



Original Article

Comparison of Complications In Patients With Central Venous Catheter Placement Via Internal Jugular, Subclavian And Femoral Route At Intensive Care Unit

 Mohammad Haroon¹ and Ayesha Anwer¹
¹Bahria International Hospital, Rawalpindi, Pakistan

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***Corresponding Author:**
 Mohammad Haroon
 Bahria International Hospital, Rawalpindi, Pakistan
drharoonjr@gmail.com

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ABSTRACT

Central venous lines are passed in almost all patients admitted in intensive care unit and a need still exist to look for best route for this purpose. **Objective:** To compare the complications in patients with central venous catheter passed via internal jugular, subclavian and femoral route at intensive care unit. **Methods:** A comparative cross-sectional study was conducted on 380 patients admitted in intensive care unit of Bahria International Hospital RWP from January 2022 to June 2022. Central venous catheters were passed by consultant critical care specialist on call at the time of reception of patient in unit. All the patients were observed for one week for presence of any local or systemic complications. **Results:** Out of 380 patients, 240 (63.2%) were male while 140 (36.8%) were female. Central venous catheter was passed via internal jugular vein in 220 (57.8%) patients, via subclavian route in 60 (15.8%) patients and via femoral route in 100 (26.3%) patients. Failed attempts were seen statistically significantly more in internal jugular route (p-value-0.041) while local cellulitis was seen more in femoral route (p-value-0.012). **Conclusions:** Internal Jugular vein was the route most commonly used for insertion of central venous catheter in patients admitted in our intensive care unit. Complications were seen more not very common in our setting. Failed attempts were more seen in internal jugular route while local cellulitis was seen more in femoral route.

INTRODUCTION

Organ support is a complex and difficult task for which patients with different ailments are referred to medical or surgical intensive care units of the hospital [1]. Primary medical or surgical conditions usually lead to multi-organ failure and if more than organ systems fail to function, intense support is required at critical care setting [2]. Multiple health related conditions which further complicate the clinical picture may arise as a result of ICU admission or different procedures performed to support the organ systems as part of overall management [3]. Different procedures are performed in critical care settings to monitor the patient, administer medications or support different organ systems. Passing central venous catheter is one of the most commonly performed procedures in all types of critical care units [4]. Though a

relatively simple procedure but may prone individual to number of local or systemic complications [5]. Different routes can be used to pass the central venous catheter but few common routes include internal jugular, subclavian and femoral route [6]. Insertion of central venous catheter can bring about few adverse events like all other medical procedures. Kornbau *et al.*, published a comprehensive paper in this regard bringing up all the complications which could happen in patients who have been inserted central line and adequate knowledge of them can only enable the treating team to prevent them [7]. Wong *et al.*, tried to look for insertion rate and complication of central lines in UK population. It was revealed that out of 117 catheters inserted only 8% had immediate complications and most of them were mild and self-limiting [8]. Incidence of

infectious complications of central venous catheters at the subclavian, internal jugular, and femoral sites in patients admitted in intensive care unit was published by Deshpande *et al.* It was concluded that infectious complications occurred in very small number of patients. Route of catheter had no relationship with incidence of infections among their patients [9]. Critical care has been evolving in Pakistan. Still medical doctors or interns pass central venous catheters in most of public sector hospital. Specialized units have critical care experts or anaesthetist performing these procedures and that too sometimes guided by ultrasound. A recent local study revealed that around 10% of patients who had central venous catheter suffered from infection at the site of insertion [10]. It becomes very important in patients admitted at critical care unit to prevent any additional harm by treatment during the admission. Limited local data had compared complications between different routes of central venous catheter. We therefore designed this study with the rationale to compare the complications in patients with central venous catheter passed via internal jugular, subclavian and femoral route at intensive care unit.

METHODS

This comparative cross-sectional study was conducted at the intensive care unit of Bahria International Hospital Rawalpindi from January 2022 to June 2022. Sample size was calculated by WHO Sample Size Calculator by using population prevalence proportion of complications with central venous catheter placement as 1.1% [11]. Study subjects were gathered via non probability consecutive technique for this study. Inclusion criteria: All patients between the age of 18 and 60 years who were admitted in critical care unit either from wards of own hospital or any other hospital and were inserted central venous catheter via either of three routes (internal jugular, subclavian or femoral) were recruited in the study. Exclusion criteria: Patients who came with central venous catheter inserted from ward or other clinical setting were not included. Those who died within 24 hours of CVC insertion or were shifted from the ICU were also not included. Patients with diagnosed bleeding disorders or blood related cancers were excluded. Patients who themselves or whose caregivers refused insertion of central venous catheter were excluded from analysis. Ethical approval from the ethical review board committee (letter no XXX) of Bahria International Hospital was taken prior to commencement of study. Written informed consent was taken from care givers of potential participants. After all these formalities, patients who were admitted in the critical care unit of Bahria International Hospital who required insertion of central venous catheter were recruited for the study.

Central venous catheters were passed by consultant critical care specialist on call at the time of reception of patient in unit. Patients were assessed in detail at the time of admission in ICU by a team member and evaluated for requirement of central venous catheter. Route of catheter was decided by the clinician inserting the catheter on the basis of multiple factors including his own expertise [12]. Catheter was passed under aseptic conditions as per set protocols [13]. All the patients were observed for one week for presence of any local or systemic complications related to insertion or presence of central venous catheter [14]. All statistical analysis was performed by using the Statistics Package for Social Sciences version 24.0 (SPSS-24.0). Frequency and percentages for gender, route of central venous catheter insertion and complications were calculated. Mean and standard deviation for age of patients recruited in the study was estimated. Pearson Chi-square test and Fischer exact tests were used to look for statistically significant difference (p-value less than or equal to 0.05) among three groups of study regarding complications.

RESULTS

A total of 380 patients who were admitted in intensive care unit for any reason and had central venous catheter placed were included. Table 1 shows general characteristics of these patients along with primary or comorbid illnesses. Out of all the patients recruited, 240 (63.2%) were male while 140 (36.8%) were female. Central venous catheter was passed via internal jugular vein in 220 (57.8%) patients, via subclavian route in 60 (15.8%) patients and via femoral route in 100 (26.3%) patients.

Study parameters	n (%)
Age (years)	
Mean + SD	41.239 ± 7.892 years
Range (min-max)	19 years - 60 years
Gender	
Male	240 (63.2%)
Female	140 (36.8%)
Primary or Comorbid illnesses	
Diabetes Mellitus	145 (38.1%)
Hypertension	75 (19.7%)
Asthma/COPD	64 (16.8%)
End stage renal disease	69 (18.1%)
Stroke	74 (19.4%)
Malignancy	22 (5.7%)
Others	09 (2.3%)
Access route of central venous catheter	
Internal Jugular	220 (57.9%)
Subclavian	60 (15.8%)
Femoral	100 (26.3%)
Complications	
Failed attempt	19 (5%)
Arterial puncture	09 (2.3%)

Pneumothorax	02 (0.5%)
Hemothorax	01 (0.26%)
Cellulitis at access site	12 (3.1%)
Bleeding at site	03 (0.7%)
Others	02 (0.5%)

Table 1: Characteristics of patients with central venous catheter admitted in ICU

Table 2 shows the results of Pearson Chi-square test and Fischer exact tests. Failed attempts to pass the central venous catheter were seen statistically significantly more in internal jugular route (p-value-0.041) while local cellulitis at the central venous catheter access site was seen more in patients in which femoral route (p-value-0.012) was used.

Complications	Internal Jugular	Subclavian	Femoral	p-value
Failed attempt				
No	204 (92.7%)	59 (98.3%)	98 (98%)	0.041
Yes	16 (7.3%)	01 (1.7%)	02 (02%)	
Local cellulites				
No	217 (98.6%)	59 (98.3%)	92 (92%)	0.012
Yes	03 (1.4%)	01 (1.7%)	08 (08%)	
Pneumothorax				
No	219 (99.5%)	59 (98.3%)	100 (100%)	0.364
Yes	01 (0.5%)	01 (1.7%)	00 (0%)	
Hemothorax				
No	220 (100%)	59 (98.3%)	100 (100%)	0.157
Yes	00 (0%)	01 (1.7%)	00 (0%)	
Arterial puncture				
No	215 (97.7%)	59 (98.3%)	97 (97%)	0.856
Yes	05 (2.3%)	01 (1.7%)	03 (03%)	
Arterial puncture				
No	219 (99.5%)	60 (100%)	99 (99%)	0.268
Yes	01 (0.5%)	00 (0%)	01 (1%)	

Table 2: Comparison of complications in patients with central venous catheter placed via internal jugular, subclavian and femoral route

DISCUSSION

Multiple procedures are involved in critical care of patients which allow smooth monitoring and management of them. Central venous catheter is passed in majority of patients admitted in ICU. This procedure may be done with or without ultrasound via various routes. Internal Jugular, subclavian and femoral are the most preferred routes. Certain complications may occur while doing this procedure or later on which catheter is in place. Currently no fixed rule exists regarding safest route of central venous catheter insertion. This study was conducted at an intensive care setting of a lower- and middle-income country with an aim to compare the complications in patients with central venous catheter passed via internal jugular, subclavian and femoral route. Marik *et al.*, published a systematic review and meta-analysis regarding difference in catheter related infections with central venous catheter passed via different routes. It was

concluded that no difference existed with regard to infection between three routes [15]. It was contrary to previous findings in a lot of studies which found femoral route to be more associated with infections. Our study results were similar to data previously generated and femoral route was more associated with presence of local access site infection as compared to subclavian and internal jugular route. In northern India, all the complications were studied related to central venous catheter and it was found that bleeding complications were found more when catheters were passed via internal jugular route as compared to other routes [16]. In our study failed attempts were seen significantly more in patients in which attempts were made via internal jugular route but bleeding at the access site was not significantly different in all the three routes. Comerlato *et al.*, published a study from teaching hospital of Brazil regarding complications related to central venous catheter insertion. They revealed that arterial perforation and infectious complications were mostly seen in patients in ICU who had insertion of central venous catheter. Route of insertion was not associated with complications in their study sample [17]. Our results showed that Internal Jugular vein was the route most commonly used for insertion of central venous catheter. Complications were seen more not very common in our setting. Failed attempts were more seen in internal jugular route while local cellulitis was seen more in femoral route. A study was published from Bahrain regarding incidence of complications of central venous catheters at an intensive care unit. They came up with the findings that internal jugular vein access for central venous catheter was associated with a lower rate of mechanical and infectious complications as compared to subclavian and femoral access [18]. We found more failure rate was seen in internal jugular vein access while more local infection rate was seen in femoral access. Our findings supported the already existing findings [19, 20] and we suggest special caution regarding infections should be taken into account while choosing femoral route for CVP insertion.

CONCLUSIONS

Internal Jugular vein was the route most commonly used for insertion of central venous catheter in patients admitted in our intensive care unit. Complications were seen more not very common in our setting. Failed attempts were more seen in internal jugular route while local cellulitis was seen more in femoral route.

Conflicts of Interest

The authors declare no conflict of interest.

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REFERENCES

- [1] Kiekkas P, Tzenalis A, Gklava V, Stefanopoulos N, Voyagis G, Aretha D. Delayed Admission to the Intensive Care Unit and Mortality of Critically Ill Adults: Systematic Review and Meta-analysis. *Biomedical Research International*. 2022 Feb; 2022(1): 4083494. doi: 10.1155/2022/4083494.
- [2] Reyes LF, Bastidas A, Narváez PO, Parra-Tanoux D, Fuentes YV, Serrano-Mayorga CC, *et al.* Clinical characteristics, systemic complications, and in-hospital outcomes for patients with COVID-19 in Latin America. *LIVEN-Covid-19 study: A prospective, multicenter, multinational, cohort study*. *PLoS One*. 2022 Mar; 17(3): e0265529. doi: 10.1371/journal.pone.0265529.
- [3] Seifu A, Eshetu O, Tafesse D, Hailu S. Admission pattern, treatment outcomes, and associated factors for children admitted to pediatric intensive care unit of Tikur Anbessa specialized hospital, 2021: a retrospective cross-sectional study. *BMC Anesthesiology*. 2022 Jan; 22(1): 13. doi: 10.1186/s12871-021-01556-7.
- [4] Tang R, Peng J, Wang D. Central Venous Pressure Measurement Is Associated with Improved Outcomes in Patients with or at Risk for Acute Respiratory Distress Syndrome: An Analysis of the Medical Information Mart for Intensive Care IV Database. *Frontiers in Medicine*. 2022 Mar; 9(3): 858838. doi: 10.3389/fmed.2022.858838.
- [5] Struck MF, Ewens S, Schummer W, Busch T, Bernhard M, Fakler JKM, *et al.* Central venous catheterization for acute trauma resuscitation: Tip position analysis using routine emergency computed tomography. *The Journal of Vascular Access*. 2018 Sep; 19(5): 461-6. doi: 10.1177/1129729818758998.
- [6] Safety Committee of Japanese Society of Anesthesiologists. Practical guide for safe central venous catheterization and management 2017. *Journal of Anesthesia*. 2020 Apr; 34(2): 167-86. doi: 10.1007/s00540-019-02702-9.
- [7] Kornbau C, Lee KC, Hughes GD, Firstenberg MS. Central line complications. *International journal of critical illness and injury science*. 2015 Jul; 5(3): 170-8. doi: 10.4103/2229-5151.164940.
- [8] Wong AV, Arora N, Olusanya O, Sharif B, Lundin RM, Dhaddaet A, *et al.* Insertion rates and complications of central lines in the UK population: A pilot study. *Journal of the Intensive Care Society*. 2018 Feb; 19(1): 19-25. doi: 10.1177/1751143717722914.
- [9] Deshpande KS, Hatem C, Ulrich HL, Currie BP, Aldrich TK, Bryan-Brown CW, *et al.* The incidence of infectious complications of central venous catheters at the subclavian, internal jugular, and femoral sites in an intensive care unit population. *Critical Care Medicine*. 2005 Jan; 33(1): 13-235. doi: 10.1097/01.ccm.0000149838.47048.60.
- [10] Ahmed B, Khan IM, Beg MA. Frequency of Central Venous Catheter Related Infections and their Culture and Sensitivity Pattern. *Journal of Islamabad Medical and Dental College*. 2016 May; 5(2): 63-6.
- [11] Björkander M, Bentzer P, Schött U, Broman ME, Kander T. Mechanical complications of central venous catheter insertions: A retrospective multicenter study of incidence and risks. *Acta anaesthesiologica Scandinavica*. 2019 Jan; 63(1): 61-8. doi: 10.1111/aas.13214.
- [12] Devia Jaramillo G, Torres Castillo J, Lozano F, Ramirez A. Ultrasound-guided central venous catheter placement in the emergency department: experience in a hospital in Bogotá, Colombia. *Open Access Emergency Medicine*. 2018 May; 10(3): 61-5. doi: 10.2147/OAEM.S150966.
- [13] Sugiki D, Matsushima H, Asao T, Tokumine J, Lefor AK, Kamisasanuki T, *et al.* A web-based self-learning system for ultrasound-guided vascular access. *Medicine (Baltimore)*. 2022 Oct; 101(43): e31292. doi: 10.1097/MD.00000000000031292.
- [14] Lenz H, Myre K, Draegni T, Dorph E. A Five-Year Data Report of Long-Term Central Venous Catheters Focusing on Early Complications. *Anesthesiology Research Practice*. 2019 Dec; 2019: 6769506. doi: 10.1155/2019/6769506.
- [15] Marik PE, Flemmer M, Harrison W. The risk of catheter-related bloodstream infection with femoral venous catheters as compared to subclavian and internal jugular venous catheters: a systematic review of the literature and meta-analysis. *Critical Care Medicine*. 2012 Aug; 40(8): 2479-85. doi: 10.1097/CCM.0b013e318255d9bc.
- [16] Kaur R, Mathai AS, Abraham J. Mechanical and infectious complications of central venous catheterizations in a tertiary-level intensive care unit in northern India. *Indian Journal of Anaesthesiology*. 2012 Jul; 56(4): 376-81. doi: 10.4103/0019-5049.100823.
- [17] Comerlato PH, Rebelatto TF, Santiago de Almeida FA, Klein LB, Boniatti MM, Schaan BD, *et al.* Complications of central venous catheter insertion in a teaching hospital. *Revista da Associação Médica Brasileira (1992)*. 2017 Jul; 63(7): 613-20. doi: 10.1590/1806-9282.63.07.613.
- [18] Akmal AH, Hasan M, Mariam A. The incidence of complications of central venous catheters at an intensive care unit. *Annals of Thoracic Medicine*.

2007 Apr; 2(2): 61-3. doi: 10.4103/1817-1737.32232.

- [19] Toor H, Farr S, Savla P, Kashyap S, Wang S, Miulli DE. Prevalence of Central Line-Associated Bloodstream Infections (CLABSI) in Intensive Care and Medical-Surgical Units. *Cureus*. 2022 Mar; 14(3): e22809. doi: 10.7759/cureus.22809.
- [20] Singh K, Bharti AK, Dubey PK. Use of 'Low approach' femoral central venous cannulation during COVID 19 pandemic. *American Journal of Emerging Medicine*. 2021 Nov; 49(3): 406-7. doi: 10.1016/j.ajem.2021.02.010.