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INADVERTENT CAROTID ARTERY CANNULATION: A CASE REPORT ON PATIENT OUTCOMES IN CENTRAL VENOUS ACCESS PROCEDURES

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Abstract

Inadvertent carotid artery cannulation is a life threatening complication occurs during central venous catheterization (CVC) procedure which leads to serious patient outcomes. The carotid artery lies in close proximity to the internal jugular vein, which is a common site for CVC insertion, increasing the risk of inadvertent arterial puncture. This case report presents a detailed examination of a 51-year-old male with a history of congenital heart disease (CHD), specifically tetralogy of Fallot (TOF), who experienced inadvertent carotid artery cannulation during a routinxe CVC procedure. The patient presented with worsening exertional intolerance, New York Heart Association (NYHA) class II symptoms, intermittent pedal edema, and anorexia. Clinical examination revealed grade III clubbing, cyanosis, elevated jugular venous pressure (JVP), and oxygen saturation (SpO2) of 82%. Preoperative coronary angiography (CAG) showed normal coronary arteries and the possibility of a conal artery crossing the right ventricular outflow tract (RVOT). Transthoracic echocardiography (ECHO) confirmed TOF with a large conoventricular ventricular septal defect (VSD) and severe infundibular annular pulmonary stenosis. The patient was scheduled for intracardiac repair (ICR) using a homograft to the main pulmonary artery (MPA). During the procedure, an internal jugular vein (IJL) puncture was performed using a conventional landmark technique. Following the insertion of a central venous catheter (CVC), the patient's blood pressure dropped, and the central venous pressure (CVP) monitor displayed an arterial waveform, indicating inadvertent carotid artery cannulation. The surgery was deferred, and the CVC was promptly removed with subsequent compression. Despite being extubated later that evening, the patient exhibited persistent drowsiness, hypoventilation, and mild left-sided weakness. Imaging revealed chronic lacunar infarcts and multiple acute infarcts in various brain regions. This case underscores the importance of immediate recognition and management of inadvertent carotid artery cannulation to prevent severe complications. The patient's neurological symptoms, although transient, highlight the potential for serious outcomes associated with inadvertent carotid artery cannulation. Continuous neurological monitoring and conservative management were crucial in this case, leading to an uneventful postoperative period despite the initial complications. The findings from this case contribute to the existing body of knowledge by emphasizing the critical need for meticulous technique during CVC procedures and the prompt identification of inadvertent carotid artery cannulation. The case also suggests that non-surgical management can be effective in certain scenarios, reducing the risk of further complications. Future research should focus on developing standardized protocols for the prevention, early detection, and management of inadvertent carotid artery cannulation to improve patient outcomes.

Keywords: Inadvertent Carotid Artery Catheterization, Central Venous Access, Patient Outcomes, Tetralogy of Fallot, Neurological Complications.

INTRODUCTION

Central venous access (CVC) procedures are integral to clinical practice, providing direct routes to the central circulation for various medical interventions. These procedures involve inserting catheters into large central veins, such as the internal jugular, subclavian or femoral veins, facilitating treatments like total parenteral nutrition, hemodynamic monitoring and medication administration (Chung & Ziegler, 1998). CVC is essential when peripheral venous access is inadequate or specific therapies require central circulation access, allowing for rapid medication administration, invasive monitoring, and specialized treatments. Despite their importance, CVC procedures are not without risks. Complications such as catheter misplacement, arterial puncture, hemorrhage, pneumothorax, infection, and thrombosis can lead to serious patient consequences, including morbidity and mortality (Galloway & Bodenham, 2004; Dixon et al., 2017). Central-line-associated bloodstream infections (CLABSIs) are particularly concerning, with a mortality risk of 12% to 25% and substantial healthcare costs. To minimize these risks, proper sterile techniques during placement, careful patient positioning, appropriate catheter maintenance and meticulous removal are essential. The use of image guidance, such as ultrasound, can improve procedural success and reduce adverse events (Lockwood & Desai, 2019). The exact incidence of inadvertent carotid artery cannulationduring CVC procedures varies depending on the specific procedure, the healthcare provider's experience and the use of imaging guidance.

Inadvertent carotid artery cannulation typically occurs due to anatomical variations (the anatomy of the neck vessels), technical errors (Improper technique during needle insertion or lack of experience can lead to inadvertent arterial puncture) and the patient factors such as obesity, short neck, or anatomical abnormalities may increase the difficulty of the procedure.

Study reports that arterial puncture rates during internal jugular vein cannulation, including Inadvertent carotid artery cannulation, occurs between 6.3% and 9.4% (Nicholson et al., 2004; Pikwer et al., 2009). However, the incidence of specifically catheterizing the carotid artery during CVC procedures is lower and less documented in the literature. Utilizing imaging guidance, such as ultrasound and adhering to best practices can significantly reduce the risk of inadvertent carotid artery cannulation.

Inadvertent carotid artery cannulation poses several serious complications, including arterial injury, hemorrhage, neurological sequelae, infection and thrombosis. Arterial injury can result in dissection, pseudoaneurysm formation or arteriovenous fistula, while hemorrhage may occur externally or internally, leading to hematoma formation and necessitating immediate intervention in severe cases (Maietta, 2012; Goulding, 2014). Neurological sequelae such as stroke or transient ischemic attacks may result from disrupted blood flow or thrombi embolization, causing motor or cognitive deficits. Infection risk increases due to catheter insertion, potentially causing systemic or local infections requiring antibiotic therapy or surgical intervention. Thrombosis, another concern, can promote thrombus formation, potentially causing embolism or artery occlusion, leading to tissue ischemia and organ damage. Long-term complications may include recurrent arterial stenosis, persistent neurological deficits, or secondary vascular complications (Bourgeois, 2015). Prompt recognition and management of inadvertent carotid artery cannulation are crucial to minimize these risks and optimize patient outcomes. Close monitoring, timely intervention, and appropriate management

strategies are essential in mitigating the potential risks associated with this iatrogenic complication. Despite the recognized risks, a comprehensive understanding of the frequency and predictors of inadvertent carotid artery cannulation during CVC procedures is lacking. Further research is needed to elucidate specific risk factors contributing to inadvertent carotid artery cannulation and identify predictive markers to prevent such occurrences. This case report aims to raise awareness about inadvertent carotid artery cannulation during CVC procedures, highlighting its impact on patient outcomes and emphasizing the importance of preventive measures and best practices. By sharing detailed clinical insights from a specific case, we seek to contribute to the existing body of knowledge, ultimately enhancing patient safety and improving procedural outcomes in clinical practice.

MATERIALS AND METHODS

The study aimed to document the clinical course and outcomes of a 51-year-old male patient who experienced inadvertent carotid artery cannulationduring a central venous access (CVC) procedure. The primary objectives were to describe the procedural steps, identify the occurrence of inadvertent carotid artery cannulation and analyze the subsequent management and outcomes (Fig:1). The rationale behind this case report was to raise awareness of inadvertent carotid artery cannulation as a serious complication of CVC procedures and to highlight the importance of immediate recognition and appropriate management to improve patient outcomes.
Blood sample collection:

Blood samples were collected during the CVC procedure and postoperatively to monitor the patient's clinical status. During the procedure, venous blood was aspirated upon successful puncture of the target vein. Following the identification of inadvertent carotid artery cannulation, arterial blood was sampled to confirm the catheter's placement within the carotid artery.

Postoperatively, blood samples were collected at regular intervals to monitor blood gases, coagulation status, and biochemical markers indicative of tissue injury and infection. Blood samples were immediately placed in anticoagulant tubes and transported to the laboratory for analysis. Samples for arterial blood gas analysis were placed on ice and analyzed within 30 minutes. Other samples were stored at 4°C and analyzed within 24 hours.

Ultrasound Guidance and Catheter Placement:

The patient was positioned appropriately and an ultrasound machine was connected and set up. A pre-procedural scan confirmed vein patency and anatomical variations. The skin at the insertion site was cleaned and sterilized, and a sterile field was established. Using ultrasound guidance, the internal jugular vein (IJV) was identified, and local anaesthetic was administered. A needle was advanced toward the vein, and non-pulsatile venous blood was aspirated. However, during the procedure, the catheter was inadvertently placed in the carotid artery, confirmed by pulsatile blood flow and arterial waveform on the central venous pressure (CVP) monitor.

Post-Procedural Monitoring and Management:

Following the recognition of inadvertent carotid artery cannulation, the central venous catheter (CVC) was removed, and manual compression was applied for 15 minutes to achieve haemostasis. The patient was closely monitored in the intensive care unit

(ICU) for neurological deficits and respiratory status. Continuous post-procedural neurological monitoring was conducted to detect any deficits indicative of carotid artery involvement. Imaging studies, including carotid duplex ultrasound and computed tomography (CT) scans, were performed to assess the extent of arterial injury and associated complications.

Neurological and Respiratory Assessments:

Neurological evaluations included assessing consciousness, motor function and sensory deficits. Respiratory assessments involved monitoring blood gases, oxygen saturation (SpO2) and partial pressure of oxygen (PO2) and carbon dioxide (PCO2). The patient exhibited mild left-sided weakness, hypoventilation and low oxygen levels, prompting reintubation and further imaging studies, which revealed chronic lacunar infarcts and multiple acute infarcts.

Case Presentation

A 51-year-old male with a history of congenital heart disease (CHD) since age 13 presented with exertional intolerance and New York Heart Association (NYHA) class II symptoms. He had experienced intermittent pedal edema for 2 months and anorexia for 3 months. On examination, he exhibited grade III clubbing, cyanosis, and pedal edema. His jugular venous pressure (JVP) was elevated with a prominent a wave and his oxygen saturation (SpO2) was 82%.

Procedure Details

The patient was scheduled for intracardiac repair (ICR) with a homograft to the main pulmonary artery (MPA). During the procedure, routine monitors and arterial line cannulation were established. However, during the internal jugular vein (IJV) puncture, the patient's blood pressure dropped to 70/50 mmHg. Using a conventional landmark technique, the IJV was punctured, and a 7.0 Fr, 10 cm central venous catheter (CVC) was inserted. The central venous pressure (CVP) monitor read 100 with an arterial waveform, indicating inadvertent carotid artery cannulation.

Immediate Complications

Following the recognition of inadvertent carotid artery cannulation, the CVC was promptly removed, and manual compression was applied for 15 minutes to achieve hemostasis. The patient was then shifted to the intensive care unit (ICU) and extubated later that evening. Despite initial stabilization, the patient remained drowsy, with a PO2 of 54 mmHg and SpO2 ranging from 70% to 80%. Hypoventilation and a PCO2 of 64 mmHg prompted reintubation.

Diagnostic Confirmation

Neurological evaluation revealed mild left-sided weakness. Imaging studies, including a computed tomography (CT) scan, demonstrated chronic lacunar infarcts and multiple acute infarcts in various brain regions, confirming the presence of acute neurological injury secondary to inadvertent carotid artery cannulation.

Management and Interventions

Continuous neurological monitoring and supportive care were provided. The patient's neurological symptoms were managed conservatively without the need for surgical intervention. Over the following days, the patient's respiratory function stabilized, and he was successfully extubated without further complications.

Post-Procedure Outcomes

The patient remained in the ICU for a total of 5 days and was subsequently transferred to a regular ward. His total hospital stay was 9 days. Follow-up neurological assessments showed significant improvement in motor function, with only mild residual weakness.

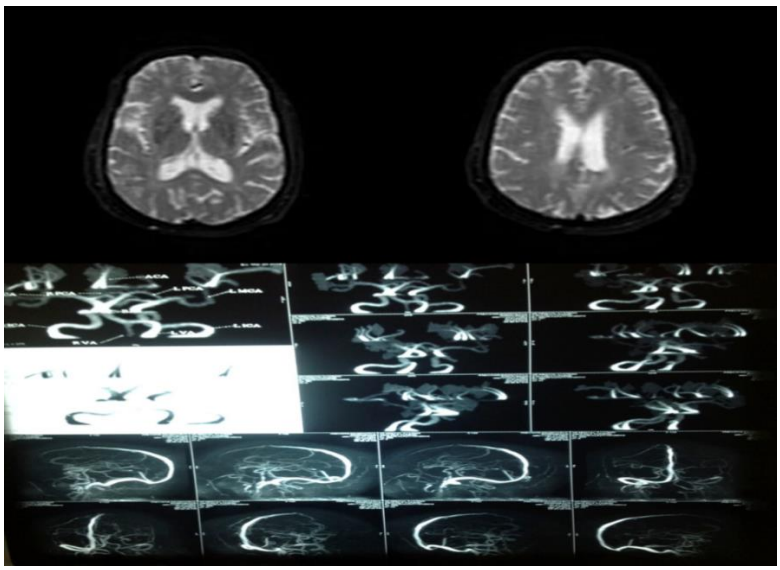

Figure 1: Showing the Radiological Image of Inadvertent Carotid Artery Cannulationduring Central Venous Access (CVC) procedure

DISCUSSION

This case report highlights the significant impact of Inadvertent carotid artery cannulation during central venous access (CVC) procedures, particularly focusing on the clinical outcomes and management of a 51-year-old male with congenital heart disease (CHD) and tetralogy of Fallot (TOF). The patient's worsening symptoms, including exertional intolerance, New York Heart Association (NYHA) class II symptoms, intermittent pedal edema, and anorexia, necessitated intracardiac repair (ICR). However, during the CVC procedure, an inadvertent carotid artery cannulation occurred, leading to a series of complications. The inadvertent placement of the central venous catheter (CVC) in the carotid artery was identified by the presence of an arterial waveform on the central venous pressure (CVP) monitor. This will be supported by evidencing the immediate bright red blood return, hematoma formation and neurological Symptoms. Immediate recognition and removal of the catheter, followed by manual compression, were crucial in managing the situation. Despite initial stabilization, the patient exhibited neurological symptoms, including mild left-sided weakness and altered consciousness, which were confirmed by imaging studies showing chronic lacunar infarcts and multiple acute infarcts.

The prolonged hospital stay observed in our case aligns with previous reports indicating increased treatment duration following inadvertent carotid artery cannulation. Bechara et al. (2013) and Ezaru et al. (2009) highlighted similar findings, where inadvertent carotid sheath insertion led to delayed operations and extended hospital stays. Our case extends these observations by demonstrating transient neurological symptoms managed conservatively without long-term sequelae. In contrast to studies by Nicholson et al. (2004) and Stone & Hern (2007), which

documented significant morbidity, including pseudoaneurysms and hemothorax requiring endovascular treatments, our study reported lower complication rates. This could be attributed to the prompt identification and conservative management of neurological symptoms, preventing more severe outcomes.

Furthermore, our findings contrast with reports by Katyal et al. (2018) and Yoon et al. (2015), who described ischemic stroke as a severe consequence of central arterial catheterization. In our case, although neurological symptoms were present, they were mild and transient, highlighting the importance of early intervention and continuous monitoring. The necessity of quality improvement guidelines to minimize complications during CVC procedures is well-documented. Dariushnia et al. (2010) and Guilbert et al. (2008) emphasized the relevance of meticulous technique and prompt intervention. Our case underscores this importance, as the use of ultrasound guidance and adherence to best practices significantly contributed to the successful management of inadvertent carotid artery cannulation.

CONCLUSION

In summary, this case report highlights the critical impact of inadvertent carotid artery cannulation on patient outcomes during CVC procedures. The findings emphasize the importance of immediate recognition, conservative management, and continuous monitoring to prevent severe complications. While transient neurological symptoms were observed, prompt intervention ensured favourable outcomes. This case underscores the need for stringent adherence to quality improvement guidelines and the use of advanced imaging techniques to enhance patient safety and procedural success in CVC procedures. Further research is warranted to establish standardized protocols for managing inadvertent carotid artery cannulation and improving patient outcomes.

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