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A case report of abdominal compartment syndrome caused by malposition of a femoral venous catheter



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ABSTRACT

INTRODUCTION: Venous catheter malposition is a rare event with potential catastrophic consequences. To our knowledge we describe one of the first case reports of an adult presenting with a rare late complication of femoral venous catheter malposition: abdominal compartment syndrome.

PRESENTATION OF CASE: A 39 year-old female sustained severe cerebral injury in a road traffic accident. During initial resuscitation a femoral venous catheter was inserted without ultrasound guidance with no immediate concerns. After 48 h whilst in intensive care unit the patient developed progressive abdominal distension. Bedside investigations revealed raised intra-abdominal pressures associated with new organ failure. Subsequent an emergency laparotomy and on-table intravenous contrast radiographs revealed extravasation of contrast into the peritoneal space from the malposition of the catheter into the abdominal cavity.

DISCUSSION: Complications of central venous catheterization are associated with adverse events with significant morbidity to the patient as well as having cost implications. Mechanical complications are underreported but are potentially preventable through ultrasound-guided insertion, in accordance with international guidelines.

CONCLUSION: This case report highlights the importance of safe methods of catheter insertion, the need for increased awareness of late femoral catheter malposition and its potential catastrophic consequences.

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1. Introduction

The insertion of femoral venous catheters is not routinely considered the first line option but it occasionally offers essential secondary access, especially when peripheral venous cannulation is not possible or contra-indicated. Venous catheter malposition is a rare event with potential catastrophic consequences. The most common complications of venous catheter misplacement or malposition include thrombophlebitis, infection and bleeding. Malposition of venous catheters in infants and children has been previously described in the literature, however, it has rarely been reported in adults. Catheter malposition can occur as an immediate complication on insertion or rarely at a later stage. In the case of femoral catheters this may rarely lead to extravasation of intra-vascular contents including blood, drugs and contrast, into the retroperitoneal space or peritoneal cavity. Extravasation into the peritoneal cavity requires prompt diagnosis and an increased awareness from the clinician, as any delays could lead to abdominal compartment syndrome (ACS). Ultrasound use offers safety during insertion of central lines. Carrying out safety checks of any

in situ catheters such as aspirating blood and post-intervention radiological imaging are indicated prior to use. We describe a rare complication of femoral vein catheterization: a case of ACS secondary to late malposition into the intra-peritoneal cavity. Late complications such as this can occur due to improper initial insertion or due to displacement during hospital transfers. Safe methods of catheter insertion, confirmation of correct placement, and continuous awareness of the possibility of malpositioning are the cornerstone tools for reducing adverse events relating to catheter use.

2. Presentation of case

A 39 year-old female was presented to the accident and emergency department of a district hospital with severe cerebral injury following a road traffic accident. The patient was intubated with a Glasgow Coma Scale score of seven and remained haemodynamically stable after initial resuscitation. Radiological investigation with computerized tomography (CT) revealed severe brain injuries with multiple skull fractures, malignant cerebral oedema with a visible midline shift, hemorrhagic contusions and a large epidural hematoma. Limited contusions of the superior and middle lobe of the right lung were also described without any intra-abdominal

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pathological findings. A small amount of fluid was noted intra-abdominally, however, this was an insignificant finding.

Following initial resuscitation through peripheral venous canulas, a multi-lumen central venous catheter (7 Fr, three lumen, 20 cm length) was introduced into the right femoral vein to maintain robust and secure intravenous access, by an experienced surgeon. There was no specific procedural difficulty during initial insertion and the use of ultrasound guidance was not performed due to a lack of resources. The catheter was immediately used after aspiration of venous blood indicated intravascular placement. Introduction of intravenous fluids during resuscitation resulted in a clinical response with a rise in blood pressure that further supported that the catheter was functioning. Three hours following admission the patient was transferred to the neurosurgery department at the regional tertiary hospital, where, a de-compressive craniotomy was performed. The patient was subsequently transferred to the intensive care unit (ICU) for on-going management.

During the ICU course, the patient remained on mechanical ventilation with sedative and anti-oedematic pharmacological support. The patient was initially exhibiting low urine output, rising lactate measurements on serial blood gases, and low central venous pressure and therefore required aggressive fluid administration in order to maintain mean arterial blood pressure and adequate diuresis. Furthermore, fluids were also required to correct electrolyte imbalances. A urine output of 200–300 ml/h with a urine specific gravity of 1005 g/ml was subsequently observed which in combination with serum sodium levels of 166 mmol/l suggested the diagnosis of diabetes insipidus. Anti-diuretic hormone and fluids were administered until the electrolyte imbalances normalized.

On the second day of ICU admission total parenteral nutrition was started due to clinical suspicion of ileus and subsequent inability to resume enteral feed. Despite the initial trauma screen and CT scan revealing no intra-abdominal organ injury, serial clinical examination in ICU revealed progressive abdominal distension. Bladder pressure measurements, as per the World Society of Abdominal Compartment Syndrome (WSACS) guidelines, revealed a persistent increase in intra-abdominal pressure ($P > 28$ mmHg) with associated new organ dysfunction that suggested the presence of abdominal compartment syndrome. (Kirkpatrick et al. ICM 2013) We were unable to obtain detailed serial intra-abdominal pressure measurements using a manual catheter, as the appropriate equipment required to connect to a recording system was unavailable.

The patient necessitated a diagnostic exploratory laparotomy. In light of the recent catheter insertion, on-table intravenous contrast-enhanced plain radiography was performed through the femoral venous catheter, indicating that it had been malpositioned into the peritoneum. (Fig. 1) The catheter and seven liters of total parenteral nutrition (TPN)-like fluids were removed during the abdominal washout. The patient remained in the ICU for 8 days with marked cerebral edema and sadly died from subsequent cardiac arrest.

3. Discussion

Central venous catheters are widely used in the emergency setting. Although their use is not widely recommended as routine practice by international clinical guidelines, it is often routine practice in this district general hospital Greece and is likely in other rural and low-resource hospitals worldwide. Femoral venous catheterization is a safe procedure with a low rate of complications. Although it is considered safer to routinely perform central catheterization under ultrasound guidance, occasionally limited resources result in insertion without direct radiological visualization. Femoral catheters are commonly utilised for intravenous parenteral nutrition, emergency intravenous access, or dialysis and

they are widely used in ICUs [1]. Insertion-related complications are usually classified as infectious, thrombotic or mechanical. Percutaneous central catheter insertion is considered a safe procedure, as the mechanical complications vary from 3% to 19% [14,15,17]. The current literature reports that subclavian insertion can lead to mechanical complications, such as a pneumothorax. Additionally, the femoral approach may lead to severe haematomas, which potentially require blood transfusion and rarely surgery. Other femoral catheter complications such as: thrombophlebitis, bleeding, catheter migration, extravasation and infection are well documented in the existing literature, and have been more frequently reported in infants and children [2]. We therefore, strongly emphasize the need to ensure that there are legitimate indications for CVC insertion as these rare but significant complications are even more unacceptable if the CVC line is inserted unnecessarily.

Ultrasound guided catheter insertion has been shown to minimize the rates of mechanical complications of the subclavian approach. A study has demonstrated that the time required for catheter insertion and operator expertise were relatively independent risk factors for complication rates [16]. Another study in the ICU setting showed that mechanical complications were reported to be higher during night-shift insertions, which could be attributed to operator-fatigue or their level of expertise [15].

The current literature reports a small number of paediatric cases of fluid extravasation from venous catheters as a result of direct perforation of the vein during insertion. Factors that can lead to vessel perforation are non-occlusive mural thrombosis, local phlebitis, and rupture of the vein wall by the catheter or the guide wire during insertion [3,13]. Nadroo and Al-Sowailem describe a case of renal vein perforation and subsequent extravasation in the renal pelvis of a neonate [3]. Another study supports the theory that an acute abdomen could potentially develop in new-born infants and children from late retroperitoneal extravasation secondary to complicated femoral venous catheter insertion [6].

Celiker et al. reported extravasation from a femoral venous catheter in a patient following total hysterectomy. As was seen with our case, this patient developed marked abdominal distension and intra-abdominal hypertension, however, this did not lead to formation of abdominal compartment syndrome due to the presence of an abdominal drain [5]. Spriggs and Brantley reported thoracic and abdominal extravasation as a complication of hyper-alimentation in infants [10]. This study describes four cases of femoral venous catheters misplacement, which formed intra-abdominal hematomas following emergency setting insertion. All cases describe that the catheter perforated the vessel wall on inser-

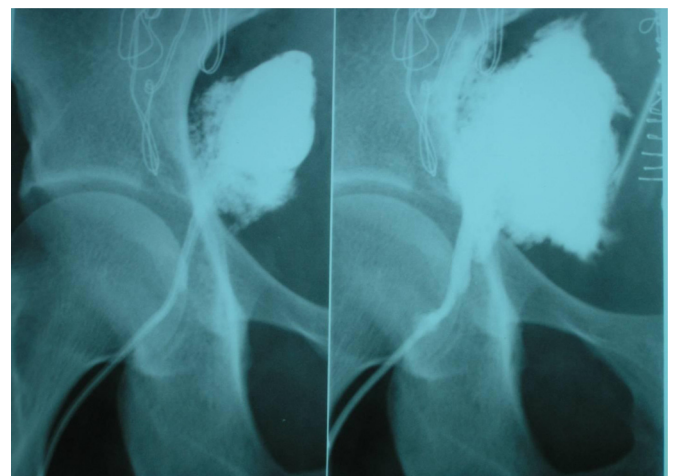


Fig. 1. Extra-vasation from femoral venous catheter malposition.

tion and that the tip was initially advanced into the peritoneal cavity. Because the catheter was placed within the haematoma, the dark-coloured venous blood that was aspirated falsely confirmed the correct positioning of the catheter [4,7,8,9]. This theory potentially explains our case of initial mis-interpretation of correct catheter placement. We speculate that during initial insertion, the guide wire perforated the vessel wall and the tip was advanced into the intra-peritoneal space. Despite the operator's expertise, the time pressures of the emergency setting could have influenced the risk of complication in this case.

Resuscitation with large amount of intra-venous fluids is common in unstable emergency and ICU patients. In our case, the management of diabetes insipidus and severe electrolyte disturbances required the administration of large amounts of intra-venous fluids through the femoral catheter. The extravasation of large volumes of fluids into the peritoneal cavity can lead to increased intra-abdominal pressure and the development of ACS [13]. Clinical examination alone has a low sensitivity for the detection of ACS development [11]. A high level of suspicion and continuous monitoring of intra-abdominal pressures are imperative in order to diagnose ACS in the early phase.

ACS is an underestimated clinical entity that insidiously develops and failure to recognise this results in renal dysfunction, organ ischemia and respiratory failure. Therefore, ACS can subsequently have high mortality rates, particularly in critically ill patients [12]. Abdominal decompression improves the haemodynamic stability and should be performed as promptly as possible to reduce mortality.

4. Conclusion

Femoral catheter malpositioning may lead to extravasation of intra-vascular contents into the retroperitoneal space or peritoneal cavity that can rarely lead to ACS. Ultrasound guided insertion offers improved safety with significantly lower rates of mechanical complications. This case highlights that during the management of critically ill patients, despite the use of safe methods of catheter insertion and confirmation of correct placement through blood aspiration alone, catheter misplacement can still occur and can be difficult to confirm. Correct positioning of intravascular lines must be regularly and systematically checked prior to their use, as these may have been incorrectly sited initially or later displaced during hospital transfers.

Conflict of interest

None of the authors has conflict of interest.

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Consent

Patients next of kin offered consent for this case report publication.

Authors contribution

Georgios Pafitanis – correspondence author, writing paper, study design, review manuscript.

Spyridon Koulas – writing paper, data collection, review manuscript.

Evgenia Theodorakopoulou – review manuscript.

Katrina Mason – review manuscript.

Olga Igropoulou – case presentation, review manuscript.

Ourania Mousafiri – case presentation, review manuscript.

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