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Guidewire Knotting During Femoral Central Venous Catheterization: A Case Report

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Abstract **Case Report**

Central venous catheters (CVCs) are used for various clinical purposes, particularly in intensive care, hemodialysis, parenteral nutrition, and for administration of prolonged intravenous therapies. Despite their clinical utility, placement of CVC may be associated with mechanical, infectious, and thromboembolic complications. However, guidewire looping and knotting during insertion remain rare but potentially serious events. We report a rare case of guidewire knotting during femoral central venous catheter insertion. Manual attempts to retrieve the guidewire were unsuccessful. The wire was ultimately removed via venotomy through a surgical approach to the femoral vein, without subsequent complications. The objective of this article is to raise awareness among healthcare professionals regarding the importance of vigilance and strict adherence to standardized protocols for CVC placement.

Keywords: Central venous catheter, Complications, Guidewire, Ultrasound guidance, Knot, Vascular surgery, Femoral vein.

INTRODUCTION

Central venous catheterization (CVC) is a commonly performed procedure to obtain reliable central venous access, particularly in intensive care units, for hemodialysis, parenteral nutrition, or long-term intravenous therapy. The standard approach to CVC placement is based on the Seldinger technique, which involves venous puncture, guidewire insertion, tract dilation, and subsequent catheter placement [1].

Although generally considered safe, this procedure can lead to mechanical, infectious, and thromboembolic complications. Guidewire-related complications, such as kinking, entrapment, looping, or knotting, are rare but well-documented in international literature.

We report an unusual case of intravascular guidewire knotting during an attempted femoral CVC placement performed without ultrasound guidance, necessitating surgical extraction in the operating room.

CASE PRESENTATION

A 60-year-old male patient, being treated for rectal adenocarcinoma with radiotherapy and chemotherapy, whose last session had been completed two months prior, was admitted to the visceral surgery department for a scheduled proctectomy.

During his hospitalization, the patient developed hypokalemia requiring central venous access. An attempt was made to insert a central venous catheter (CVC) via the femoral vein using the Seldinger technique, without ultrasound guidance. After the introduction of the metallic guidewire and the insertion of half of it, the patient encountered difficulty progressing the catheter, with a sensation of intravascular snagging. An attempt was made to withdraw the guidewire, but significant resistance was encountered. Due to the risk of guidewire breakage or venous injury, the attempt to manually pull the additional guidewire was abandoned.

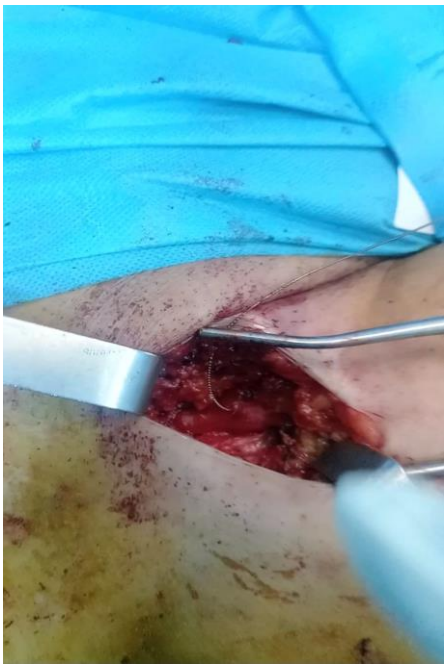
While the exact number of needle passes was not documented, multiple puncture marks were visible at the femoral site.

An ultrasound Doppler, performed in the operating room, confirmed the intraluminal position of the guidewire within the common femoral vein, revealing a looped and knotted appearance. The decision

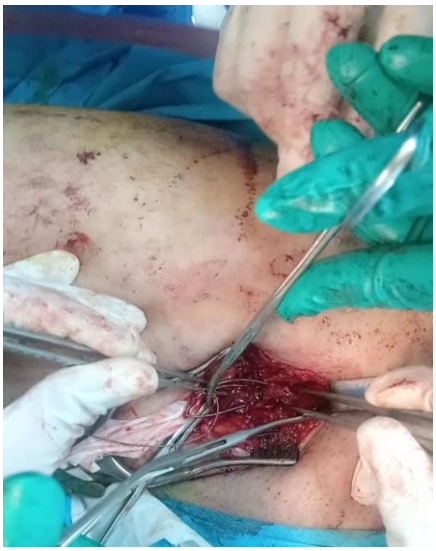
was made to remove the guidewire via surgical extraction.

Under general anesthesia, a longitudinal Incision for the Exposure of the Femoral vein centered on the vascular axis was performed. After dissection, the common femoral vein was isolated and controlled. A longitudinal venotomy was performed on the anterior surface of the vein at the guidewire's exit point. Exploration revealed a guidewire with two loops associated with a knot, fixed to the posterior wall, without an associated venous breach.

The guidewire was delicately untied and extracted using atraumatic forceps, without injury to the vascular wall. The venotomy was repaired with two Prolene 5/0 hemi-sutures. Closure was performed layer by layer after rigorous hemostasis. The immediate postoperative course was uneventful, and the patient was placed on anticoagulant therapy for three months.



A longitudinal surgical approach exposing to the femoral vein



Guidewire unravelling performed using atraumatic forceps

DISCUSSION

Central venous catheterization (CVC) is essential for patients requiring reliable venous access. When short-term vascular access is required, a non-tunneled central venous catheter is typically inserted. However, for patients requiring long-term therapy, a tunneled CVC (TCVC) or subcutaneous, implanted port (port-CVC) is placed [2].

CVC placement, first described by Werner Forssmann in 1929 [3], is generally attempted at the

internal jugular vein, subclavian vein, femoral vein, or brachial veins [4]. While often lifesaving, CVC placement is associated with a mechanical complication rate of approximately 15% [5]. Intravascular or extravascular knotting during guidewire insertion is highly uncommon; nevertheless, such cases have been reported in the literature [6,7,8].

These complications are associated with mechanical damage or disruption of the guidewire's structural integrity [9]. Guidewires are relatively flexible structures that may bend or loop when subjected to external force; continued application of force after loop formation can result in guidewire knotting.

Two key factors are fundamental in preventing guidewire kinking during the Seldinger technique. First, when advancing the wire through the needle, no resistance should be felt; The guidewire should advance freely. To avoid shearing, the guidewire should not be withdrawn once it has passed the needle bevel. When advancing the dilator, it should follow the guidewire's direction; forcing it may kink the wire and risk venous perforation with potentially fatal consequences [10].

The rate of mechanical complications during CVC placement increases with various factors, particularly operator experience and the number of puncture attempts [11]. Complication's rate increases significantly when the number of needle passes exceeds two, with reported complication rates of up to 24%, versus about 4% following a single puncture [12]. Unsuccessful insertion attempts are the strongest predictor of complications, occurring in nearly 28% of failure cases. Finally, a history of catheterization, surgery, or radiotherapy can alter local anatomy and increase complication risks [13,14].

CVC placement is now generally performed under real-time ultrasound control. In our case, the placement was attempted using the anatomical landmark technique without ultrasound guidance. Intraoperative navigation of the guidewire tip under ultrasound guidance can help prevent loops and knots [15]. Literature shows that using ultrasound, for both preoperative venous assessment and intraoperative guidance, significantly reduces the risk of mechanical complications and the number of attempts while improving overall procedure safety [16, 17].

Recent guidelines recommend the routine use of ultrasound for jugular, subclavian, and femoral CVC insertion. The consultants and members of the American Society of Anesthesiologists's recommendations (ASA) strongly agree with the recommendation to use real-time visual confirmation of venous access at each step, including needle puncture, guidewire advancement, and final catheter placement [18].

While this case concluded without major harm to the patient, guidewire-related complications are associated with significant morbidity and mortality [19]. The discovery of an intravascular knot in a guidewire or catheter necessitates its removal to reduce the risk of further complications. Interventional radiology techniques have largely replaced open surgical extraction. Management may consist of knot capture using a "push–pull" interventional approach, followed by guidewire extraction through venotomy.

Dissection of the jugular or common femoral vein is preferred. Conversely, the subclavian vein can be difficult to control and may require clavicular disarticulation or thoracotomy. Surgery is reserved for cases where the knot is large in size and many loops are involved in its formation the so called ''bowtie'' knot, or intracardiac fixing of the knot is encountered [20].

CONCLUSION

Knot formation during central venous catheterization is uncommon but clinically significant complication that may lead to serious vascular and thrombotic events if not promptly recognized and managed. This report aims to increase operator awareness and to to emphasize the importance of strict compliance with insertion guidelines in order to reduce its incidence and prevent related complications.

Highlights:

- Knotting is a rare complication but may lead to potentially fatal consequences.
- A thorough understanding of guidewire behavior and careful handling are essential to prevent looping and knot formation.
- Surgical removal is required when attempts at manual extraction are unsuccessful.

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