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# COMPLICATIONS OF CENTRAL VENOUS CATHETER INSERTION: A PROSPECTIVE STUDY IN SURGICAL PATIENT

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## Abstract

**Background**: Central venous catheter (CVC) insertion is a routine procedure in surgical patients, used for intravenous fluids, medication administration, hemodynamic monitoring, and central venous pressure measurement. However, it is associated with complications that can affect patient outcomes. This study aims to prospectively assess the complications of CVC insertion in surgical patients.

**Objective**: To determine the frequency, types, and associated risk factors for complications of central venous catheter insertion in surgical patients.

**Material and Methods**: A prospective observational study was conducted in the Department of Surgery at a tertiary care hospital, enrolling 100 surgical patients who underwent CVC insertion. Data were collected on patient demographics, site of catheter placement, duration of catheterization, and complications such as mechanical, infectious, and thrombotic events. All insertions were performed using ultrasound guidance where available, and patients were followed until catheter removal.

**Results**: Among the 100 patients, the most common complications were mechanical injuries (12%), infections (10%), and thrombotic events (8%). Mechanical complications included arterial puncture (6%) and catheter malposition (4%). Infectious complications were primarily catheter-related bloodstream infections (CRBSI), with a median duration of catheterization of 8 days. Thrombotic events, including deep vein thrombosis, were noted in 8% of cases. Patients with prolonged catheterization (>10 days) had a higher risk of infectious complications.

**Conclusion**: Central venous catheter insertion is associated with a variety of complications, with mechanical injury and infections being the most frequent. Proper technique, use of ultrasound guidance, and stringent aseptic measures are essential to minimize risks. Regular monitoring and early removal of the catheter reduce infectious complications.

**Keywords**: Central venous catheter, complications, mechanical injury, infections, thrombosis, surgical patients

## Introduction

Central venous catheter (CVC) insertion is a standard procedure in the management of surgical patients. It provides direct access to large veins for fluid resuscitation, medication delivery, parenteral nutrition, and hemodynamic monitoring. Despite its utility, CVC insertion is not without risk and is associated with various complications, which can lead to increased morbidity, prolonged hospitalization, and healthcare costs (1,2).

Complications associated with CVCs are generally classified into three types: mechanical, infectious, and thrombotic (3). Mechanical complications occur during insertion and include arterial puncture, hematoma, and catheter malposition. Infectious complications, such as catheter-related bloodstream infections (CRBSI), are significant concerns, especially in critically ill or immunocompromised patients (4). Thrombotic complications, including deep vein thrombosis (DVT), may also arise from prolonged catheter placement (5).

The use of ultrasound guidance has reduced some mechanical complications, but infections and thrombotic events remain substantial concerns (6). This study aims to assess the frequency, types, and risk factors associated with complications of CVC insertion in surgical patients, contributing valuable insights into improving patient safety and care.

## Aim and Objectives

**Aim**:
To determine the incidence and types of complications associated with central venous catheter insertion in surgical patients.

**Objectives**:

1. To assess the frequency of mechanical, infectious, and thrombotic complications related to CVC insertion.
2. To identify risk factors associated with these complications, such as site of insertion and duration of catheterization.

## Material and Methods

### Study Design and Setting

This was a prospective observational study conducted in the Department of Surgery at a tertiary care hospital.

### Sample Size

The study enrolled 100 patients who underwent central venous catheter insertion during surgery or in the perioperative period.

### Inclusion Criteria

- Adult patients (≥18 years) undergoing CVC insertion during surgical management.
- Patients consenting to participate in the study.

### Exclusion Criteria

- Patients with pre-existing bloodstream infections or deep vein thrombosis.
- Patients with coagulation disorders contraindicating catheter insertion.

### Data Collection

Demographic data (age, gender, comorbidities) were collected for each patient. Detailed information on the site of catheter insertion (internal jugular, subclavian, or femoral vein), duration of catheter use, and complications (mechanical, infectious, thrombotic) was recorded.

**Complications Monitored**:

1. **Mechanical**: Arterial puncture, hematoma, pneumothorax, catheter malposition.
2. **Infectious**: Catheter-related bloodstream infections (CRBSI), exit site infections.
3. **Thrombotic**: Deep vein thrombosis (DVT), catheter-associated thrombosis.

### Procedure

- Catheter insertions were performed by trained surgeons using standard aseptic techniques.
- Ultrasound guidance was used where available to minimize mechanical complications.
- Patients were monitored daily for signs of infection and thrombotic events.
- Catheters were removed promptly when no longer required.

### Follow-up

Patients were followed until catheter removal or discharge. Any complications were documented, along with interventions such as antibiotic treatment or anticoagulation therapy.

### Statistical Analysis

Data were analyzed using SPSS software. Descriptive statistics were used to report frequencies and percentages. Chi-square tests were used to identify associations between variables, and a p-value $<0.05$ was considered statistically significant.

## Results

### Demographic and Clinical Characteristics

| Parameter | Patients (n=100) |
|---|---|
| Age (Mean ± SD) | 48.6 ± 12.4 years |

| | |
|---|---|
| Gender (M) | 58:42 |
| Comorbidities (Hypertension, Diabetes) | 36% |

**Types of Catheter-Related Complications**

1. **Mechanical Complications** (12%):
   - Arterial puncture: 6%
   - Catheter malposition: 4%
   - Pneumothorax: 2%
2. **Infectious Complications** (10%):
   - Catheter-related bloodstream infections (CRBSI): 8%
   - Exit site infections: 2%
3. **Thrombotic Complications** (8%):
   - Deep vein thrombosis: 5%
   - Catheter-associated thrombosis: 3%

**Table 1: Comparison of Complications by Site of Catheter Insertion**

| Site | Mechanical (%) | Infectious (%) | Thrombotic (%) |
|---|---|---|---|
| Internal Jugular Vein | 8 | 4 | 2 |
| Subclavian Vein | 3 | 5 | 4 |
| Femoral Vein | 1 | 1 | 2 |

Mechanical complications were most frequently observed with internal jugular vein insertions, while infectious complications were higher with subclavian catheter placements. Thrombotic events were seen across all insertion sites, with a slightly higher incidence in subclavian and femoral sites.

**Impact of Catheter Duration on Infection Risk**

- **<7 days**: 2% infections
- **7–10 days**: 4% infections
- **>10 days**: 6% infections

Patients with catheters in place for more than 10 days had a significantly higher risk of developing infections ($p<0.05$).

**Discussion**

This study highlights the various complications associated with central venous catheter insertion in surgical patients. Mechanical complications such as arterial puncture and catheter malposition were common, particularly with internal jugular vein insertions. These findings are consistent with previous studies showing higher mechanical complication rates with internal jugular access (7).

Infectious complications remain a significant concern, especially with prolonged catheterization. Catheter-related bloodstream infections (CRBSI) accounted for 8% of cases, emphasizing the need for strict aseptic techniques and timely catheter removal (8). Subclavian access was associated with a higher rate of infections, possibly due to difficulty in maintaining site hygiene.

Thrombotic events, though less frequent, were clinically relevant, with some patients requiring anticoagulation. The use of ultrasound guidance during insertion helped reduce the incidence of mechanical complications (9).

**Conclusion**

Central venous catheter insertion is associated with multiple complications, with mechanical injuries and infections being the most frequent. Proper site selection, ultrasound guidance, and stringent infection control practices are essential to minimize risks. Regular monitoring and prompt removal of catheters are necessary to reduce infectious complications.

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