



A Prospective Study on Complications of Central Venous Catheter Insertion in Surgical Patients

Dr. Kunal Kailas Jadhav

Assistant Professor, Department of General Surgery, Smt. Kashibai Navale Medical College and General Hospital

ABSTRACT

Central venous catheter (CVC) insertion is a common procedure in surgical patients for administering medications, fluids, blood products, and hemodynamic monitoring. Despite its benefits, the procedure is associated with various complications, including mechanical, infectious, and thrombotic events. This prospective study aimed to evaluate the incidence and types of complications related to CVC insertion in surgical patients. Over six months, 200 patients undergoing elective surgery who required CVC insertion were included. The overall complication rate was 15%, with mechanical complications being the most frequent (10%), followed by infectious (3%) and thrombotic complications (2%). Mechanical complications were significantly reduced with the use of ultrasound guidance (5% vs. 15% without ultrasound guidance). This study highlights the importance of adopting preventive measures such as ultrasound guidance and strict aseptic techniques to minimize complications. Proper training and adherence to protocols can reduce the risks and improve patient outcomes.

Keywords: Central venous catheter, Surgical patients, Complications, Ultrasound guidance, Mechanical complications

INTRODUCTION:

Central venous catheter (CVC) insertion is an essential procedure in surgical patients for various diagnostic and therapeutic purposes, including fluid resuscitation, medication administration, central venous pressure monitoring, and access for parenteral nutrition. Despite its widespread use, CVC insertion is associated with several risks and complications, which can range from mechanical issues, such as arterial puncture or pneumothorax, to more serious infectious and thrombotic complications (1,2).

Mechanical complications are often related to the insertion technique, patient anatomy, and the operator's experience. These include arterial puncture, hematoma formation, pneumothorax, hemothorax, and catheter malposition. Studies have shown that these complications are more common when operators rely solely on anatomical landmarks for insertion, as opposed to using ultrasound guidance. Pneumothorax, one of the most feared mechanical complications, can lead to respiratory distress, requiring immediate intervention such as chest tube placement (3,4).

Infectious complications, such as catheter-related bloodstream infections (CRBSIs), occur due to contamination during catheter insertion or poor catheter maintenance. The incidence of CRBSIs varies between institutions, but it remains a significant cause of morbidity and mortality in hospitalized patients (5). Various guidelines recommend the use of full-barrier precautions and aseptic techniques to reduce the risk of CRBSIs (6).

Thrombotic complications, including deep vein thrombosis (DVT) or catheter-related thrombosis, occur due to endothelial injury during catheter insertion, prolonged catheter dwell time, or hypercoagulable states in the patient. Thrombotic events can lead to complications such as catheter malfunction, venous congestion, and pulmonary embolism (7,8).

To mitigate these risks, several preventive strategies have been developed. Ultrasound-guided catheter insertion is now widely recommended as it increases the success rate of first-pass insertion and significantly reduces the risk of mechanical complications (9). Similarly, adherence to strict aseptic techniques during both catheter insertion and

maintenance has been shown to reduce infectious complications (10).

Despite these advancements, CVC-related complications remain a concern in clinical practice, especially in the surgical patient population where co-existing conditions, such as immunosuppression or coagulopathy, may increase the risk of complications. This study aims to assess the incidence of CVC-related complications and evaluate the effectiveness of preventive measures such as ultrasound guidance and aseptic techniques in reducing these complications in surgical patients.

Aim and Objectives:

Aim:

To assess the incidence and types of complications associated with central venous catheter insertion in surgical patients.

Objectives:

1. To determine the overall complication rate of CVC insertion in surgical patients.
2. To evaluate the effectiveness of ultrasound guidance and preventive measures in reducing CVC complications.

Materials and Methods:

This prospective observational study was conducted in the surgical departments of a tertiary care hospital over a six-month period. A total of 200 adult patients (aged 18 years or older) who required central venous catheterization for elective surgeries were included in the study. Patients were excluded if they had pre-existing CVCs or were undergoing emergency surgery.

The primary data collected included patient demographics, insertion site, use of ultrasound guidance, and any complications encountered during or after CVC placement. Complications were categorized into mechanical (e.g., arterial puncture, pneumothorax), infectious (e.g., catheter-related bloodstream infections), and thrombotic (e.g., deep vein thrombosis) complications (11).

Inclusion Criteria:

- Adult surgical patients aged 18 years and above requiring CVC insertion.
- Patients undergoing elective surgery.

Exclusion Criteria:

- Patients with pre-existing CVCs.
- Patients undergoing emergency surgeries.

Results:

Complication Type	Number of Cases (n)	Percentage (%)
Mechanical	20	10
Infectious	6	3
Thrombotic	4	2
Total	30	15

Variable	Ultrasound Guidance Used (n = 120)	No Ultrasound Guidance (n = 80)
Mechanical Complications	5	15
Infectious Complications	2	4
Thrombotic Complications	1	3

Description:

Of the 200 patients studied, 30 (15%) experienced complications. Mechanical complications were the most common (10%), followed by infectious (3%) and thrombotic (2%). The use of ultrasound guidance significantly reduced the incidence of mechanical complications (5 out of 120 cases with ultrasound vs. 15 out of 80 without).

Discussion:

The findings of this study are consistent with previous literature indicating a significant rate of complications associated with CVC insertion, particularly mechanical complications (12). The use of ultrasound guidance was shown to significantly reduce mechanical complications, which is in line with recommendations from various clinical guidelines. Previous studies have also demonstrated a lower incidence of complications when ultrasound is used for CVC placement, reducing

the risk of arterial puncture, pneumothorax, and malposition (13).

Infectious complications, though less frequent, pose a serious risk. Catheter-related bloodstream infections (CRBSIs) are a known complication of CVC insertion and can lead to significant morbidity and mortality. In this study, the CRBSI rate was 3%, consistent with other studies (14). Adherence to aseptic techniques during insertion and catheter care is essential in minimizing these infections (15).

Thrombotic complications occurred in 2% of cases, similar to previously reported rates in surgical patients. These events are often associated with prolonged catheter use or patient-related risk factors, such as hypercoagulable states (16). Preventive strategies such as using smaller catheters and minimizing dwell time are recommended to reduce the risk of thrombosis (17).

Overall, this study underscores the importance of preventive measures, such as ultrasound guidance and aseptic techniques, in reducing CVC-related complications. Training healthcare providers in these techniques can further improve patient safety and outcomes.

Conclusion:

Central venous catheter insertion in surgical patients is associated with a significant risk of complications, with mechanical complications being the most frequent. The use of ultrasound guidance during catheter insertion significantly reduces the risk of mechanical complications. Infectious and thrombotic complications, though less frequent, also present serious risks. The findings of this study highlight the importance of adopting best practices, including ultrasound guidance and strict aseptic techniques, to minimize the incidence of CVC-related complications. Future studies should focus on optimizing these preventive strategies and exploring their long-term impact on patient outcomes.

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