

Incidence of Complications after Central Venous Cannulation- A Prospective Observational Study

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Abstract:

Background and aim: The use of central venous catheters or central lines has developed into an essential element of medical practice in critical care, anaesthesia and emergency medicine as well as for long-term therapies such as chemotherapy or dialysis. As with all invasive procedures central venous cannulation also is associated with multiple complications. The aim of our study was to determine the incidence of complications after central venous catheter insertion in a rural tertiary care teaching hospital in south India

Methods: The study was a prospective observational study conducted in a rural tertiary care center, for a period of 6 months (August 1ST, 2014 to January 31ST, 2015). We collected data from 50 patients in whom landmark-based central venous cannulation using Seldinger technique was performed during this period. Complications were classified as immediate complications, which occurred at the time of central line insertion and delayed complications as that which occurred during the time the central line was insitu. The data was tabulated and analyzed using SPSS 16.0. Continuous data was expressed as mean± Standard Deviation. Categorical data was expressed as percentages.

Results: The mean age of the patients in the study sample was 55.65±19.92. 52% of patients were male. The average number of days for which the central line maintained was 12.22±10.387day. The immediate complications that occurred were arterial puncture(10%), bleeding (4%) and arrhythmia (16%). The main delayed complication of central venous cannulation was occlusion of the lumens of the catheter (22%). One patient had thrombosis of the vein. There was only one incidence of catheter tip infection.

Conclusion: This study shows that the commonest complications of central line insertion are arterial puncture and arrhythmia during insertion of the central venous catheter. We recommend the routine use of an ECG monitor and ultrasound guidance or pressure transducer during central venous cannulation to minimize the incidence of these complications

Keywords: Central Venous Cannulation, Arterial Puncture, Catheter Occlusion, Complications.

I. Introduction

The history of central venous cannulation starts in 1929 when Forssmann described the advance of a plastic tube to the heart by puncturing his own arm vein. At the beginning of the 1950s Aubaniac reported about the puncture of the subclavian vein. The Seldinger technique described in 1953 revolutionized the field of bedside procedures especially central venous cannulation(1). The use of central venous catheters or central lines has developed into an essential element of medical practice in critical care, anaesthesia and emergency medicine as well as for long-term therapies such as chemotherapy or dialysis.(2)

Three central veins are typically used for venous access: the internal jugular vein (IJ), subclavian vein, and femoral vein. The common complications of the procedure are arterial puncture leading to hematoma, pneumothorax, infection and thrombosis and the relative contraindications for central line insertion are coagulopathy and infection at the site of insertion. The benefits of a central line over peripheral access include greater longevity without infection, line security in situ, avoidance of phlebitis, larger lumens and multiple lumens for rapid administration of combinations of drugs, a route for nutritional support, fluid administration, and central venous pressure monitoring.

The aim of our study was to determine the incidence of complications after central venous catheter insertion in a rural tertiary care teaching hospital in south India.

II. Materials And Methods

The study was a prospective observational study conducted in a rural tertiary care centre, for a period of 6 months (August 1ST, 2014 to January 31ST, 2015). We collected data from 50 patients in whom landmark-based central venous cannulation using Seldinger technique was performed during this period.

Central venous catheterization in three different sites i.e internal Jugular Vein, Subclavian Vein and Femoral vein in were analyzed. We recorded baseline data for each patient, comorbidities of the patient, site

of central line and where the patient was admitted for further care. The indication for the insertion and removal of central line was noted. Complications were classified as immediate complications, which occurred at the time of central line insertion and delayed complications as that which occurred during the time the central line was insitu. A diagnosis of catheter related blood stream infection was made if patient had sepsis with positive culture reports of central line tip culture. The data was tabulated and analyzed using SPSS 16.0. Continuous data was expressed as mean± Standard Deviation. Categorical data was expressed as percentages.

III. Results

A total of 50 patients were enrolled in the study over a period of 6 months. The mean age of the patients in the study sample was 55.65±19.92. 52% of patients were male. Out of 50 patients, 30 central venous catheters (CVC) were inserted in ICU (60%) and 20 CVC were inserted in OT (40%). 45 patients were admitted in ICU (90%) and 5 were admitted in ward (10%) after insertion of CVC. 26% of these patients required mechanical ventilation. The average number of days for which the central line maintained was 12.22±10.387day

Table 1 : Site Of Central Line

Site	Frequency	Percent
LFemoral	3	6.0
LInternal Jugular Vein	3	6.0
L Subclavian Vein	1	2.0
RFemoral	4	8.0
RInternal Jugular Vein	10	20.0
R Subclavian Vein	29	58.0
Total	50	100.0

Table 2: Indication For Insertion Of Central Line

Indication	Frequency	Percent
CVP	2	4.0
FLUID THERAPY	31	62.0
TPN	5	10.0
VASOPRESSORS	12	24.0
Total	50	100.0

Of the 50 patients, maximum number (62%)of central lines were inserted for intravenous administration of fluids and drugs especially intraoperatively. Two catheters were inserted for Central Venous Pressure (CVP) measurement (4%), 5 catheters were inserted for giving Total Parenteral Nutrition (TPN) (10%) and 12 central venous catheters were inserted for giving vasopressor(24%) therapy.

Table 3: Immediate Complications

COMPLICATION	PERCENTAGE
Arterial Puncture	10%
Bleeding	4%
Hematoma	10%
Arrhythmia	16 %
Pneumothorax	2%

Table 4: Delayed Complications

DELAYED COMPLICATION	PERCENTAGE
Infection	2%
Thrombosis	2%
Occlusion	22%

The immediate complications that occurred were arterial puncture and bleeding. Though arterial puncture occurred in 5 patients there was persistent bleeding only in 1 patient. There was persistent hematoma after central line insertion in 5 patients. Cardiac dysrhythmia occurred in 8 patients(16%) which settled after withdrawing the guide wire except in one patient.Pneumothorax was detected in one patient in post procedure chest x-ray .

The main delayed complication of central venous cannulationwas occlusion of the lumens of the catheter (22%). One patient had thrombosis of the vein. There was only one incidence of catheter tip infection.

Table 5: Indications For Removal Of Central Line

Indication	Frequency	Percent
DEATH	5	10.0
HEMATOMA	1	2.0
OCCLUSION	11	22.0
STOPPED I.V	27	54.0
FEVER	5	10.0
THROMBOSIS	1	2.0
Total	50	100.0

The central Venous Line was removed once there was no requirement of large volume fluids and noxious intravenous agents (62%). Other reasons for removal were occlusion of central line lumens, new onset fever and death of patient. Two central lines were removed due to hematoma formation and thrombosis in the vein.

IV. Discussion

Central venous lines are being widely used in modern medicine in all specialties especially emergency medicine, critical care and anaesthesiology. Despite their widespread use, central lines are associated with high rates of complications like hemorrhage, pneumothorax, infection and thrombosis. These complications can increase mortality rates and cost of hospital stay. Recent attention has been focused primarily on reduction of infectious complications of central venous catheters but mechanical complications of central venous cannulation remain a significant cause of morbidity and mortality.(3)

Out of 50 patients, 30 CVC were inserted in ICU (60%) and 20 CVC were inserted in OT (40%) but most of the patients with central lines in situ were managed in ICUs where more nursing care is available. Only 10% of patients were admitted in ward. In our study the central vein most commonly used for cannulation was right subclavian vein. This might be because most of the patients were neurosurgery patients. In neurosurgical patients preferred route of central line cannulation is via right subclavian vein because of ease of insertion, low complication rate and it does not affect cerebral perfusion.(4) Other sites of insertion were internal jugular vein and femoral vein.

During insertion of the central line the complications that occurred were arterial puncture and bleeding. Observing the color and pulsatility of the blood coming from the needle hub is the traditional way of identifying an arterial puncture. However multiple studies have shown that this method can be unreliable(5),(6). Dynamic ultrasound can guide needle placement into the vein and confirm the presence of guide wire in the vein. A study by Troianos et al found a higher success rate with a single attempt with lesser rate of arterial puncture using ultrasound guidance compared to traditional landmark method of central venous catheterization. (7). Another method of avoiding arterial cannulation is pressure measurement using a transducer through the introducer needle. (5,6). Ultrasound guidance and pressure measurement are complementary and can be used simultaneously to prevent arterial puncture and cannulation.

Cardiac arrhythmias due to guide wire touching the myocardium was common. (16%). But usually the arrhythmia settled on withdrawing the guide wire. The incidence of arrhythmias reported in other studies is around 40-50%(8)(9). The lower incidence in our study could be due to insertion of central lines with ECG monitoring and our sample includes femoral lines also. One patient with sepsis had persistent arrhythmia, which could be due to the inotropes she was on and her underlying cardiac dysfunction. Pneumothorax was detected in one patient by chest Xray after Left subclavian vein cannulation.

We did not have any incidence of hemothorax or misplaced guide wire during insertion. Catheter malposition was not assessed in our study.

Catheter occlusion was the main complication of the CVC (22%) in our study. The incidence of this complication was similar to previous studies which reported an incidence of 14-36%.(10). This was an indication for removal of central line in our institution. Thrombolytic therapy with alteplase has been shown to clear thrombotic causes of catheter occlusion and can be tried in these situations.(10). But the total number of patients in these trials were small and further studies are required to prove without doubt the benefit of thrombolytic therapy for prevention and treatment of catheter occlusion.

Only one patient in our study had culture positivity of central line tip culture. Factors like parenteral nutrition, blood transfusion, increasing days of central line insertion and femoral access have been shown to increase incidence of central line associated blood stream infections(11). But multivariate logistic regression of total duration of central line, TPN, patient co morbidities and site of central line insertion did not show any significant association to the incidence of infection in our study. The reason could be the small sample size and early removal of central line in patients with any signs of infection

V. Conclusion

This study shows that the commonest complications of central line insertion are arterial puncture and arrhythmia during insertion of the central venous catheter. We recommend the routine use of an ECG monitor and ultrasound guidance or pressure transducer during central venous cannulation to minimize the incidence of these complications. Central line occlusion was the most frequent delayed complication. The efficacy of thrombolytic therapy is yet to be proven for prevention and treatment of catheter occlusion.

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