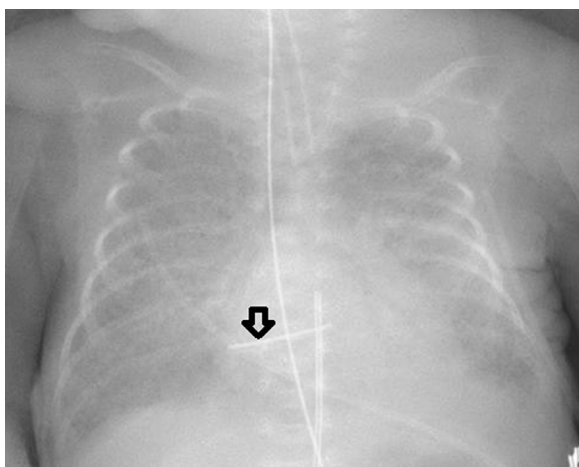


Fig. 5 – Pretranscutaneous removal radiograph: Catheter migrated through the tricuspid valve into the right ventricle. Arrow is pointing to catheter fragment.

catheter piece was snared (Fig. 7). This catheter piece was removed under fluoroscopic guidance without any complications (Fig. 8, video 1). Subsequently, the sheath was removed from the vessel. Hemostasis was achieved with manual compression. Sterile dressing was applied. The baby tolerated the procedure well. Refer to the IITV images and video for details of the catheter retrieval (Figs. 6, 7, 8 video 1)

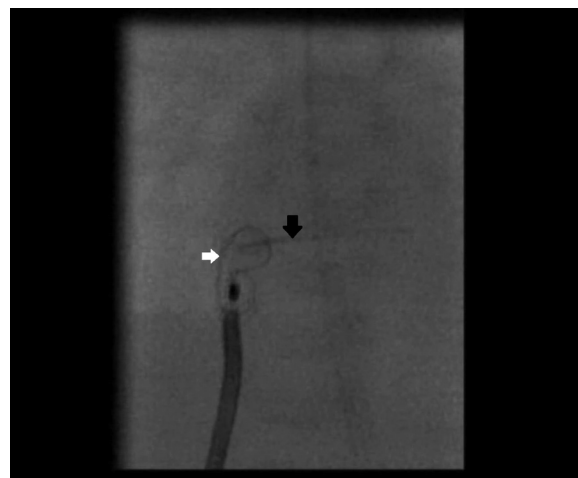


Fig. 6 – Intraprocedure fluoroscopy image. 4F Kumpe catheter advanced up to inferior vena cava and 2.2 Fr micro-snare introduced through Kumpe catheter. The black arrow is pointing to catheter fragment, and the white arrow is pointing to snare.

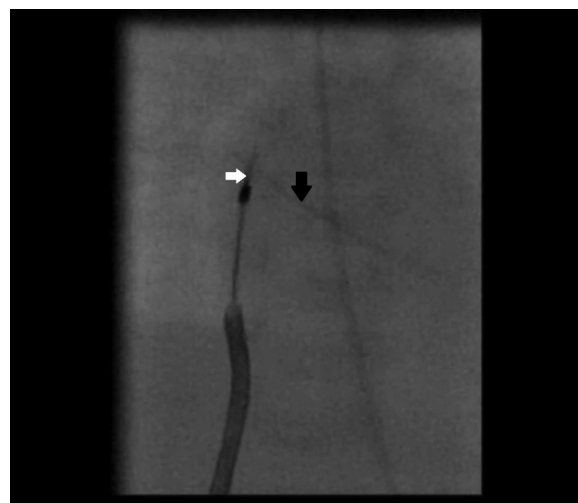


Fig. 7 – Fluoroscopy image with snared catheter fragment: The black arrow is pointing to catheter fragment, and the white arrow is pointing to snare in place.

Discussion

UVCs are widely used in critical care for rapid and dependable central access in extremely preterm babies in neonatal intensive care units (NICU). UVCs are often subsequently replaced by PICC lines for long term vascular access. Several complications involving UVCs have been described including injury to other organs during insertion, catheter migration, malposition, thromboembolism, infection, dysfunction, pleural effusion, pericardial effusion, cardiac perforation and fracture of the catheter causing embolization. Occasionally, catheters can adhere to tissue or develop a blockage.

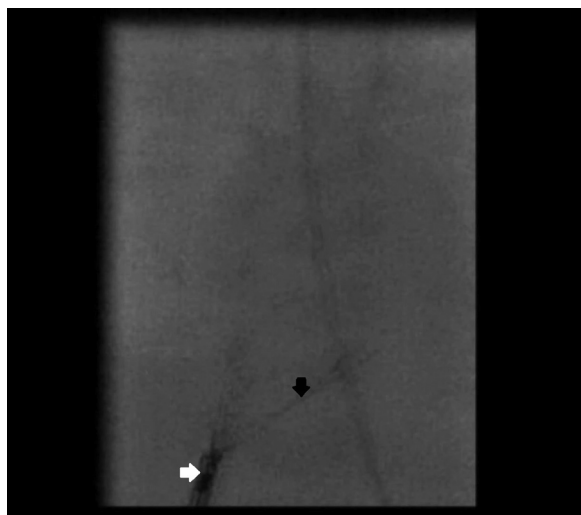


Fig. 8 – Fluoroscopy image showing catheter fragment retrieval: the black arrow is pointing to catheter fragment, and the white arrow is pointing to snare retrieving catheter fragment.

For fractured segments of UVCs, further complications depend on the location of embolization. If the segment travels to the heart, atrial/vessel wall perforation, causing uncontrolled bleeding and possible cardiac tamponade are likely serious complications. This may cause cardiac arrhythmias, thromboembolism, infection, and possible sudden death of an infant.

The best preventive strategy to avoid such complications is the implementation of guidelines standardizing the use of umbilical catheters in the NICU [6]. It is not uncommon to encounter resistance while removing UVC catheters, espe-

cially when they have been inserted for a longer duration. If resistance is encountered while removing the catheter, application of excessive force should be avoided. The use of intraluminal thrombolytic therapy can be considered for release of an adhered catheter for removal. Systemic thrombolytic therapy can also be used judiciously due to risk of hemorrhage in the infant [7]. Patience and gentle handling are key in these situations. It is important to examine the removed catheter for its entirety. If a catheter is found to be broken without an obvious known etiology or reason, it is very important to note the lot number and contact the manufacturers for further investigation. The possibility of a bad lot can be identified and a subsequent re-call may be issued.

Although retrieval of a foreign body is commonplace in adults, older children and bigger neonates >1000 g, there have been very few case reports which have mentioned successful retrieval of the embolized catheter in ELBW neonates (<1000 g) using interventional techniques [1–5,8]. In the case of fractured catheters, several techniques have been described in the literature.

An open surgical approach can be attempted to remove embolized catheter fragments, but this may be unsuccessful, as in our case [9]. Also, the location of the embolized fragment may make surgery an unfavorable option. Nonsurgical retrieval is ideal in many cases. This approach is technically very challenging when dealing with extremely preterm infants. Due to the extremely small size of blood vessels in these premature neonates, it is challenging to obtain the appropriately sized sheaths and interventional catheters for the needed access. There have been a few cases described in the literature successfully using 4 or 5 Fr sheaths (Table 1). Although at times the catheter fragment could be snared, it may not be difficult to retrieve back into a 4F sheath if the fragment is looped, thus limiting the success of its retrieval using this technique [3].

Table 1 – Prior case reports compared to our case.

Author, Year	GA	Weight	Emboli type	Fragment location while retrieval	Equipment and technique	Access for retrieval
Simon-Fayard et al [5]	29	815	UAC 3.5 Fr	Left iliac artery to the left carotid artery	Heishima catheter 4-Fr wire loop snare	Umbilical artery
Brion et al [1]	26	870	UVC 3.5 Fr	Umbilical vein to left superior pulmonary vein.	4-Fr Amplatz microvena wire loop snare	Umbilical vein (supra umbilical cutdown)
Hsu et al [2]	26	840	PICC	SVC-right atrium-IVC	Wire loop snare	Left femoral vein
Young et al [4]	28	800	PICC	Base of the right atrium into the mid superior vena cava	4 Fr sheath, 5 mm microvena amplatz gooseneck snare	Right femoral vein
Nigam et al [3]	28	970	UVC	IVC - Pulmonary artery	2 × 10 mm coronary balloon snugly fitting inside UVC catheter and then removing it*	Right femoral vein
Present case	24	660	UVC	Right atrium through the tricuspid valve into the right ventricle	4 Fr KMP catheter, 2.2 Fr Microsnare	Femoral vein

This table demonstrates the relative size and characteristics of cases reported in literature along with retrieval techniques compared to our case.

* Balloon technique is described in detail in discussion.

Once access is obtained, several different techniques have been described in neonates. The use of snares is the most commonly used technique, which was also used in our case. Four or 5 Fr access can be obtained by the femoral or umbilical venous route through which the snare can be advanced, and the foreign body can be captured and retrieved [2,4,8]. In the venovenous loop technique, initially double access though both femoral veins are established. A pigtail catheter is advanced through one side, and a guide wire is advanced through the pigtail catheter. Through the second access, a goose neck snare catheter is advanced. A venovenous loop is formed by catching a guide wire via snare around the foreign body (ie, dislodged PICC or UVC) to disimpact and move the foreign body to a favorable location. Subsequently, the foreign body is removed by catching it with snare [9].

In the balloon technique, through a 4 or 5 Fr sheath, a coronary guidewire can be manipulated into the catheter, securing it internally, and after confirming a snug fit by manipulating it slightly forward and backward and then demonstrating the catheter's mobility with a coronary guidewire, the foreign body catheter can then be pulled back into the sheath along with an internally snugly fit coronary balloon over coronary guidewire. Subsequently, the entire assembly could be retrieved. There are other techniques described for retrieval of a foreign body such as retrieval baskets, biopsy forceps and small balloon techniques for extraction of intravascular foreign bodies from coronary arteries [10]. To our knowledge, these have not been tried for retrieval of foreign bodies in ELBW neonates successfully.

Several complications are possible while attempting the retrieval of a segment of a UVC catheter. These include risk of hemorrhage, infection, dysrhythmias, and poor perfusion of a lower extremity due to thrombosis/occlusion of femoral vessels.

Conclusion

In conclusion, a rare but challenging complication of UVC catheter breakage and embolization should be recognized. In these unfortunate cases in extremely tiny neonates, nonsurgi-

cal retrieval of these embolized fragments is feasible and can be accomplished with skilled hands. These procedures can be lifesaving in these critically ill neonates.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.radcr.2019.09.006.

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