Case Report

Management of Accidental Fracture and Embolization of Intravenous Cannula in Peripheral Veins using a Novel J- Flap Technique: A Case Series

C Isiguzo, C Opara, A Uzoho, K Opara[1]

Department of Surgery, Plastic and Reconstructive Surgery Unit, Federal University Teaching Hospital, Owerri, Imo State, Nigeria, [1]Department of Surgery, Imo State University Teaching Hospital, Orlu, Imo State, Nigeria

Received: 13-Dec-2022;
Revision: 03-Mar-2023;
Accepted: 31-May-2023;
Published: 14-Jul-2023

Abstract

The use of intravenous cannulas is a common procedure in healthcare. It's a common way of accessing the intravenous route for several purposes in patient care. Procedure is fraught with a significant risk of fracture and embolization of cannula that merits immediate intervention. There is paucity of well-defined techniques in literature for retrieval of such fractured cannulas from peripheral veins. A case series highlighting the use of a novel J-flap surgical technique in the management of fractured intravenous cannula in six (6) adult patients by the authors over a 24-month period. The intervention reduces or eliminates the risk of central embolization with its attendant severe consequences and invasive intervention. The learning curve of the technique seems gentle and does not need sophisticated surgical instrumentation.

Keywords: *Exploration, J- Flap, peripheral, technique, venous*

Introduction

Insertion of intravenous cannulas has turned out to be one of the "welcome handshake procedures" for all patients presenting at the Emergency Room (ER) and the wards just next to vital signs. They are used for several purposes.

It is the most common intravascular procedure.[1] Modification of the intravenous cannula has blossomed since Christopher Wren discovered intravenous therapy using the quill of a bird feather that was used to inject drugs into a dog in 1657.[2] The first clinical application was in 1952 by a military surgeon, Robert Aubianiac, who used a percutaneous catheter to rapidly infuse fluids.[2,3] This procedure is generally considered benign; however, it is fraught with complications that may range from minor to severe. The worst complication is intracardiac embolization as it could move into pulmonary circulation with the risk of death in 66% of cases.[4]

Access this article online

Quick Response Code:

Website: www.njcponline.com

DOI: 10.4103/njcp.njcp_887_22

Fracture of intravenous cannula is one of the uncommon complications of percutaneous intravascular cannulation. This may be associated with embolization of the cannula centrally, peripherally or opposite the direction of venous blood flow.[5] The first documented description of intravascular catheter embolization was in 1954.[6] Complications associated with fracture embolization could range from asymptomatic[6] to symptomatic.[7]

Peripheral venous exploration is one of the commonest ways of extracting the cannula in acute and late cases that have not been embolized centrally.[8] A review of literature showed that there is no well-described technique for doing the procedure. Most authors did not

Address for correspondence: Dr. C Isiguzo, Plastic and Reconstructive Surgery Unit, Department of Surgery, Federal University Teaching Hospital, Owerri, Imo State, Nigeria.
E-mail: mcisiguzo@gmail.com

How to cite this article: Isiguzo C, Opara C, Uzoho A, Opara K. Management of accidental fracture and embolization of intravenous cannula in peripheral veins using a novel J- flap technique: A case series. Niger J Clin Pract 2023;26:832-6.

demonstrate the procedure in details. While some are deficient in actions that need to be taken prior to the procedure to prevent further proximal embolization, others were silent on intraoperative measures that need to be taken to stop proximal embolization. The article is set to provide solutions to the mentioned issues

Patients and Methods

This is a prospective series of cases that were presented at the Emergency Department of the Federal University Teaching Hospital, Owerri, Imo State, South East Nigeria within a 24-month-period (January 2018 – November 2021).

Case I

A 32-year-old female nursing staff of the institution presented with a fracture and 3 cm embolization of an 18G Fr cannula on the right upper limb (RUL) while trying to remove the cannula herself. She had a caesarian section for preeclampsia 3 days prior to the presentation. The time lag before surgery was 2 hours for the consult, ultrasound scan, transit and preoperative preparation. The percutaneous puncture point was in the proximal half of the cubital fossa. The patient was quite anxious.

Case II

A 53-year-old male with background uncontrolled diabetes managed in the medical ward presented with a fracture of size 20G Fr on the cubital fossa of the RUL which occurred during sleep. The time lag before surgery was 3 hours.

Case III

A 50-year-old female being managed for enterocutaneous fistula which had fractured 16G Fr cannula. The cannula was in the forearm of the left upper limb (LUL). Patient tried to reapply the plaster over the cannula that was loose. The time lag before surgery was approximately 2 hours.

Case IV

A 30-year-old multiple injured male managed by the orthopedic team presented with accidental fracture and 2 cm proximal embolization of 16G Fr cannula in the distal half of the right cubital fossa. The patient was quite anxious and tried to milk out the intravenous segments. The intern and junior resident tried to do the same before being advised to the contrary. The lag time before surgery was 3 hours.

Case V

A 28-year-old female had a blocked 16G Fr cannula that was fractured while the intern tried to remove it from the distal third of the left arm. She had a cesarean section 20 hours prior to the incident. The lag time before surgery was 6 hours due to a lack of information on whom to send the consult to.

Case VI

A 28-year-old female with a fractured 18G Fr cannula in the left forearm was admitted and was managed for traumatic soft tissue injuries of the right thigh. The patient could not explain the mechanism. The lag time before surgery was 10 hours because of hesistance to give consent for surgery.

A total of 6 patients (2 males and 4 females) with an age range of 28 – 53 years were presented via referrals from other units to the ER [Table 1]. More than eighty percent (83.6%) were surgical patients while 16.4% had a medical morbidity. The inclusion criterion is a presentation with fracture+/- embolization of intravenous cannula irrespective of any associated morbidity. All patients consented to have their case details and images published.

Preoperative Preparation and Diagnostic Assessment

First, identify the involved limb because it will be the focus of all precautions. Reassure the patient that the retained component can be retrieved without any severe consequence if instructions are followed (*most patients panic and become anxious and may try to retrieve by self thereby encouraging embolization*). Be sure to minimize limb movement (*Muscle movements may encourage venous drainage and hence central embolization*). Then identify the cannula puncture site and mark it with an indelible skin marker (*location will serve as a guide to the ultrasonographer*) and apply a superficial venous tourniquet (*enough pressure to make the superficial veins to be prominent and prevent central embolization*). Transport the patient with assistance (*wheelchair only or wheelchair – ambulance – wheelchair*) to the ultrasound room with the limb rested in a semi-flexed position. The limb should not be elevated because gravity can aid central embolization.

The ultrasound should confirm location of the fractured segment that should be traced out on the skin with a marker showing its orientation in the superficial vein [Figure 1]. Extend the marking proximally to the tourniquet so as to trace the course of the vein in case it embolizes further centrally, but not beyond the tourniquet (*Assumed that the tourniquet occluded the vein adequately*). Move the patient into the theatre in a wheelchair or stretcher. Patient is discouraged from walking because upper limb movement will encourage embolization as described earlier.

Table 1: Summary of the patients with fractured cannula

Age in years	Sex	Cannula size	Limb affected	Duration before surgery	Technique	Mode of presentation	Status of patients	Complicaton
32	F	18	RUL	2 Hours	J- FLAP TECH	Surgical referral	In- patient	Nil
53	M	20	RUL	3 Hours	J- FLAP TECH	Medical referral	In- patient	Nil
50	F	16	LUL	2 Hours	J- FLAP TECH	Surgical referral	In- patient	Nil
30	M	16	RUL	3 Hours	J- FLAP TECH	Surgical referral	In- patient	Nil
28	F	18	LUL	6 Hours	J-FLAP TECH	Surgical referral	In- patient	Nil
28	F	18	LUL	10 Hours	J-FLAP TECH	Surgical referral	In- patient	Nil

*RUL – Right upper limb. *LUL – Left upper limb

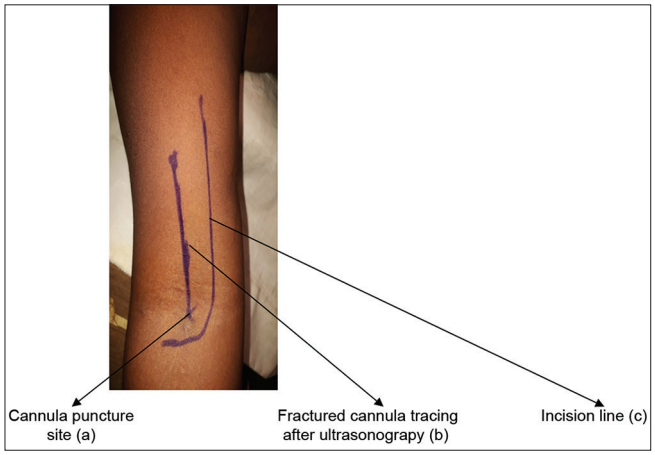

Figure 1: J- Flap markings

Figure 2: Vein dissected with proximal ligation and tourniquet removed

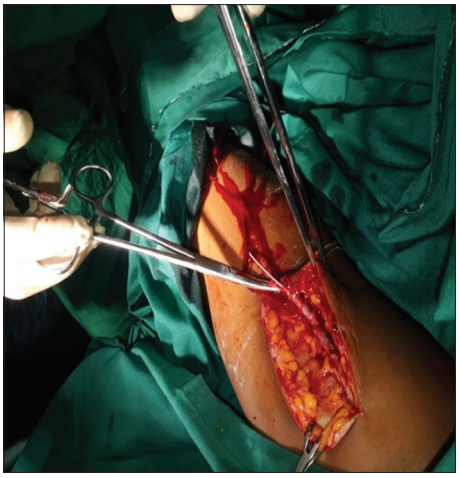

Figure 3: Cannula delivered through a venotomy site

Figure 4: Immediate post op wound and fractured cannula segment

Intraoperative Technique

Patient is positioned supine with the limb placed abducted on an arm board, cleaned and draped. Care should be taken not to elevate the limb against gravity to prevent embolization beyond the markings. The surgeon should stand on the medial side of the abducted limb while the assistant should be on the lateral side of the abducted limb. The scrub nurse is stationed distal to the hand with a trolley of instruments lying over the hand/ forearm.

Then flap incision is marked with the vertical limb about 1 – 2 cm parallel to the vein and the transverse limb perpendicular to the vein and distal to the distal end of the fractured cannula as traced on ultrasound scan. The vertical incision is away and parallel to the vein and cannula in order to reduce further direct manipulation of the fractured segment during dissection. The lower transverse segment of the J-incision aims to create a flap of skin that can be turned away like a leaf of a book and create adequate exposure of the affected vein. Extend the vertical limb 2 cm above the proximal end

of the cannula. A 2–3 cm circumferential band of skin 2 cm above the superior margin of the cannula position is infiltrated with 1% Xylocaine + adrenaline for new tourniquet application (*the tourniquet applied in the preoperative period will start becoming discomforting*). Reapply another venous tourniquet over the anaesthetic band and remove the initial proximal tourniquet. *Do not remove the initial tourniquet without the new tourniquet in place. The build-up of intravenous pressure due to occlusion from the first tourniquet can encourage embolization immediately after release of the initial*. The pressure should be enough to occlude the veins and make them prominent. Maintenance of arterial flow can be confirmed by palpating the distal arterial pulsation for regularity and volume in comparison with the contralateral limb.

Infiltrate the perivenular area with 1% lidocaine and adrenaline and wait for about 6–8 minutes for the vasoconstrictory effect to start and reduce bleeding. Make a skin-deep incision along the J-flap marking to develop the flap. Do not go beyond the subcutaneous fat layer where the peripheral veins are found. Then dissect and carefully at the subcutaneous plane to expose the entire length of the vein to reduce bleeding due to the venous tourniquet. Ligate the vein proximally with vicryl 2/0 and remove the proximal venous tourniquet to reduce bleeding due to venous occlusion – Figure 2 (*ligation can be substituted with vascular clamping*). Ligate the vein distally to reduce venous inflow (*ligation can be substituted with vascular clamping*). Make a venotomy incision distal to the proximal venous ligation/clamp and proximal to the cannula [Figure 3]. Extract the fractured cannula with a non-tooth dissecting forceps. If vascular clamps were used proximally and distally on the vein then repair the venotomy site with nylon 6/0 and release the clamps to re-establish drainage. The veins can be tied off if vein repair is not possible. Finally, close the flaps in two layers using subcutaneous (2/0 absorbable) and subcuticular (3/0 absorbable) techniques, respectively, or simple suturing. The wound should be dressed in two layers.

Discussions

The technique offers a detailed description of peripheral venous exploration.[8] Most literature did not offer a detailed and methodical explanation of what venous exploration entails in the management of a fractured intravenous cannula. The series has put out an operative step-by-step approach to the surgical treatment. This will assist with standardization and comparison amongst peers. It will also serve as a basis for assessment of outcomes that will be the basis for modifications and improvements. The procedure is reproducible and deals with a named problem.

The preoperative precautions must be strictly adhered to. The precautions aim at reducing the risk of embolization centrally.[4] The precautions are worthwhile because various anatomical factors encourage central embolization. First is the fact that the direction of flow of venous blood encourages movement of the fractured segment to the heart. Secondly, the veins generally are more capacious structurally towards the heart, hence more room for migration. Finally, the valves are naturally opened by blood flow and the valves open towards the heart and as such will not likely resist or block an embolizing cannula.

Since intravenous cannula is used commonly at several levels of healthcare, a good understanding of preoperative precautions if a cannula fracture occurs is very important to prevent fatal outcomes by healthcare workers at all times. Even where surgical facility is not available for immediate extraction, the precautions can be adhered to improve patient safety and outcomes.

Out of curiosity and frenzy, the younger doctors and patients may want to palpate/manipulate the region to extract the fractured segment. The latter should be advised against and avoided at all times.

A methodical approach as seen in the J-Flap technique described above will benefit any physician with basic surgical skills to successfully treat the cannula fractures. The instrumentation can best be described as conventional or basic that can be found in almost all theatres.

The diagnosis is made from clinical history and confirmed by ultrasonography. Ultrasonography is likely affordable and available to most patients. Exercise caution with a history of intraoperative presumed intravenous cannula fracture that is not sighted by any clinical staff in theatre. This may be noticed in post op patients few days after surgery who have thrombophlebitic vein changes at sites that had cannulas before surgery.

Analgesia and anaesthesia are very important components of the technique since the patient will be awake and anxious. Mild sedation can be used if anxiety is uncontrolled. This makes cooperation with the surgeon during the procedure possible

An obvious sequale of the surgery is the scaring at the incision site which may or not be unsightly depending on the resultant scar [Figure 4]. Every attempt should be made to avoid factors that may promote excessive scarring even in those that have a predisposition to form keloids.

The learning curve seems not to be too steep. Therefore, we encourage all doctors to master the technique as the benefit far outweighs the risk of central embolization. The cost of managing a symptomatic central embolization is enormous, the risk may be significant and complications may be varied and severe, hence the advocacy of the above-described J-flap technique. The lag time before surgery should be as short as possible to further reduce the risk of embolization.

Patients with fractured cannula can be discharged from the service of the surgeon as soon as the surgery is over and then followed up. Most of our patients are already in the ward for other reasons and as such be referred back to the originating unit.

From the series, we could propose possible common reasons why a cannula can fracture. The common site of fracture is at the junction between the external and intravenous parts. Any weakness at that point will lead to fracture. Manipulation by a patient attempting to remove/adjust or a healthcare worker can weaken the junction likely twisting or bending during insertion. Placing the cannula in the cubital fossa may present a risk resulting from flexion/extension movements at the elbow (Case I and II). Poor stabilization of the cannula with plaster can lead to the twisting and folding of the external part during sleep or wakefulness.

The main limitation of this study is the sample size. We leave it open to more modification as more surgeons apply it to clinical scenarios.

Conclusions

J-Flap technique describes a surgical technique of extracting a fractured cannula with or without embolization in the limbs so as to prevent central embolization. The management of central embolization is invasive and expensive. This intervention is cost-effective and improves patient safety and outcome.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Mihriban Y, Katırcıoğlu EG, Kutlu Y. Kesilmiş Intravenöz Kanülün Ultrasonografi Eşliğinde Çıkarılması. Ege Tıp Dergisi 2019. Available form: https://doi.org/10.19161/etd.415996.[Last accessed on 2020 Nov 16].
2. Rivera AM, Strauss KW, Van Zundert A, Mortier E. "The History of Peripheral Intravenous Catheters : How Little Plastic Tubes Revolutionized Medicine," Acta Anaesth Bel 2005, 12271-278.
3. 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;251:744-5.
4. Linz DN, George SB, and Brad WW. "Fracture and Embolization of a Peripherally Inserted Central Venous Catheter." Journal of Parenteral and Enteral Nutrition 18, no. 1 (1994): 79–80. Available form: https://doi.org/10.1177/014860719401800179. [Last accessed on 2020 Nov 16].
5. Andrea DA, Chady A, Alessio C, Rocco D. Peripheral venous catheter fracture with embolism into the pulmonary artery. J Thorac Dis 2016;8:E1581-4.
6. Srihari T, Ayyassamy P, John Y. Retrieval of an IV catheter fragment from the pulmonary artery 11 years after embolization. Chest 117: 2000; 1209-11.
7. Andrea DA, Chady A, Alessio C, Rocco D. Peripheral venous catheter fracture with embolism into the pulmonary artery. J Thorac Dis 2016;8:E1581-E1584.
8. Chitta RM, Ritesh P. Fracture and embolization of intravenous cannula placed in external jugular vein: A rare complication. Saudi J Anaesth 2018;12:504–5.