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Mechanical Complications Associated With Central Venous Catheterization

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Abstract
Introduction - Central venous catheterization (CVC) is a blind procedure and none of the different approaches are completely free of complications. Skilled hand and good knowledge of the procedure can minimize the complications.
Objective - To study the mechanical complication associated with central venous catheterization with special reference to the experience of the operator.
Type of study – Case study.
Material and method- This study was conducted in tertiary teaching hospital from July 2011 to September 2013. A total no of 80 patients who required central venous catheterization in medicine intensive care unit (ICU) were studied.
Results – Sex distribution - 62.5% were male and 37.5% were female. Internal jugular vein catheterization was most commonly done in 86.25% patients. Mechanical complication was observed in 65 patients (81.25%) with arterial puncture in 31 patients (38.75%), hematoma in 5patients (6.25%), catheter block occurred in 25 patients (31.25%) and catheter pull occurred in 4 patients (5%).There were no episodes of pneumothorax or hemothorax.
Conclusion- Arterial puncture was the most common mechanical complication associated with CVC. The complication rate has an inverse relation with the experience of the operator. Use of heparin prevents catheter block.

Keywords: Central venous catheterization, Mechanical, Complications

1. Introduction
CVC are an integral part of patient care in the ICU. For many years CVC have been used for various purposes including access for total parental nutrition, central venous pressure monitoring, volume resuscitation, hemodialysis and medication that are not tolerated peripherally. Percutaneous techniques has revolutionized vascular cannulation. They essentially eliminated the need for open cut down procedures and the associated wound related morbidity. Working knowledge of surface, deep anatomy, site, assessment of which technique to use minimizes the complications. CVC carries a significant risk of procedural and operator related complications. Use of CVC are associated with adverse events that are hazardous to the patients [8] A study by Merre *et al.* [9] found 5-19% complications due to mechanical complications. CVC has a relationship between inexperience operator and the rate of complications. Multiple attempts for catheterization can increase the incidence of complications. Skilled hand and good knowledge of the procedure can minimize the complications. The common mechanical complications are arterial puncture, bleeding, pneumothorax and hematoma.

2. Materials and method
This prospective study was conducted in tertiary care teaching hospital, from July 2011 to September 2013. A total no of 80 patients who required central venous catheterization admitted in medicine ICU were studied.

2.1 Inclusion criteria - CVC done for monitoring of central venous pressure in patients to quantify fluid balance, dialysis in patients with renal failure, intravenous therapy when peripheral venous access is impossible and continuous infusion pump.

2.2 Exclusion criteria - Patient who is discharged or transferred to other center with the central venous line, patient who is admitted to the hospital with existing central venous line done in previous hospital and patient coming for dialysis as out - patient case.

All cannulation were performed by the medicine resident in ICU. The choice of type of procedure and site for central venous catheterization was left on the performing doctor. Detailed clinical history, physical examination, pre existing infection and the details regarding catheterization were recorded in the proforma. Attention to aspectic precaution was maintained during the procedure of central venous catheterization. A pre sterilized polyurethane insertion set was used for cannulation. The catheter was fixed to the skin with the help of 2 – 4 sutures. Post procedure chest X ray was taken. An non occlusive dressing with sterile gauze and adhesive strips were used for all patients. Topical antibiotics cream or powder was not used for any patients. Systemic antibiotics were administered as prophylatically and where it was indicated with pre-existing source of infection. Catheters were not changed periodically.

2.3 Definition

1. Experience group - Experience group includes those operators who had performed CVC more than 25 times.
2. Inexperience group - Inexperience group includes those operators who had performed CVC less than 25 times.
3. Catheter idle - A central venous catheter was considered to be idle if it was not put in any therapeutic use for 12 -24 hours or if it is being used only for therapy which could be given by some other route with the same effect.
4. Heparin flush - Heparin flush is considered when the central venous catheter is flushed at least once daily with normal saline containing heparin.

3. Results

All data collected in the proforma were tabulated and analysed. A total no of 80 patients had undergone CVC out of which 50 patients (62.5%) were male and 30 patients (37.5%) were female. Internal jugular vein catheterization was most commonly done in 69 patients (86.25%), out of which right side catheterization was done in 51 patients and left side catheterization was done in 18 patients.

As shown in table I, mechanical complication was observed in 65 patients (81.25%). Arterial puncture was the most common complication observed in 31 patients (38.75%). Catheter block occurred in 25 patients (31.25%). 5patients (6.25%) developed hematoma. Catheter pull occurred in 4 patients (5%). There were no episodes of pneumothorax or hemothorax.

Table I: (Original) Type of mechanical complications

Type Of Complication	Number	Percentage %
Arterial Puncture	31	38.75
Hematoma	5	6.25
Catheter Block	25	31.25
Catheter Pull	4	5
Total	65	81.25

Type of mechanical complication and their percentage

As shown in table II, arterial puncture and local hematoma in inexperienced group was observed in 23 (28.75%) and 4 (5%) respectively. Whereas, arterial puncture and local hematoma in experienced group was 8 (10%) and 1(1.25%).Total complication in experience group was 11.25% and inexperience group was 31.25%. Local hematoma, which was observed during procedure resolved without any long term scale.

Table II: (Original) Type of operator responsible for complication

Type Of Operator	Experienced	Inexperienced
Arterial Puncture	8	21
Hematoma	1	4
Total	9	25
Percentage %	11.25%	31.25%

Percentage of complication high with inexperienced operator

As shown in table no III, central venous catheter block was observed in 25 cases (31.25%), out of which 9 cases (11.25%) were due to catheter being idle, 11 cases due to no use of heparin flush and 5 cases due to both catheter being idle and no use of heparin flush.

Table III: (Original) Type of block used

Type Of Block	Number	Percentage %
Cather Idle	9	11.25
No Heparin Flush	11	13.75
Both	5	6.25
Total	25	31.25

Type of block used after CVC

4. Discussion

This study was conducted to understand the mechanical complications associated with CVC. The result of this study, indicate that arterial puncture was the most common mechanical complication associated with CVC, which was observed in observed in 31 patients (38.75%). According to the literature arterial puncture was observed in 28 cases [36] and arterial puncture in 15 cases (3%). [152] As compared to the other studies, in our study, we have found more number of arterial puncture which was observed in 31 patients (38.75%).

In this study, we have found that the mechanical complications with CVC were more in the inexperience group which is similar to the other studies in the literature. In the experience group arterial puncture and hematoma was observed in 23 patients (28.75%) and in 4 patients (5%) respectively. in 12.5% which is similar to other studies. Herbst CA *et al.* [51] found that physicians inexperience was an important cause for complications. A study by Lennon M *et al.* [152] they have found operators with <25 previous insertions caused significantly more complications (25.2% *vs.* 13.6%; P=0.04), they required the help of a second operator more frequently and had more failed attempts (5.2% *vs.* 1.8%; P=0.02) as compared to operators with > 25 previous insertions. In a study by Sitzmann JV *et al.* [153] have found both arterial puncture and local hematoma in experience group who performed more than 25 catheterization to be 3 (2.9%). As compared to the other studies, in our study we have found more number of arterial puncture which was observed in 31 patients (38.75%).

Use of heparin flush to fill the lumens of central venous catheters locked between use, in an attempt to prolong the duration of catheter patency and to prevent thrombus formation.

In our study, heparin flush was use in .... out of which ... catheter idle was observed in 11 +5 cases due to no use of heparin flush. A study by Mitchell MD *et al.* [103] found that heparin flushing reduces occlusion of catheters. In a study by Hanson RL *et al.* [102] recommends heparin-saline solution following each intravenous injection of medication or every eight hours, if medications are not given more frequently. Bowers L *et al.* [105] out 102 patients, 50 subjects were assigned

to normal saline in which 3 cases (6%) experienced occlusions. There were no occlusions in the other 52 subjects assigned to the heparinised saline group. As per the above mentioned studies, the use of heparin flush prevented the formation of catheter block. These finding match our observations.

5. Conclusion – CVC carries a significant risk of procedural and operator related complications. Arterial puncture was the most common mechanical complication associated with CVC. The complication rate has an inverse relation with the experience of the operator. Use of heparin prevents catheter block.

6. References

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