

Assessment of Peripheral Venous Cannulation associated complications in an inpatient cohort where omission of aseptic insertion techniques occurred

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ABSTRACT

Objective: To assess the frequency of complications associated with peripheral venous cannulation in admitted patients and to check for any association between days left in situ and frequency of complications.

Study Design: Prospective Observational Study

Place and Duration: The study was conducted at Khyber Teaching Hospital Peshawar from 1st January 2018 to 31st July 2018.

Methodology: All peripherally placed Intravenous lines were monitored from the time of insertion of the cannulas up to 48 hours after removal for development of complications like Phlebitis, Cellulitis and Abscess formation along with recording of all the hygienic and antiseptic measures used by the health care provider.

Results: The most common peripheral venous cannulation associated complication was phlebitis at the rate of 40.8% on the dorsum of the right hand and dorsum of left hand which were the most frequent sites for insertion 23.3%. Aseptic measures were used in less than 1% of patients (2/279), while gloves were used in 9.3% of patients by the health care worker inserting the cannula (26/279). A significant association was found between Increased duration of cannulation and the development of complications ($p < 0.05$).

Conclusion: The frequency of PVCs associated complications are much higher in present study. It has shown that complications were higher in those when aseptic measures are not taken. Similarly, complications increase with increase in number of days.

Keywords: Peripheral venous cannula, Peripheral venous cannula associated adverse events, Health care providers, Complications, Intravenous, Aseptic measures

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INTRODUCTION

Peripheral Venous Cannulas (PVCs) are commonly used in in

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patients for the purposes of intravenous (IV) treatments, including medications, blood products and other agents. Published data on IV route for treatment is dates back to 1880, when it was used in cholera epidemics. The use of the IV route for the administration of normal saline (NS) began in the early 1900s. With the discovery of blood groups after the Second World War, the use of the IV route gained more traction. The IV route becomes wide spread and popular therapeutic option with discovery of plastic container and bags and modern infectious control practice. IV route is a lifesaving maneuver in emergency conditions, like major trauma, sepsis; acute blood loss and intractable pain¹.

Millions of PVCs are inserted each day. HCP like most of the nurses and paramedics are involved in insertion of IV lines and some are carried out by specialty team. The nurses are looking after the patients are responsible for the care of PVC. It has been found that every patient admitted in hospital have a PVC². Health care providers like nurses and doctors are responsible for insertion of cannula, taking care of, maintaining it and preventing its complications. It is estimated that 30–80% of hospitalized patients receive at least one PVC during their hospital stay and every third patient admitted in a hospital have a peripheral venous cannula^{1,3}.

In France, it is estimated that 25 million of peripheral cannulas are inserted annually and almost 20% of admitted patients have

these lines^{4,5}. In the United States about 200 million catheters are used per year. Fifty percent of the hospitalized patients in Spain has an intravenous cannula, 95% constitute distal lines. Greater than 70% of hospitalized patients need distal intravenous cannula⁶. Some few studies show the use of peripheral venous catheters in 86.4% and 80.6% of the patients^{4,7}. Those areas are selected for cannula, where the veins are straight and superficial like Cephalic, basilica vessels of the distal arms, dorsal venous arch located on the dorsal surface of the hands⁸. The superficial placed veins of the distal part of the lower limb can be also used for insertion of cannulas, but they are associated with higher risk of infections and embolism and need to be avoided. Bony prominences and joint should be avoided in performing cannulations.

In Peripheral venous cannulations there should be no more than two unsuccessful attempts by the same practitioner on same patient at the same time. The use of patient dominant arm should be avoided for inserting a cannula if possible. In order to prevent complications before insertion of cannula proper antiseptic measures like cleaning the site with alcohol swab and wearing disposable gloves should be practiced⁵.

The complications associated with peripheral venous cannulation are phlebitis, cellulites, abscess, leakage and accidental displacement or dislodgment contributing to increased patient hospital stay, financial cost, and patient pain and stress and additional morbidity^{7,8}. Phlebitis is the inflammation of the veins; it is characterized by localized swelling redness, swelling, warmth and which can extend further along the vein. Studies show that the rate of phlebitis incidence varies greatly from 2% to 80%, based on the definitions used⁹. The smallest and shortest gauge cannula should be used for insertion⁵. If signs and symptoms indicate phlebitis, or if the PVC is not working, it must be removed immediately; it can be reinserted if there is a clinically needed for PVC¹⁰. Studies show that clinical indication should be the only reason for the removal of PVCs⁶. However, some guidelines states that removal may be reviewed if the PVC has been placed for more than 72 hours or 72-96 hours as the chances of complications is directly proportional to the time^{11,12}. In emergency conditions the PVC may be replaced within 1st 24 hours⁵.

This study will identify all major PVCAE and to reduce these complications to improve patient outcome, effort should be made through providing education training, clinical vigilance involving all the stake holder HCPs and families. So, this study was conducted with an objective To assess the frequency of complications associated with peripheral venous cannulation in admitted patients and to check for any association between days left in situ and frequency of complications.

METHODOLOGY

This was an observational prospective study conducted in Khyber Teaching Hospital Peshawar from 1st January 2018 to 31st July 2018. The sample size was calculated by using WHO calculator. Simple random sampling was done according to inclusion and exclusion criteria. All patients admitted in Medical and Surgical Units of both genders having PVC with age greater

than 15 years and having I/V line for more than 48 hours were included in the study. While all patients below 15 years of age had cannula insertion time less than 48 hours were excluded from study. Approval from ethical committee was sought.

Data was collected on standardized questionnaires which were filled out on the basis of information gathered from discussions with patients, paramedical staff involved in care of these patients and by inspecting the cannula insertion sites. Bio data of the patients including date of coming to hospital emergency or ward and date of sending them home, age, sex of the patient, dermatological conditions, co morbidities, duration of cannula, insertion site, last PVC during the current in patient stay were recorded.

PVC parameters consist of dates of insertion and removal, antiseptic measures like using alcohol swab and using gloves, PVC gauge, PVC monitoring data and reasons for cannula withdrawal. The PVC was monitored daily for signs and symptoms like swelling, erythema/change in temperature, site sensitivity/pain, edema, and consistency of vessel by palpation, any purulent/clear discharge/leakage, clearer skin, and hematoma till 48hrs after removal. The complications were classified into Phlebitis, Cellulites and Abscess. Phlebitis was defined as inflammation of a vessel wall resulted from the placement of the PVC assessed on the basis of Ray Maddox phlebitis grading scale^{13, 14}. Cellulitis means skin and subcutaneous tissue bacterial or fungal or viral infection, the symptoms include redness, discomfort and tenderness. An abscess was defined as accumulation of pus within skin or subcutaneous tissue. It presents as a painful/discomfort, fluctuant, erythematous lump or bump, with or without cellulitis in the vicinity¹⁴.

RESULTS

The sample consisted of 279 patients of which female were 51.3% (n=143) while male were 48.7% (n=136) (Figure-1). The mean age for the study population was 52.3 with a Standard Deviation of 18.9. About 77.1 % patients had comorbidities including diabetes, HTN, Hepatitis and Thalassemia while 22.9% patients had co morbidities. Most common complication of PVC noted was phlebitis 40.8% and cellulites were noted in 12 % patients, 18% reported with obstruction and swelling while other 29.2 had no complications (Figure-2). There was no major difference identified between two sexes in the incidence rate of phlebitis.

The most common site for insertion of PVC was Right Hand Dorsum and Left Hand Dorsum with percentage of 23.3% each shown in Figure-3. Majority of insertions were carried out with a 20-gauge catheter (94.6%). Most of insertions were performed at first attempt (96.1%). Fifty three point eight percent of patients had catheter permanence of 3 days (minimum, 1 day; maximum, 7 days), while 12.6% of people had catheter permanence of greater than 3 days shown in figure 4. The mean permanence duration of cannula was 2.75 with standard deviation of 0.941.

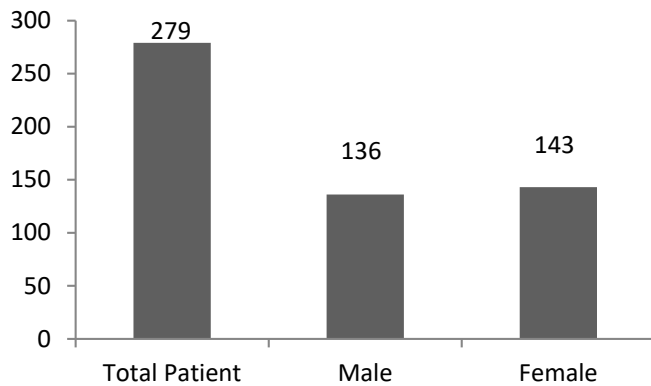


Figure-1: Gender distribution (N=279)

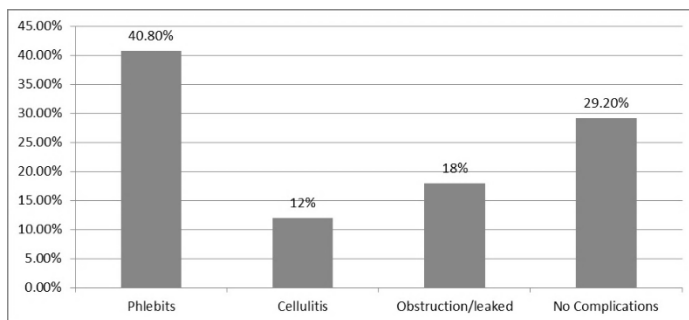


Figure-2: Frequency of PVC complications (N=279)

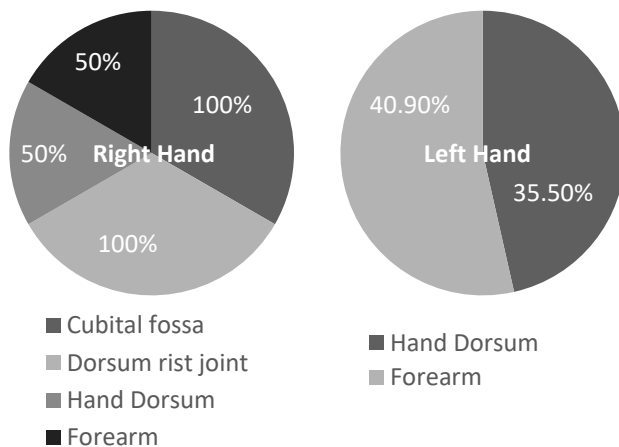


Figure-3: Frequency of Phlebitis according to site (N=279)

There was no outstanding difference identified between two genders in the rate of incidence of phlebitis. Data analysis has shown that aseptic measures were used in only 0.7% (n=2) patients and only gloves were used in 9.3% (n=26) patients and in the rest of patient 90% (n=251) no a septic measure were taken. Moreover no incidence of phlebitis was noted with the patients in whom antiseptic measures were used. Fifty percent of patients developed phlebitis when disposable gloves were used compared to 42.6% for which gloves were not used. The most common site for development of phlebitis was Right Cubical Fossa and Right Hand Dorsum Wrist Joint, with 100% developing phlebitis, and was followed by Right Hand Dorsum and Right Forearm with percentage of 50% each. The lowest incidence rate was found with Left Hand Dorsum and Left

Forearm of 35.5 and 40.9% respectively. Similarly. Among 279 patients 134 have 18 gauge cannula, 68 had cannula with 20 gauges while 77 patients had 22 gauge cannula. Among 134 patients 75% developed phlebitis, among 20 gauge 44.4% developed phlebitis while 33% reported with phlebitis in which 22 gauge cannula were used for IV administration (Figure-4). The percentage of Phlebitis was 2.3%, 22.5% and 83.7% on day 1, 2 and 3 respectively. Significant association was found between incidence and increase in duration of permanence with p value <0.05. Percentage of complications increased with increase in number of attempts with higher percentage (89%) in 5th attempt.

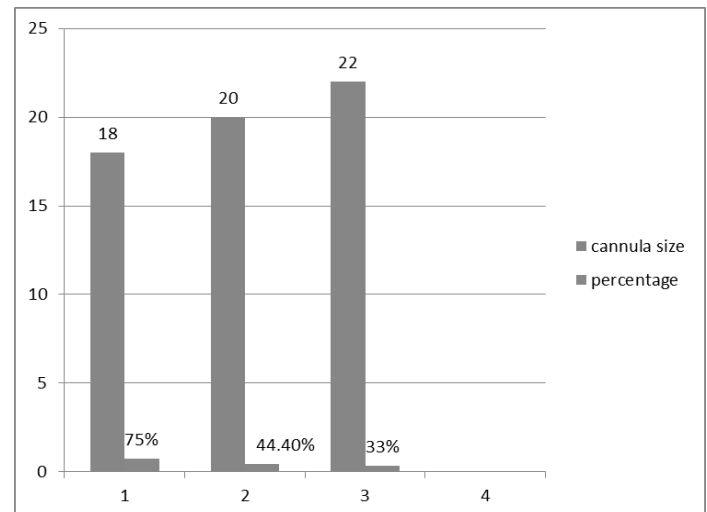


Figure-4: Frequency of complications with respect to cannula size (N=279)

DISCUSSION

A higher incidence of complications related to PVC were seen in our study as compared to those found in the few studies already published using a composite measure of both clinical and mechanical adverse incident^{4, 6, 15}. In our study, the phlebitis was most common PVCAE, this result is closely comparable with that found in other published studies even though comparisons should be made carefully due to variability of definition criteria^{4, 5, 15-17}. Our study showed that duration of more than 72 hours was a threat for development of complication (p value 0.001) and it was in concordance with a prospective cohort study which included 100 patients, that was conducted in Brazil, that have shown significant association between greater than 3 days cannula longevity and phlebitis¹⁸. Majority of published studies in medical journals reported that duration of cannulas greater than 5 is unexpected; a cohort prospective study reported only 7.8% incidences⁹. This study has also showed the same results with only 2.5% of patients with duration of 120 hrs or greater. The average time of cannula durability was similar to the study conducted earlier in which the average duration was 2.75 days¹⁹. Another study have shown that duration of peripheral catheters was 3 days in 93% patients, 5.8% of patients had cannula 3 to 4 days while remaining 1.2% were kept for more than 4 days²⁰. Another study consist of 76 adult patients in which peripherally

placed cannula used found results almost similar to that found in our study, they identified greater rate of incidence of phlebitis in those who used 18- and 20-gauge cannula, however their study found more complications in cannula with duration of durability equal or less than 3 days same outcome was reflected by another researcher²¹.

The placement site at the cubital fossa was identified to be significantly associated with greater incidence of PVCACs. However some studies showed a less incidence of PVCACs when inserted at cubital fossa^{22,23}. For phlebitis, some studies detected that placement of iv line at forearm and cubital fossa was found to have a higher risk in comparison at the area of hand dorsum or wrist joint but iv line at the dorsal surface of hand dorsum and the area of elbow have high chances of blockade and accidental slipping out but not with phlebitis^{4,24,25}. Some study found that PVC placement at the site of elbow and area in between elbow and wrist joint veins have a lower risk of development of vein inflammation as compared to the dorsal vein of hand. In our results, a higher incidence of complications is noted with insertion at cubital fossa (100%) and joints like the wrist and elbow joint²². A study in the literature revealed the common use of 20-gauge catheters (53%) and our study reported it to be 94.6%²⁶⁻²⁸. The main reason for catheter elimination was the development of problems and most prevalent one was phlebitis. Our study reported a higher incidence of PVCACs in cannulation of right limb or dominant limb. This could be due to the fact that the dominant limb is involved in activities and performing daily works. The guidelines recommended internationally said that iv lines that placed in case of emergency usually compromise aseptic measures and they should be transformed as early as possible to avoid complications and iv line infections²⁹⁻³¹.

CONCLUSION

The frequency of PVCs associated complications are much higher in present study. It has shown that complications were higher in those when aseptic measures are not taken. Similarly complications increase with increase in number of days.

Limitations: No standard tool for measurement of severity and degree of various complications. Individuals and subjective variations were there in differentiation of complications for example infective and mechanical phlebitis. Difficulty in relating or association of complications related to different treatment or due to infections or size of IV line i.e chemical or mechanical or infected phlebitis.

AUTHOR'S CONTRIBUTION

Ali K: Conceived idea, Manuscript writing

Sajjad MM: Data collection, Designed research methodology, Data analysis, Data interpretation

Shahzad A: Data collection, Data analysis, Data interpretation

Izhar N: Manuscript writing, Data collection and analysis

Yousaf S: Designed research methodology, Manuscript writing,

Khan MK: Literature search, Manuscript writing,

Nasir A: Final critical review of manuscript

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