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Original Research Article

Retrospective analysis of incidence of complications of central venous catheterization at an intensive care unit

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Abstract

Objectives: To compare mechanical, infectious, and thrombotic complications of internal jugular; subclavian and femoral venous catheterization at an post surgical and medical intensive care units

Methods: It is a retrospective study in which the data from the medical records was evaluated and analyzed. Data, such as sex, date of insertion and removal, failure to place, malposition, complications and site of central venous catheterization were recorded. Landmark-based central venous catheterization using seldinger technique was performed under all aseptic precautions in 597 patients in postsurgical and medicine intensive care units. Central venous catheterization by three different routes i.e. IJV, SV and femoral vein were performed in critically ill patients.

Results: Incidence of mechanical, infectious, and thromboembolic complications of central venous catheterization was 8.71%, 7.37 %, and 2.68% respectively. Incidences of different mechanical complications are as follows, arterial puncture4.18%, hematoma 3.18%, pneumothorax 1 %, haemothorax 0.33% .Incidence of central venous catheter with failure to place at various sites were 11.72 %. Incidences of central venous catheter with malposition at various sites were 6.36%.

Conclusion: We found that complication rates of CVC insertion at our hospital are similar to those reported previously. Based on our experience, internal jugular venous access is associated with a low rate of mechanical complications like arterial punctures, hematoma, pneumothorax, thrombosis. Incidence with infection was least with subclavian cannulation.

Keywords: central venous catheter (CVC), complications

1.Introduction

Central venous catheters (CVC) are widely used in critically ill patients throughout the world. They permit hemodynamic monitoring and allow reliable access for the administration of fluids, blood products, medications and total parenteral nutrition (TPN)[1,2]. First venous catheterization was subclavian vein; it was first described in 1952 by Aubaniac. It was popularized in the United States by Wilson and his associates in 1962 as a method of monitoring central venous pressure [3,4]. These percutaneous techniques left the operating physician exclusively reliant upon the relationships between surface anatomic landmarks and the underlying deep anatomic structures [5]. Despite their utility, placement of central venous catheters is often associated with mechanical, infectious and thromboembolic complications [6]. CVC -related thrombosis and infections are frequently occurring complications [7-11]. The purpose of the study was to compare the incidence of mechanical, infectious, and thrombotic complications of internal jugular; subclavian and femoral venous catheterization at post surgical and medical intensive care unit.

2. Materials and Methods

2.1 Study design

This study was designed as a retrospective observational study.

2.2 Study area

This study was carried in Jawaharlal Nehru medical college (JNMC), Sawangi (Meghe), Wardha,

Maharashtra which is NAAC A accredited a tertiary care level hospital and teaching institute.

2.3 Study period

The study was conducted during July 2013 to June 2014.

2.4 Study size

Landmark-based central venous catheterization using seldinger technique was performed under all aseptic precautions in 597 patients in postsurgical and medicine intensive care unit.

2.5 Exclusion criteria

central venous catheterization in bleeding disorder, on anticoagulation therapy, with distorted anatomy, burns at insertion site, severe dermatitis at insertion site, performed in operation theater, casualty and by inexperienced residents were excluded from study.

2.6 Statistical analysis

Data was recorded using a predesigned semi structured proforma and entered into Microsoft Excel worksheet. Appropriate tests were applied for analysis.

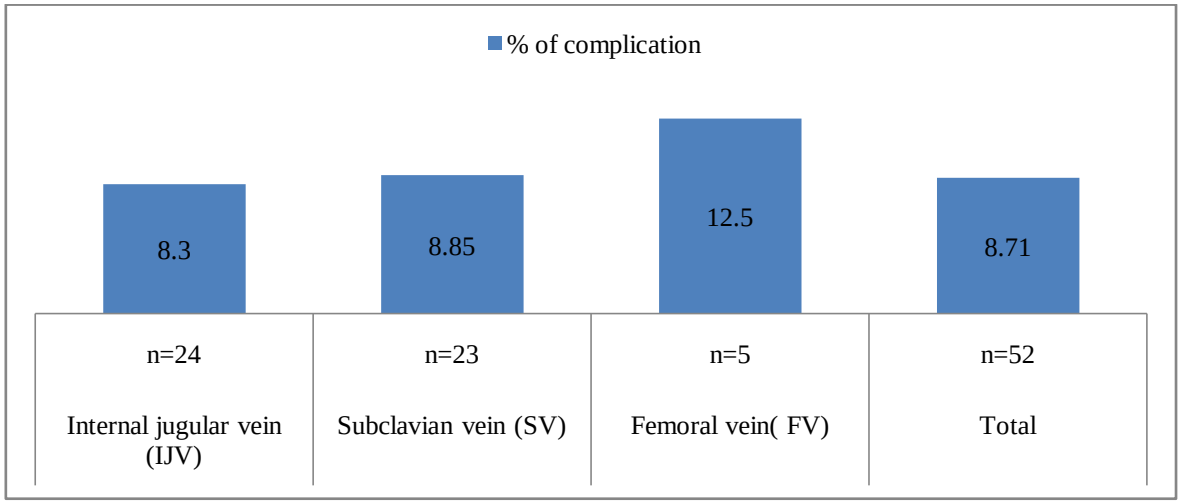
During cannulation if red bright colored blood gushed into the syringe, arterial puncture was suspected. If patient developed unexplained tachypnea and/or tachycardia during cannulation, procedure was abandoned and chest radiograph was taken to check for pneumothorax and air embolism. If patient had symptoms of catheter related blood stream infection (CRBSI) and/or local infection, blood culture/ site swab was sent for culture and sensitivity. Catheter-associated infections were defined as follows: 1) Exit site infection – erythema, tenderness, induration, purulent discharge and growth on culture. (2) Catheter tip colonization – growth on culture of the distal segment of the CVC with clinical signs of infection. (3)CRBSI –isolation of the same organism from the catheter tip culture and from at least one of the two blood cultures, along with signs and symptoms of infection [12].

3. Results and discussion

Out of 597 Central venous catheterization, 289 (48.4%) patients were catheterized by internal jugular approach, 268(44.89%) patients by subclavian approach, and 40(6.70%) patients by femoral approach Of the 597 catheterization, 218 were females (36.51%) and 379 males (63.48%).

Mechanical complication:-This retrospective study found that incidence of mechanical complications of central venous catheterization was 8.71%. Incidence of mechanical complication in internal jugular, subclavian and femoral venous cannulation were 8.30%, 8.85% and 12.5 % respectively The incidence of mechanical complication has been studied and our results are consistent with other studies. David *et al*[12] reported mechanical complications were occurred in between 5 to 19 % of patient. This study also found that internal jugular and subclavian venous catheterization carry similar risks of mechanical complications. Kusminsky *et al*[13] reported that complication associate with central venous catheterization varies between 5 to 19%.

Figure 1: Incidence of mechanical complications in internal jugular, subclavian and femoral venous catheterization.



In this study, incidences of different mechanical complications are as follows, arterial puncture 4.18% (25/597), hematoma 3.18% (19/597), pneumothorax 1.0% (6/597), haemothorax 0.33% (2/597). These findings were consistent with other studies.

In present study, total number of CVC associate with arterial puncture were 4.18%.Out of this, 4.84% (14/289) arterial puncture occurred in

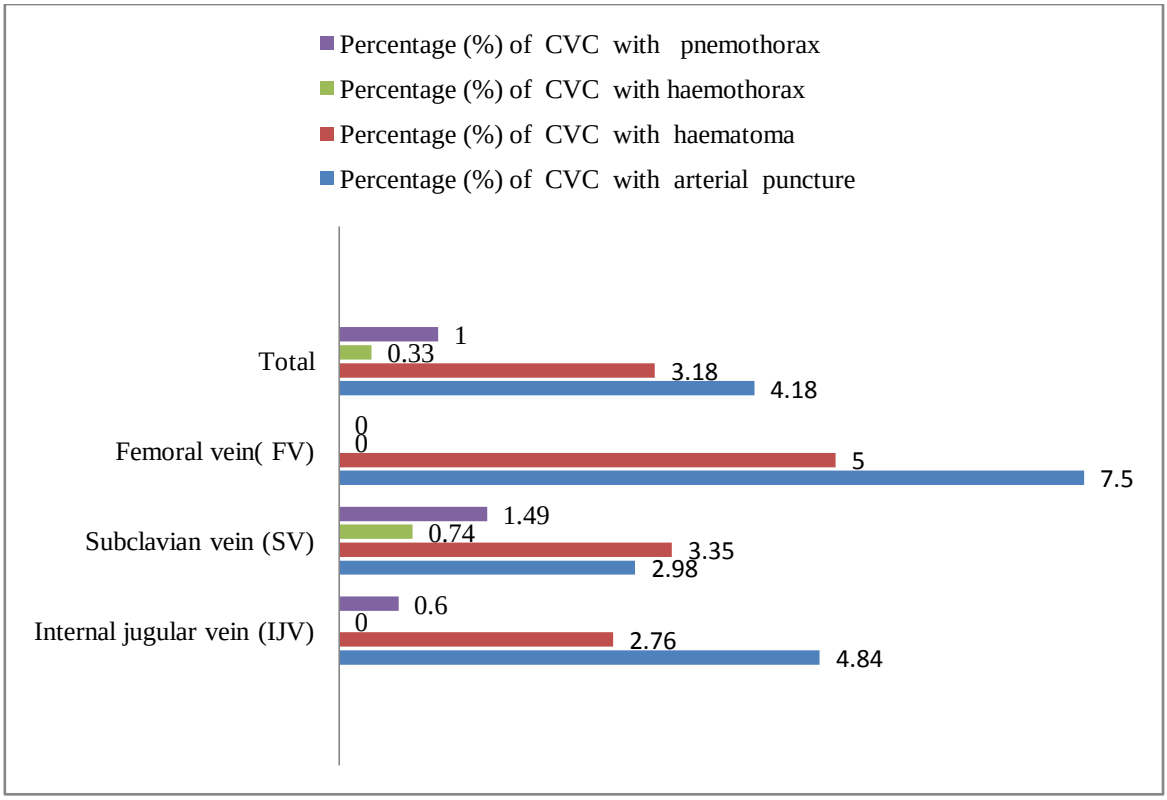
internal jugular venous catheterization, 2.98% (8/268) in subclavian catheterization and 7.5% (3/40) in femoral venous catheterization. Graham *et al*[14] found that incidence of arterial puncture during internal jugular, subclavian, and femoral venous catheterizations were 3%, 0.5%, and 6.25 % respectively. Our study and this study show that incidence of arterial puncture is more with internal jugular cannulation than subclavian cannulation. Risk of arterial puncture was highest with femoral cannulation.

Total numbers of CVC associate with hematoma were 3.18 %(19/597). Out of this, 2.76 % (8/289) hematoma occurred in internal jugular venous catheterization, 3.35% (9/268) in subclavian catheterization and 5% (2/40) in femoral venous catheterization. David *et al* [12] reported incidence of hematoma during internal jugular, subclavian and femoral venous cannulation were 0.1–2.2 %, 1.2–2.1%, and 3.8–4.4 % respectively.

Total numbers of CVC associate with haemothorax were 0.33% (2/597). Out of this, all 0.74% (2/268) occurred in subclavian venous catheterization. Haemothorax was not found during internal jugular and femoral venous catheterization. Graham *et al*[14] found that incidence of haemothorax during internal subclavian catheterization was 0.4-0.6%.

Total numbers of CVC associate with pneumothorax were 1.00% (6/597). Out of this, 0.60 % (2/289) pneumothorax occurred in internal jugular catheterization and 1.49% (4/268) in subclavian venous catheterization. Femoral venous catheterization was not associated with pneumothorax. Graham *et al*[14] found that incidence of pneumothorax during internal jugular, subclavian catheterization were 0.1-0.2 %, and 1-3.1 % respectively. Our result is consistent with study with maximum risk of pneumothorax with subclavian venous cannulation.

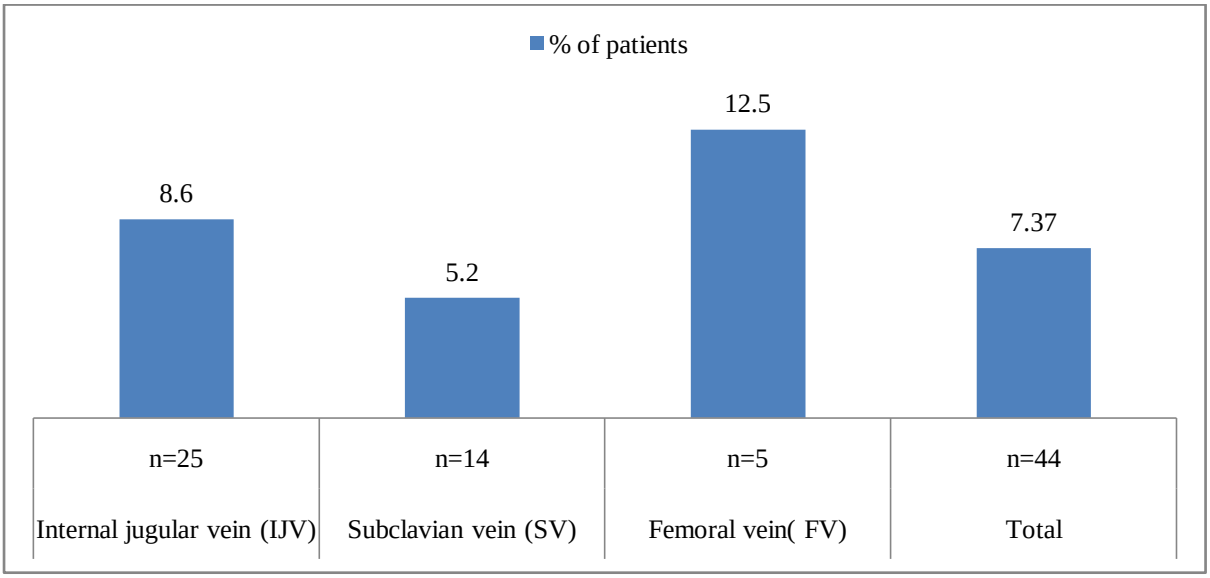
Figure2: Incidence of different mechanical complications in internal jugular, subclavian and femoral venous catheterization



3.1 Infectious complications

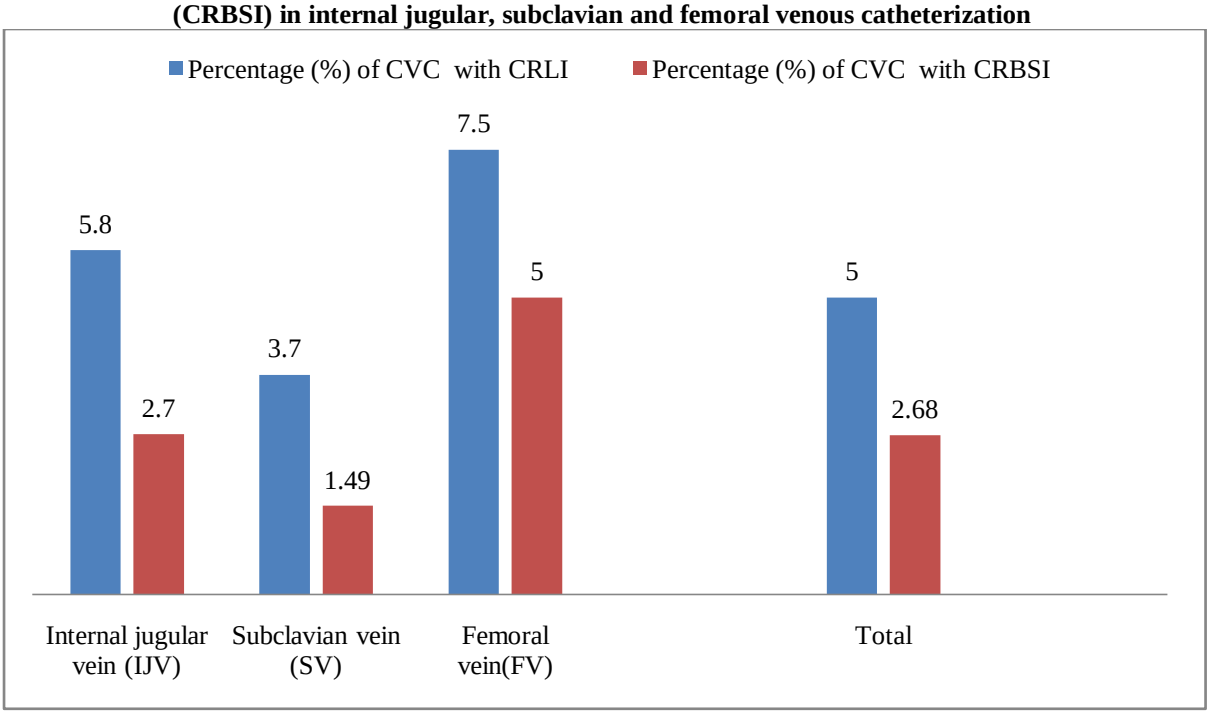
In this study, 7.37 % (44/597) cases of CVC-related infectious complications were documented; 8.60% (25/289) cases in internal jugular catheterization, 5.2% (14/268) in subclavian cannulation and 12.50 % (5/40) cases in femoral venous catheterization. This study indicates that infectious complications were common with femoral venous cannulation and least with subclavian catheterization. Thus our results are consistent with other studies. David *et al*[12] reported infectious complications were occurred in between 5 to 26 % of patient. Graham *et al* [14] reported infectious complications (rate per 1000 catheter-days) were 8.6%, 4 %, 15.3%, in internal jugular, subclavian and femoral venous cannulation respectively. Sibylle *et al*[15] found that the incidence of bloodstream infection was 8.6% with the jugular access and 4.0% with the subclavian access.

Figure 3: Incidence of infectious complication in internal jugular, subclavian and femoral venous catheterization



Total numbers of patients with catheter related local infection (CRLI) was 5% (30/597) and with catheter related blood stream infection (CRBSI) was 2.68% (914/597). Leonardo *et al* [16] reported that the percentage of CVCs that developed CRLI was 4.43% and CRBSI was 2.04%.

Figure 4: Incidence of catheter related local infection (CRLI) and catheter related blood stream infection (CRBSI) in internal jugular, subclavian and femoral venous catheterization

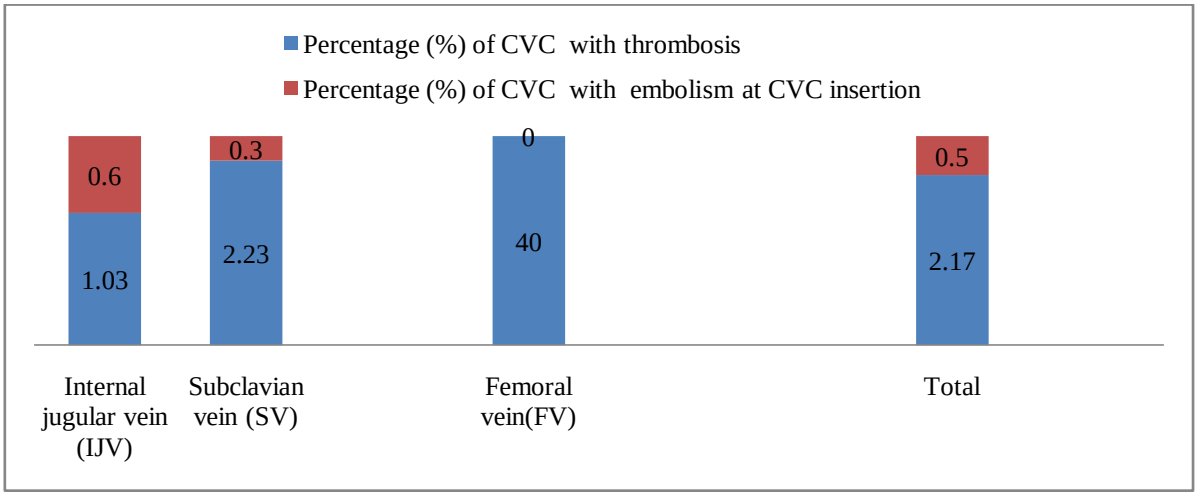


3.2 Throboembolic complications

Total number of CVC associate with thrombosis was 2.17% (13/597). There was occurrence of 1.03 %(3/289) thrombosis in internal jugular vein, 2.23% (6/268) in subclavian vein and 10% (4/40) in femoral vein cannulation. Jacques *et al*[17] reported that catheter-related thromboses were detected in 21.5% patients who received a femoral catheter and in 1.9% patient who received a subclavian catheter.

Total number of CVC associate with embolism were 0.5 %(3/597), there was occurrence of 0.6 %(2/289) embolism in internal jugular veins and 0.3 % (1/268) in subclavian veins cannulation. No embolism was found during femoral cannulation. Yildizeli *et al*[18] reported that incidence of embolism with central venous cannulation was 0.4% of patients.

Figure 6: Incidence of throboembolic complications in internal jugular, subclavian and femoral venous catheterization



3.3 Catheter Malposition

In our study , it was observed that total number of central venous catheter (CVC) with malposition at various sites were 6.36% (36/597).Out of this, 4.84% (14/289) malposition in internal jugular vein (IJV) and 8.95% (24/268) in subclavian vein (SV) cannulation. No Malposition was found in femoral venous (FV) cannulation. Masoud *et al*[19] reported that the incidence of the catheter tip malposition on both sides was 5.7%.

3.4 Failure to place CVC

Total numbers of central venous catheter (CVC) with failure to place at various sites were 11.72 % (70/597). Out of this, 11.41% (33/289) internal jugular vein (IJV), 13.43% (36/268) subclavian vein (SV) and 2.5% (1/40) femoral vein (FV) catheters were fails to place. Lewis *et al*[7] found that the most common complication was failure to place, occurring in 22% of all attempts by intern, residents, fellows and attending. He also found that Subclavian, internal jugular and femoral catheterization attempts were unsuccessful 26%, 25%, and 15% respectively. He also observed that incidence of failure to place CVC by only fellow and attending was 10%. This finding was consistent with our study.

4. Conclusions

Central venous lines, although effective in establishing vascular access, were time-consuming to insert and are associated with high complication rates, with accompanying patient morbidity and mortality .We found that complication rates of CVC insertion at our hospital are similar to those reported previously. Based on our experience, internal jugular venous access is associated with a low rate of mechanical complications like arterial punctures, hematoma, pneumothorax, thrombosis. Incidence with infection was least with subclavian cannulation. Ultrasonography guided CVC are best performed to prevent mechanical complications and improve patient safety.

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