African Journal of Emergency Medicine 10 (2020) 277–280

Contents lists available at ScienceDirect

African Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/afjem

Case report

CT-guided retrieval of a fractured intravenous cannula in a toddler: A case report

Peter Olalekan Adeosun[a,*], Abdulateef Temitope Abdulazeez[b], Uchenna Ifeoma Okeke[c], Olamide Emmanuel Ehinmosan[d], Eziamaka Gloria Eze[b]

[a] Department of Oral and Maxillofacial Surgery, Nigerian Navy Reference Hospital, Calabar, Cross River State, Nigeria
[b] Department of Paediatrics, Nigerian Navy Reference Hospital, Calabar, Cross River State, Nigeria
[c] Department of Radiology, Nigerian Navy Reference Hospital, Calabar, Cross River State, Nigeria
[d] Accident and Emergency Department, Nigerian Navy Reference Hospital, Calabar, Cross River State, Nigeria

ARTICLE INFO

Keywords:
Peripheral intravenous cannula
Foreign body
Computed tomography

ABSTRACT

Introduction: Fractured cannula is a complication of peripheral intravenous cannula (PIVC) insertion. It is a rare but potentially fatal complication. We present a case of iatrogenic fracture of a PIVC in a toddler.
Case report: An acutely ill 30-month-old boy presented at the emergency room and a PIVC insertion was attempted several times using the same cannula which fractured in the process. While the main part of the device was recovered, about 7 mm of the cannula was retained in the tissues and was not palpable. Computed tomography was used to locate the foreign body which was surgically removed under general anesthesia.
Discussion: A fractured and retained PIVC, especially when it is not palpable clinically, is an emergency due to possible embolization and the consequent potentially fatal outcome. This case underscores strict adherence to standard guidelines in prevention and the importance of computed tomography in the management of this condition.

African relevance

- In resource-limited settings, health workers are often unable to adhere to international standards for clinical procedures due to the restrictions that go with resource-limitations.
- Resource-limitations often encourage overutilisation of consumables.
- Most health facilities lack advanced imaging equipment to manage similar cases.

Introduction

A peripheral intravenous cannula (PIVC) is a medical device that is inserted into a peripheral vein for the administration of fluids, blood, and medications. The essential parts of the device include a flashback chamber, a hub, a pair of wings, a catheter, a metal trocar that slides into the catheter and a grip for the trocar. PIVC insertion is one of the commonest invasive procedures in the emergency room (ER). The commonest complications are thrombophlebitis, infiltration, occlusion, and dislodgement [1] while fracture of the catheter is rare. The catheter can fracture at any point but its junction with the hub presents a potential weak point. A fractured PIVC can lead to complications ranging from local site infection [2] to limb loss and proximal embolization which can cause fatal cardiac and pulmonary damage [3–6]. Locating the retained fragment is requisite for a successful removal. This can be achieved through clinical examination, and supported by imaging as necessary. An unsuccessful location of the retained catheter fragment is disturbing, and indeed a cause for alarm for the ER staff, patient and patient's relatives. Recourse to location of the fragment by imaging then becomes paramount. We present a case of a fractured and retained PIVC in a toddler.

Case report

A 30-month-old boy presented acutely ill at the ER of the Nigerian Navy Reference Hospital, Calabar. With a weight of 21 kg and a height of 101 mm, he had a BMI of 20.6 which was in the 99th percentile (*Z*-score + 2.5) for his age and sex. His arm circumference was 178 mm which was in the 96th percentile for his age and sex. After a clinical review, he was scheduled for immediate intravenous medications and fluids. His hand was chosen as the point of PIVC insertion and a yellow cannula (24G) was selected as the appropriate size.

* Corresponding author.
E-mail address: stone2soul79@gmail.com (P.O. Adeosun).

https://doi.org/10.1016/j.afjem.2020.06.010
Received 9 February 2020; Received in revised form 7 May 2020; Accepted 15 June 2020
Available online 13 July 2020

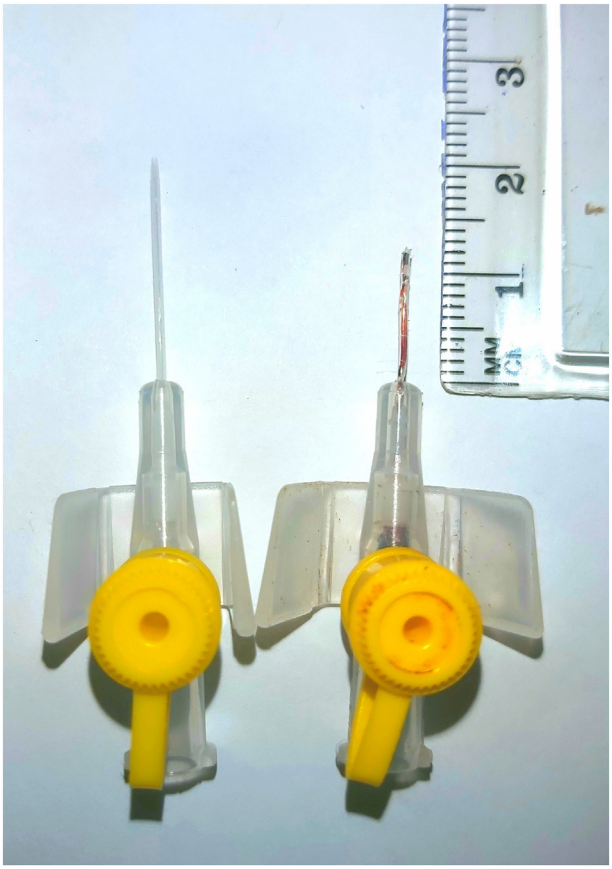

Fig. 1. Fractured PIVC measured against an intact sample.

However after several failed attempts at cannulating a dorsal vein, the duty physician elected to discard the spent cannula for a fresh one. On withdrawal of the cannula, he noticed the catheter length was shorter, and its tip appeared truncated and ragged. A quick measurement showed that it had become 7 mm shorter (Fig. 1). After trying to locate the fragment without success, he released the tourniquet and informed the consultant on duty. Further detailed and careful examination of the whole limb failed to locate the retained fragment and a diagnosis of embolized foreign body was made.

A PIVC was successfully inserted in the other hand for the commencement of the earlier prescribed intravenous therapy and the patient was immediately transferred to the radiology department. After an ultrasound scan and radiographs failed to show the object, we opted for computed tomography which showed the fragment at the distal forearm posteriorly (Fig. 2). The approximate location was marked on the patient's hand and surgical retrieval was scheduled.

Inhalational anesthesia was instituted. A transverse incision was made along a wrist crease and careful dissection identified the vein that was being cannulated. It was then skeletonized proximally for about 1 cm to expose the retained catheter which was buried in the tissues beside the vein (Fig. 3). It was retrieved and matched with the stump (Fig. 4). The fragment was successfully removed 3 h 22 min after it had fractured intravenously. Postoperatively, the patient recovered satisfactorily.

Discussion

Even though only a few cases have been published in scientific literature, fractured PIVC has been recognized as a complication since the 1960's [7]. PIVC fracture is rare because of the relative safety of the procedure of insertion. However this complication can result from a poor insertion technique, device defects, and patient's anatomical and

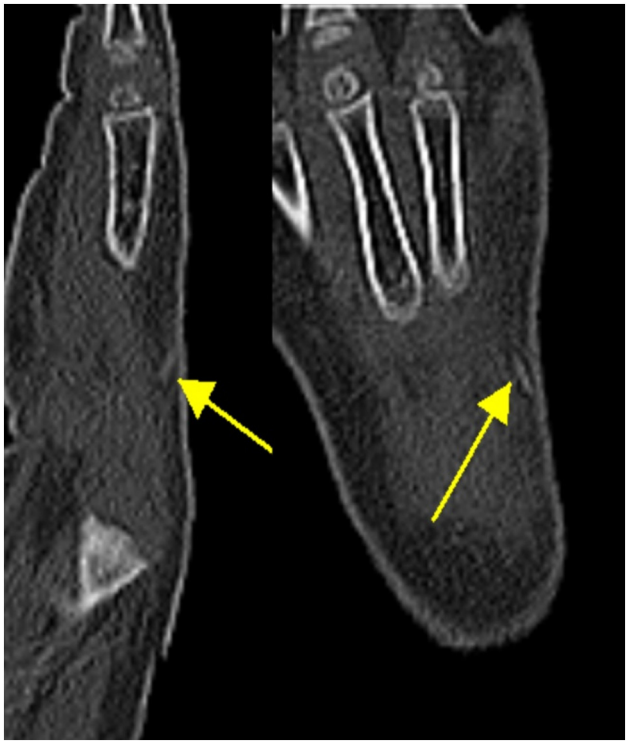

Fig. 2. Sagittal (left) and coronal (right) CT images (300% zoom) showing the foreign body (arrowed).

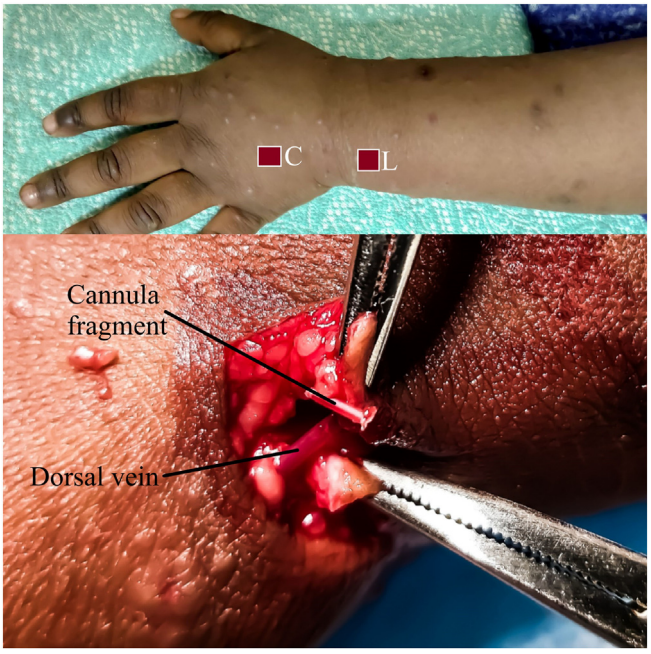

Fig. 3. *Top*: C, site of attempted cannulation and L, the approximate location of fragment as determined by CT. *Bottom*: intraoperative view showing the dorsal vein and the fragment.

behavioural factors [4]. In our case, a few risk factors can be identified.

The child was restless and uncooperative and the doctor did not institute local anesthesia before attempting the insertion. This is a common practice in Africa just as it is, albeit to a lower extent, even in Europe [8]. He was also obese with abundant subcutaneous fat. This made the peripheral veins difficult to identify and cannulate, informing the choice of a 24G cannula instead of a 22G or even a 20G in a patient

Fig. 4. Retrieved fragment matched with the rest of the device.

of that body weight. Unlike most reported cases in literature which involved adults and large-gauge cannulas, our case is unique as it involved a child and a small-gauge cannula.

Similar to other reports [9,10], repeated insertion of the same cannula, which is again a common practice in this resource-limited setting, might have contributed to material failure. The needle could also have punctured the tubing sometime during the procedure similar to what Glassberg et al. [11] and Dell'Amore et al. [3] suggested. Therefore a small-gauge cannula, probably punctured already after being re-inserted several times in an obese and uncooperative child could explain the fracture. Inexperienced medical personnel did not seem to be a factor: the duty doctor had practiced for eight years since basic qualification and had worked in our Paediatric Department for four years. Manufacturing defects remain a possibility even though unconfirmable while the expiry date on the cannula was November 2023.

Unlike in other reports [10,12], the fragment was not palpable in our case. Uncertainty of its location, coupled with its miniature dimensions that would have made it easier to embolize, made us fear it had embolized proximally in the limb as reported by Bloom et al. [13] or even into the chest with potentially life-threatening outcomes as reported by some authors [3–6]. Distal migration [11] was also another possibility. Therefore when it is not palpable, all clinical possibilities should be considered.

Presently, there is no standardized protocol for managing fractured PIVC. However in all cases of palpable fragments, it is necessary to prevent embolization pending urgent removal. A tourniquet is commonly applied proximally to prevent embolization [11,12] while, if the fragment is in the hand, wrist dorsiflexion and splinting can prevent embolization [10]. In our case, we did not attempt to prevent embolization since we were not certain of the fragment's location. Instead we opted for urgent radiological exploration of the limb.

Glassberg et al. used ultrasonography [11] while Khoo et al. used radiographs [10] to image the fragment. In our case, both modalities failed probably because of the small gauge of the cannula which could only be picked by the high resolution and three-dimensional capabilities of CT. The broken fragment could not even be sighted till images were zoomed to 300% and carefully examined. This probably explains why most authors [9,12] have preferred CT in the management of PIVC facture and embolized fragments. However, plain radiographs might be adequate for metallic objects like broken needles.

For centrally located fragments, imaging-guided non-surgical percutaneous retrieval offers less morbidity than surgical extraction [4,14] which is reserved for cases where the non-surgical method has failed [3,14]. However for peripherally located fragments like in our case, surgical retrieval is favoured.

Surgical retrieval was done under local anesthesia in most reported cases because the patients were adults. In our case, a traumatized and uncooperative toddler in distress necessitated the use of general anesthesia. Dissecting around the vein is always necessary whereas a venotomy is not indicated until it is certain that the fragment is intravascular. In our case, a venotomy was not performed since exploratory dissection around the vein had revealed the extravascular location of the fragment.

Due to the dearth of advanced imaging equipment, the management of similar cases can be difficult for most health facilities in Africa. In such resource-limited health facilities, the fragment should be localized by detailed and meticulous manual palpation as soon as possible. This should be done preferably before releasing the tourniquet to avoid proximal embolization in the process of localization. However, if the fragment can not be palpated, the tourniquet should be released and close monitoring of the patient's clinical condition should commence. Although an embolized PIVC fragment may remain asymptomatic even within the chest for a prolonged period of time [14], it is still imperative to transfer the patient to the nearest fully-equipped health facility for further management as soon as possible.

In Africa, the proximity of such a fully-equipped health facility may pose a challenge. Therefore prevention should be emphasized. Adhering to the standard operating procedure for intravenous cannulation — especially pain control and behavioural management in uncooperative patients, selecting the right site for cannulation and the right size of cannula, using the right technique, avoiding reinsertion of the same cannula, and avoiding nicking the tubing with the trocar — is key in the prevention of PIVC fracture.

Dissemination of results

All hospital staff were called for a meeting to discuss this case. Points of lesson were highlighted to prevent a future occurrence. The meeting unanimously decided that it should be published in a scientific journal.

Authors' contributions

Authors contributed as follow to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: PO contributed 45%; AT 30%; UI 15%; and OE and EG contributed 5% each. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Declaration of competing interest

The authors declared no conflicts of interest.

References

[1] Simin D, Milutinović D, Turkulov V, Brkić S. Incidence, severity and risk factors of peripheral intravenous cannula-induced complications: an observational prospective study. J Clin Nurs 2019;28(9–10):1585–99.

[2] Elhardello OA, John A, Khamis K. Overlooked particle of a peripheral venous cannula presenting as a foreign body in the subcutaneous tissue. Journal of Emergency Medicine 2012;2012(1):23. Trauma and Acute Care.
[3] Dell'Amore A, Ammari C, Campisi A, D'Andrea R. Peripheral venous catheter fracture with embolism into the pulmonary artery. J Thorac Dis 2016;8(12):E1581–4.
[4] Tateishi M, Tomizawa Y. Intravascular foreign bodies: danger of unretrieved fragmented medical devices. J Artif Organs 2009;12(2):80–9.
[5] Freiberg DB, Barnes DJ. Fatal sepsis following peripheral intravenous cannula embolus. CHEST 1992;101(3):865–6. 2020/01/31.
[6] Turner DD, Sommers SC. Accidental passage of a polyethylene catheter from cubital vein to right atrium; report of a fatal case. N Engl J Med 1954;251(18):744–5. Oct 28.
[7] Lewis EB. Disappearing plastic cannula. Br Med J 1964;2(5415):1010.
[8] Sado DM, Deakin CD. Local anaesthesia for venous cannulation and arterial blood gas sampling: are doctors using it? J R Soc Med 2005;98(4):158–60.
[9] Khadim MF, Leonard D, Moorehead RA, Hill C. Back to basics: iatrogenic intravenous cannula embolus. Ann R Coll Surg Engl 2013;95(7):110–1.
[10] Khoo PJ, Tay KL, Jamaluddin AA, Gunasaker D. Self-inflicted and iatrogenic peripheral intravenous cannula fracture: a case report. Ann Med Surg (Lond) 2018;33:44–6.
[11] Glassberg E, Lending G, Abbou B, Lipsky AM. Something's missing: peripheral intravenous catheter fracture. J Am Board Fam Med 2013;26(6):805–6.
[12] Singh A, Kaur A, Singh M, Kaur S. CT guided removal of iatrogenic foreign body: a broken intravenous cannula. J Clin Diagn Res 2015;9(9). PD28-PD9.
[13] Bloom AI, Woolf YG, Cuenca A. Accidental embolization of an intravenous cannula in the upper limb: retrieval following computed tomography localization. Eur J Emerg Med 1996;3(2):106–7.
[14] Surov A, Buerke M, John E, Kosling S, Spielmann R-P, Behrmann C. Intravenous port catheter embolization: mechanisms, clinical features, and management. Angiology 2008;59(1):90–7.