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Case Report

An Emergent Intraoperative Intervention: Central Venous Catheterization in a Prone Patient during Spinal Surgery

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ABSTRACT

Central venous catheterization is a critical procedure for patients undergoing major surgeries, particularly when peripheral venous access is compromised. This case report delineates the emergency placement of a central venous catheter (CVC) through the right internal jugular vein in a 63-year-old female patient positioned prone during spinal surgery. The necessity arose following significant intraoperative blood loss and the failure of peripheral venous access, presenting unique challenges due to the patient's position and the absence of sonographic guidance. The procedure was successfully executed by anatomically identifying the insertion site and utilizing a posterior lateral approach, which underscores the feasibility and urgent need for CVC placement in atypical scenarios. The patient demonstrated significant improvement with stable postoperative outcomes, emphasizing the importance of adaptability in clinical practices. This case contributes to the limited but growing body of literature on prone position CVC insertion, highlighting its viability in emergencies, despite inherent risks and technical difficulties. The findings advocate for further research and development of guidelines to enhance patient safety and procedural success in complex clinical settings.

Introduction

A Central Venous Catheter (CVC) is a medical device used for various procedures, including medication administration, fluid and blood product delivery, hemodynamic monitoring, and facilitating complex interventions [1]. The CVC is typically inserted into the subclavian vein, the internal jugular vein (IJV), or the femoral vein. The IJV is often preferred due to its relative safety and lower risk of complications [2].

Patient positioning can significantly affect the procedure and hemodynamics. For instance, in surgeries requiring prone positioning, such as spine surgeries, establishing reliable venous access beforehand is crucial. If venous access is compromised after positioning, it can be challenging to establish a large-diameter venous line [3].

During the pandemic, healthcare professionals faced difficulties in establishing a central line in prone patients with respiratory issues. These patients could not tolerate supine positioning due to their critical gas exchange requirements. Despite these challenges, there have been successful instances of CVC placement in the prone position [4-5].

This approach can be crucial for patients undergoing surgery in the prone position who may encounter difficulties with peripheral venous access and hemodynamic changes. The article presents a case where a patient, under anesthesia for spine surgery and after losing peripheral venous access, received a CVC in the right IJV in the prone position [6]. This case underscores the significance of this technique in specific surgical situations.

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Case Report

A 63-year-old woman was admitted to the operating room for a four-level lumbar fusion surgery from L3 to S1.

History and Assessment

The patient presented without any notable medical or medication history, except for the occasional use of pain relievers like acetaminophen and ibuprofen. The physical examination revealed no significant abnormalities, with the exception that the patient's Body Mass Index (BMI) was 34 kg/m². Moreover, there was no significant family medical history noted in the preoperative assessment. All laboratory values, including a hemoglobin level of 14.3 g/dl, were within normal ranges. She was thoroughly briefed on the surgical procedure along with the associated potential risks and benefits. Following a comprehensive response to all her inquiries, she provided informed consent for the surgery.

Intervention

Before the operation, four units of packed cells were prepared for the patient. Comprehensive monitoring was planned according to American Society of Anesthesiologists (ASA) standards, including ECG, NIBP, SpO_2, Capnography, and Temperature monitoring.

General anesthesia was induced following standard procedures, and a 7.5 mm internal diameter armored endotracheal tube was used for tracheal intubation. Post-induction, an 18-gauge and a 16-gauge peripheral intravenous line were established, and a 16 French Foley catheter was placed for bladder catheterization.

After the patient was positioned prone, the monitoring devices were reconnected, and vital signs were stabilized before surgery. The initial vital signs recorded were a Blood Pressure of 111/55 mmHg, a Heart Rate of 84 beats per minute, and an Oxygen Saturation of 98%.

The depth of anesthesia was continuously monitored with a Bispectral Index (BIS) monitor, maintaining a BIS value between 40 and 60.

Adverse/Critical events

During the surgery, the patient lost 1100 ml of blood, causing a drop in blood pressure to 100/48 mmHg and an increase in heart rate to 110 bpm. Both pre-established peripheral veins failed, and only a smaller, 20-gauge vein could be secured. A CVC was inserted into the internal jugular vein despite challenges due to the patient's positioning and limited visibility (Figure 1). The catheter's position was confirmed using a Siemens Arcadis Avantic Mobile C-Arm. Two units of packed red blood cells and 2500 ml of crystalloid solutions were administered through the central line, stabilizing the patient's vital signs to 115/65 mmHg and 90 bpm within 45 minutes. The operation lasted approximately 3.5 hours.

Figure 1- Illustration of the needle entry point at the level of the cricoid cartilage, showing its insertion posterior to the sternocleidomastoid muscle and the subsequent direction of advancement towards the area anterior to the carotid pulse, as utilized in the described procedure.

Follow up and outcomes

After surgery, the patient was monitored in the post-anesthesia care unit, with regular checks on vital signs and response to transfusion. The patient improved steadily with no adverse reactions. The CVC was kept for 48 hours for additional medication or fluids. The team monitored coagulation status using parameters like PTT, INR, D.Dimer, FDP, and ATIII. After three days of

observation, the patient was discharged with home care instructions and a follow-up schedule

Discussion

Reliable venous access is essential during major surgeries, but challenges arise when patients are positioned prone, necessitating central venous access [7]. CVC insertion is typically avoided in the prone position due to technical challenges and risks. However, in cases where patients cannot tolerate supine positioning, central venous access becomes a significant challenge in the prone position [8-9].

Literature provides insights into the challenges and outcomes of CVC insertion in the prone position, highlighting potential risks associated with nontraditional positions. Conventionally, CVCs are inserted with the patient in the supine or Trendelenburg position to ensure safe and effective placement. However, in specific cases where patients are intolerant of supine positioning due to critical gas exchange requirements, central venous access becomes a significant challenge in the prone position [5].

On the other hand, another report presents the case of a 46-year-old male admitted to the ICU with COVID-19 pneumonia complicated by acute respiratory distress syndrome (ARDS), requiring intermittent prone positioning [4]. The article discusses the necessity of central venous access in such cases, emphasizing the need for alternative methods when traditional approaches are not possible.

A study published in the Clinical Journal of the American Society of Nephrology [6] provides further evidence in favor of using CVC insertion in the prone position when necessary. The study explains a series of 36 cases where CVC was placed in patients who needed prone position due to critical gas exchange requirements and couldn't tolerate supine positioning. The study highlights the success rate and potential complications associated with this technique.

A study in BMJ Open Quality analyzed all intubated adult patients admitted to the COVID ICU at Parkland Hospital between March 2020 and March 2021 who had a Central Venous Catheter CVC placed, including those who underwent internal jugular vein (IJV) cannulation while prone [9]. The study found that 32 patients successfully had a CVC placed while in the prone position, but two patients (6%) developed pneumothorax within 24 hours following CVC placement. The increased incidence of pneumothorax in this cohort was attributed to the predominance of hemodialysis catheters and the elevated baseline incidence of pneumothorax in COVID-19 ARDS patients.

These studies collectively demonstrate that CVC insertion in the prone position, despite challenges and risks, remains a vital tool for providing adequate care in select clinical settings. It's important to weigh the benefits against the risks when considering this approach.

The main challenge in our case was the patient's significant blood loss during surgery, necessitating an emergent blood transfusion. However, both pre-established peripheral veins became non-functional, leading to the decision to establish a CVC via the internal jugular vein, despite the patient being in the prone position. The successful insertion of the CVC was crucial, utilizing detailed knowledge of neck anatomy and precise identification of vascular pathways and key anatomical landmarks (Figure 2) [10]. This case demonstrates that in emergencies, such measures may be necessary despite the associated challenges and risks, aligning with previous studies highlighting the potential for successful CVC placement in the prone position under specific circumstances.

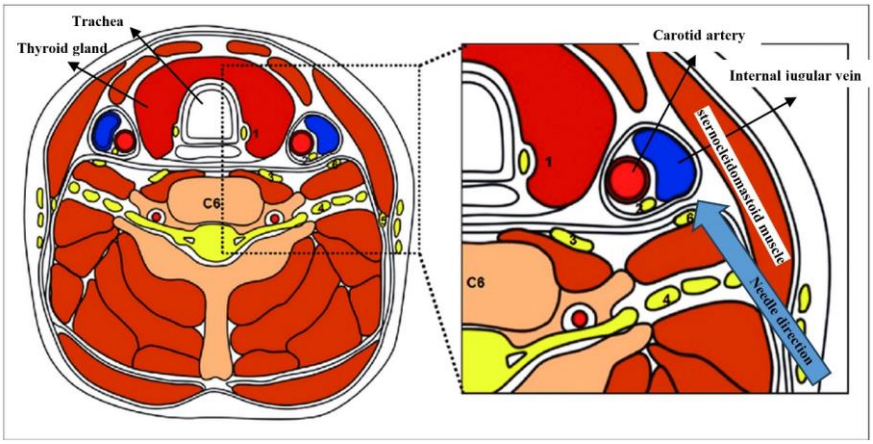

Figure 2- Cross-sectional anatomy of the neck at the level of C6, illustrating the schematic pathway of needle insertion as described in the procedure.

The distinctiveness of this case lies in several factors that differentiate it from typical scenarios reported in medical literature. The absence of sonography equipment, the patient's neck positioned in flexion, the urgent nature of the situation, the execution of the procedure amidst ongoing surgery, and the critical risk of hemodynamic instability all contributed to the complexity of establishing central venous access. These

challenges required the medical team to adapt and overcome significant obstacles to ensure the patient's care. Despite these difficulties, the team's expertise and determination enabled the successful placement of the CVC and the completion of the necessary blood transfusion, demonstrating resilience and adaptability in critical care.

This case underscores the importance of flexibility, preparedness, and the ability to quickly adapt to unexpected events during surgery. It also highlights the need for alternative plans for venous access in surgeries, especially in challenging scenarios such as the prone position. However, it is important to note that each case is unique, and what worked in this situation may not be applicable or successful in others.

Conclusion

This case report highlights the successful insertion of a CVC in a prone position during emergencies despite the challenges and risks. It emphasizes the need for adaptability and specialized expertise and calls for further research and specific guidelines to enhance patient safety and outcomes.

Abbreviations

CVC: Central Venous Catheter
IJV: Internal Jugular Vein
ARDS: Acute Respiratory Distress Syndrome
PTT: Partial Thromboplastin Time
INR: International Normalized Ratio
D.Dimer: D-Dimer
FDP: Fibrin Degradation Products
ATIII: Antithrombin III
ASA: American Society of Anesthesiologists
ECG: Electrocardiography
NIBP: Non-Invasive Blood Pressure
SpO_2: Pulse Oximetry for Oxygen Saturation
BIS: Bispectral Index
SVC: Superior Vena Cava
ICU: Intensive Care Unit
COVID-19: Coronavirus Disease of 2019

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