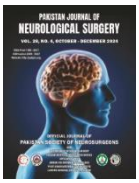

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Original Research

Ultrasound Guided Midline Catheter Insertion and Its Associated Complications in ICU Of Lahore General Hospital

Rehan Hassan Khan Niazi[1], Sara Khan Niazi[2], Anjana Kafle[2], Muhammad Saqib[3], Sidrah Batool[3], Muhammad Hassan Raza[4], Anum Zeb[1]

[1]Department of Anesthesia, Critical Care and Pain Management, Lahore General Hospital, Lahore, Pakistan
[2]Department of Obstetrics and Gynecology, Lahore General Hospital, Lahore, Pakistan
[3]Department of Anesthesia, Punjab Institute of Neurosciences, Lahore, Pakistan
[4]Department of Neurosurgery, Punjab Institute of Neurosciences, Lahore, Pakistan

ABSTRACT

Objectives: A midline catheter is a vascular access device that is frequently used among patients requiring long-term medications. Along with its benefits, it holds some complications during insertion and use. So, with this study, we aimed to determine the associated complications during the insertion and use of midline catheters among patients admitted to the ICU of Lahore General Hospital.

Materials & Methods: A cross-sectional study was conducted in the ICU of Lahore General Hospital including 70 patients fulfilling the inclusion criteria and who required a midline catheter for further treatment. We recorded and analyzed the data of those patients, to whom we attempted to insert ultrasound-guided midline catheter. In this study, we observed the success rate of catheter insertion along with associated complications like hematoma, arterial puncture, occlusion of the catheter, dislodgement, edema, and thrombosis.

Results: Mean age of patients was 42.74 ± 10.48 years. The most common diagnosis at the time of catheter insertion was sepsis (52.9%). Median attempts for catheter insertion were 1 with (IQR 1 to 1, minimum 1; maximum 4). The success rate of the ultrasound-guided midline catheter insertion was 95.7%. Occlusion of catheters was frequently observed among 10.4% of patients. The arterial puncture was noted among four patients at the time of insertion. Thrombosis was observed in only one patient.

Conclusion: Ultrasound-guided midline catheter is beneficial and safe for ICU-admitted patients who need long-term treatment and use of Vasopressors.

Keywords: Midline catheter, ICU, Ultrasound, Thrombosis, Hematoma.

Corresponding Author: Rehan Hassan Khan Niazi
Department of Anesthesia, Critical Care and Pain Management, Lahore General Hospital, Lahore, Pakistan
Email: drrehanniazi78@gmail.com

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INTRODUCTION

A midline catheter is an alternative to the intravenous catheter for securing intravenous access. It is similar to a peripherally inserted central venous catheter (PICC) but shorter in length, ranging from 8cm to 20cm. It is frequently used as an alternative to intravenous catheters due to its low complication rate and potential for long-term use.[1] Midline catheters are also placed similarly to PICC, but they end in the peripheral vein, which makes them different from the central venous catheter. The use of ultrasound for inserting and locating the tip of a midline catheter is safe and easy. The location of the tip of the midline catheter is usually at the axillary vein 3cm distal to the transition of the subclavian and axillary vein. Along with the usefulness and wide use of midline catheters, they hold many complications like blockade, infection, hematoma, and thrombosis.[2,3]

Conventionally peripheral venous access is obtained with great ease and low complication using intravenous cannula. But can be used for a short duration and multiple pricks and access are needed for the long term.[4,5] Central venous catheters (CVC) and peripherally inserted central (PICC) catheters are other means for prolonged IV access.[6] CVC is associated with a high rate of bloodstream infection and insertion of PICC needs more expertise and increases patient discomfort.[5] Use of the midline catheters is increasing in practice for securing intravenous lines in emergency department and intensive care units as it is easy to insert, holds low complications compared to CVC and can be used for long term.[7,8] Safe administration of the different drugs, vasopressors, and nutrition through midline catheters are being studied extensively.[9] Compared with central venous catheters, midline catheter holds a low risk of bloodstream infection but have more other mechanical complications.[10]

Many aspects should be considered for the use of midline catheters. It depends upon the resource availability, affordability, expertise for its insertion, and clinical condition of the patients. There are some studies in Pakistan regarding peripherally inserted central catheters (PICC), their use, and safety, but till now no literature has been found regarding the use of midline catheters.[11] So, our study will focus on the incidence of complications that may occur during insertion and use of midline catheters.

MATERIALS & METHODS

Study Design & Setting

This cross-sectional study was conducted in the surgical ICU of Lahore General Hospital, Lahore, Pakistan, consisting of 20 beds. Ethical clearance from the institutional research review committee was obtained before the conduction of this study (vide IRB approval letter with ref no: 073/2021, Dated: 13-12-2021). Written consent from the patients or their first guardian was taken before placement of the midline catheter.

Sampling

It was conducted over 6 months, starting from 01/01/2022, including 70 cases who were admitted in the ICU and who required placement of midline catheter. The requirement of placing a midline catheter was determined by an intensivist for resuscitation or long-time intravenous medication, difficult intravenous access, and use of vasopressors.

Inclusion Criteria

Patients with age ≥18 years and who gave consent to participate in this study requiring placement of midline catheter.

Exclusion Criteria

Patients with burn injury, local site infection, history of venous thromboembolism, midline line catheter replacement, and second-time midline catheter placement.

Clinical/Surgical Management & Data Collection

Ultrasound-guided double-lumen midline catheter was passed either on the basilic brachial or cephalic vein by one of the three senior consultant anesthesiologists who have been practicing this procedure for at least 3 years duration. After consent and arrangement of the required instruments, patients were placed in the supine position, axillary tourniquet was applied to the nondependent limb. Visualization of the vein was done using a linear high-frequency ultrasound probe and the site was marked. A 4 ml of 2% xylocaine was infiltrated subcutaneously at the site of midline catheter insertion. Following aseptic measures, under ultrasound vision, veins were cannulated using a 21G needle, and venous blood flow was identified. The guide wire was inserted and dilated using the dilator. A midline catheter was inserted and blood flow from each lumen was checked. After successful insertion, the catheter was fixed using a suture, and a transparent dressing was done. For unsuccessful attempts, the site was changed on both hands and tried up to 4 attempts. If unable to insert a midline catheter up to four attempts, it was declared to be unsuccessful, and a central venous line was placed. The everyday catheter was checked for lumen patency, edema, and leakage from the insertion site. Thrombosis was defined as a radiologically identified thrombus on the same extremity in which the midline catheter was placed and was during the time of stay in ICU.

Data Analysis

Data was analyzed using SPSS ver.25. Continuous variables like age were presented as mean ± SD. Other categorical variables like gender, diagnosis, limb, site of catheter insertion, the success rate of the procedure, complications during placement, and use of midline catheter were presented as frequency and percentage.

RESULTS

Gender Distribution

Among participants in this study, 39 (55.7%) were female and 31 (44.3%) were male.

Age Distribution

The mean age of the patients in this study was 42.74 ± 10.48 years.

Site of Insertion

A Midline catheter was inserted due to the need for prolonged medication among most of the patients. The right hand and basilic veins were the most common sites of catheter insertion. The success rate of the midline catheter was high under ultrasound guidance at 95.7%.

Comorbidities

Hypertension (27.1%) followed by diabetes (25.7%) were the most encountered comorbidities among patients.

Table 1: Characteristics of patients with midline catheter.

Characteristics	Number (%) N=70
Age (mean ± SD)	42.74 ± 10.48 years
Female	39 (55.7%)
Diagnosis	
Sepsis	37 (52.9%)
Polytrauma	13 (18.6%)
Peripartum cardiomyopathy	8 (11.4%)
Congestive heart failure	4 (5.7%)
Cerebrovascular accident	3 (4.3%)
Others	5 (7.1%)
Comorbidities	
Hypertension	19 (27.1%)
Diabetes	18 (25.7%)
Chronic obstructive pulmonary disease (COPD)	5 (7.12%)
Congestive heart failure (CHF)	4 (5.7%)
End-stage renal disease (ESRD)	6 (8.6%)

Complications

Among 70 patients, failure to insert a midline

catheter was observed in 3 patients. During the insertion of a midline catheter, the most common complication was arterial puncture, identified in 4 (5.7%). During use of midline catheter, the most common complication observed was catheter occlusion, identified in 7 (10.4%) of patients.

Table 2: Midline catheter insertion site and success.

	Number	Percentage
Successful	67	95.7%
Unsuccessful	3	4.3%
Right hand	38	56.7%
Left hand	29	43.3%
Cephalic vein	20	29.9%
Basilic vein	36	53.7%
Brachial vein	11	16.4%

Table 3: Complications during insertion and use of midline catheter.

Complications	Number (%)
Arterial puncture	4 (5.7%)
Hematoma	3 (4.3%)
Thrombosis	1 (1.5%)
Oedema	5 (7.5%)
Catheter occlusion	7 (10.4%)
Dislodgement	2 (3.0%)
Leakage	3 (4.5%)

DISCUSSION

This study was conducted among those patients admitted to ICU with an indication of a midline catheter. Some other studies were conducted on the patients presenting in the emergency department, with difficult intravenous lines. [2,12] We used midline catheters in those patients who required long-term intravenous medication or the use of vasopressors during treatment. Ultrasound was used for the insertion of a midline catheter in our study which helped to locate veins and reduce the number of attempts along with the risk of artery puncture. We were successful in inserting a midline catheter in 95.7% of the patients using ultrasound. Similar findings were found in other studies in which the success rate ranged from 92% to 100%.[13-15]

Complications like failure, artery puncture, hematoma, infection, occlusion, dislodgement, leakage, and thrombosis were studied in this study. The most common complication during use of midline catheter was lumen occlusion which was observed among 10.4% of the patients. The least common was thrombosis which was observed only in 1.5% of patients. A systemic review conducted by Tripathi et al, observed less evidence of occlusion to be only 3.8% which was lower than the findings of our study. In his analysis, they found the incidence of thrombosis to be 4.1% but we had venous thrombosis in only 1.5% of patients. Dislodgement of catheter was comparable in both studies, 3% in our study and 5% in the systemic review.[10] The difference in the incidence of complications is due to differences in facilities, equipment, and care provided to the patients.

This is the first study conducted on the insertion and use of midline catheters in Pakistan. It could give a view regarding the safety and usefulness of midline catheters for patients who need a long-time intravenous infusion. Our study was conducted on a small number of patients who were admitted to ICU. This study shows the result of only one setup with minimal facilities compared to another advanced ICU setup. So, variability of the findings and occurrence of complications is expected. More studies will be needed for proper evaluation and conclusion.

CONCLUSION

With the findings of this study, we concluded that hematoma and occlusion of midline catheters are the most frequently encountered complications.

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Additional Information

Disclosures: Authors report no conflict of interest.
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Human Subjects: Consent was obtained by all patients/participants in this study.
Conflicts of Interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following:
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AUTHORS CONTRIBUTION

Sr.#	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Rehan Hassan Niazi Khan,Muhammad Saqib & Sidra Batool	1. Study design and methodology.
2.	Sara Khan Niazi, Anjana Kafle & Muhammad Hassan Raza	2. Paper writing.
3.	Rehan Hassan Niazi Khan, Anum Zeb & Sara Khan Niazi	3. Data collection and calculation.
4.	Anjana Kafle, Muhammad Saqib & Muhammad Hassan Raza	4. Analysis of data and interpretation of results.
5.	Rehan Hassan Niazi Khan, Anum Zeb & Sara Khan Niazi	5. Literature review and referencing.
6.	Muhammad Saqib, Sidra Batool, Anjana Kafle & Anum Zeb	6. Editing and quality insurer.