

ORIGINAL RESEARCH

INTENSIVE CARE

Evaluation of insertion methods and the anatomic region preference by the intensivists in central venous catheterization during COVID-19 pandemic: a survey-based study from Turkey

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ABSTRACT

Background & Objective: COVID-19 pandemic caused several clinicopathological conditions. The majority of the patients required intensive care. Even in the intensive care unit (ICU) setting, invasive procedures were challenging for healthcare workers due to the highly infectious nature of the disease and the need to work in cumbersome personal protective equipment. Peripheral and central venous catheterisation (CVC) were the most performed invasive procedures. We evaluated the preferred anatomical region and the preferred insertion method of CVC by the intensive care physicians.

Methodology: The study was conducted between July 2020 and October 2020, after obtaining institutional ethics committee approval. Physicians working in ICUs across Turkey were included in the survey. A specially prepared questionnaire was delivered online to the study sample via email invitation or social media applications. A total of 314 people received the questionnaire, 4 of the respondents did not allow the use of the survey data and 53 did not complete the questionnaire, so 57 records were excluded from the study and statistical data analysis was performed on 247 responses.

Results: Participants were aged between 25 and 60 y. Regarding academic status, 97 of the participants were assistants, 112 were specialists, 25 were assistant professors, 5 were associate professors and 8 were professors. The number of catheters inserted by the physicians participating in the study showed statistically significant decrease during the pandemic period but controversially total number of catheters inserted in the ICUs showed no difference. Femoral vein was the most preferred anatomic region during pandemic period in both intubated patients, and patients using other ventilation support devices. Physician's preferred method of catheter insertion remains the same.

Conclusion: Central venous catheterisation is one of the vital invasive procedures performed on patients admitted to intensive care. The vital nature of the procedure, the proximity of the insertion site to the airway and the cumbersome personal protective equipment worn by healthcare workers made it a challenging intervention. We concluded that intensive care physicians in our country are reluctant to use central venous catheters because of concerns about contracting infection, and as a result of these concerns, they increase the use of personal protective equipment and protect themselves by changing anatomical site for catheterization.

Key words: COVID-19; Central Venous Access; Central Venous Cannulation; Ultrasound-Guided; ICU

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1. INTRODUCTION

In December 2019, a new coronavirus variant emerged in Wuhan, China, causing a new pandemic in the world.^{1,2} This pandemic-causing variant was transmitted through the respiratory tract and had an acute clinical course that could cause acute respiratory distress syndrome (ARDS). Many patients needed admission to intensive care units due to respiratory failure;^{3,4} many required mechanical ventilation support and central venous catheterisation (CVC).⁵ CVC is often performed in high-risk patients for monitoring fluid management, intravenous administration of multiple drugs, vasoactive agents and parenteral nutrition.^{6,7} Generally central veins around head and neck or femoral veins are used for venous access. There are many factors that influence the choice of central venous catheter site including patient's anatomy, susceptibility to thromboembolism or bleeding, clinician's experience, or the risk of infection or pneumothorax.⁸ Another factor influencing CVC after the COVID-19 pandemic was concern about infection transmission. During the COVID-19 pandemic, it was recommended that central venous interventions be performed from the femoral vein rather than the head and neck central veins to minimise transmission to healthcare workers.⁹

However, CVC is often performed using anatomical landmarks, and in the recent years, USG-guided catheterisation is increasingly preferred and the use of USG is recommended in the COVID-19 guidelines.⁹⁻¹¹ In this study, we aimed to determine the preferences regarding the method and site of access by the anesthetists and intensive care physicians caring for patients diagnosed with COVID-19 for CVC.

2. METHODOLOGY

The study was conducted between July 2020 and October 2020, after obtaining institutional ethics committee approval (No. KDEAH-KAEK 2020/91). Physicians working in ICUs across the country were included in the study.

A specially prepared questionnaire was delivered online to the study sample via e-mail or social media. Data were collected in the database of the website where the questionnaire was prepared. A total of 1233 people were invited to the study via e-mail; 144 responses were received from e-mail invitation and 170 responses were received from social media applications. A total of 314 people replied the questionnaire, 4 of the participants refused the informed consent and 53 did not complete the questionnaire. A total of 57 records were excluded from the study and statistical data analysis was performed on 247 participants.

The first part of the study data form was the information and consent section. Participants were informed about the study and their consent was obtained. The following 13 questions were about the participant's socio-demographic characteristics, professional experience, physical conditions of the hospital and ICU, where he/she worked, and his/her status during the COVID-19 pandemic. While the second part asked about the participant's general attitudes and behaviours towards catheter use in the ICU, where the participant worked, grouped into pre-pandemic and pandemic periods and compared.

The reliability and validity of the questionnaire were assessed using the test-retest method. In this method, 10 participants were interviewed twice with an interval of 3 weeks. The results of the questionnaire were evaluated and the consistency of each question was assessed by Pearson-Spearman correlation. Questions with a correlation value of less than +0.3 were excluded from the questionnaire. The Cronbach alpha value of the questionnaire was found to be 0.816. In addition, the language of the questionnaire was assessed by face-to-face interviews with the participants.

Statistical analysis

SPSS 25.0 was used for the statistical analyses. The mean, standard deviation, median, minimum, maximum, frequencies and ratios were used in the descriptive statistics of the data. The distribution of variables was measured using the Kolmogorov-Smirnov test. The Mann-Whitney U test was used to analyse quantitative data. Wilcoxon test was used to analyse repeated measurements. Spearman correlation analysis was used for correlation analysis.

RESULTS

Out of 247 participants, 131 were female and 116 were male; aged between 25 and 60 y; 97 of them were assistants, 112 specialists, 25 assistant professors, 5 associate professors and 8 were professors (Table 1).

No significant difference was observed between the total number of catheters inserted in the pre-pandemic period and the number of catheters inserted during the pandemic period ($P = 0.720$).

A statistically significant difference was observed between the number of catheters inserted by the physicians participating in the study in the pre-pandemic period and the number of catheters inserted during the pandemic period ($P < 0.05$) (Table 2).

Significant difference was observed between the anatomical region preferred by the physicians participating in the study in the pre-pandemic period and

Table 1: Socio-demographic data of the participants; (n = 247)

Parameters		n (%)
Gender	Female	131(53.0)
	Male	116 (47.0)
Age (y)	25-29	65 (26.3)
	30-34	45 (18.2)
	35-39	53 (21.5)
	40-49	68 (27.5)
	50-59	16 (6.5)
Academic Degree of Participants	Resident	97 (39.3)
	Specialist	112 (45.3)
	Assistant Professor	25 (10.10)
	Assoc. Professor	5 (2.0)
	Professor	8 (3.2)
Institutional nature of the participants' hospitals	Public Hospital	45 (18.2)
	Training & Research Hospital	147 (59.5)
	University Hospital	28 (11.3)
	Private Hospital	27 (0.9)

during the pandemic period in intubated and non-intubated patients for catheter insertion, both in general and patient-specific ($P < 0.05$) (Table 3).

Significant difference was observed between the protective equipment preferred by the physicians in the pre-pandemic period and the during the pandemic period ($P < 0.05$) (Table 4).

A statistically significant difference was observed between the indications for catheter insertion in the pre-pandemic period and the indications for catheter insertion during the pandemic period ($P < 0.05$) (Table 5). There was no significant difference between in the frequency of central venous catheter replacement or the

Table 2: Comparison of the number of participants inserting catheters per month during the pre-pandemic and pandemic periods

Catheter insertions (per month)	Pre-pandemic Period (n = 247)	Pandemic Period (n = 247)	P
1-5	76 (30.8)	96 (38.9)	0.001*
6-10	90 (36.4)	64 (25.9)	
11-20	57 (23.1)	39 (15.8)	
>20	24 (9.7)	48 (19.4)	

^k *Ki-kare test: values are given as frequency (percentage)*

^{*} $P < 0.05$ Statistically significant difference between groups

use of USG by participating physicians during the pre-pandemic period and the pandemic period.

When comparing the pre-pandemic period with the pandemic period for participants who did not follow patients diagnosed with COVID-19, no significant differences were observed in the number of catheter insertions per month in the ICUs where they worked, the number of catheter insertions per month by the participants themselves, anatomical site selection, indications for catheter insertion, and frequency of catheter replacement, while a statistically significant difference was found between the two periods for the use of personal protective equipment (PPE) ($P < 0.001$).

4. DISCUSSION

Following the first COVID-19 diagnosis in our nation, changes were made to the medical system nationwide. Only patients with a COVID-19 diagnosis were accepted at a few public hospitals that were designated as pandemic hospitals.

Of the participants in our study, 92.7% reported that they were caring for patients diagnosed with COVID-19, the rest did not follow COVID patients.

It was noted that 77.8% of the participants came from a state hospital or a training and research hospital that was also a pandemic hospital; therefore, most of the participants were academicians and residents.

CVC is a common procedure for patients in intensive care. Central venous access is required for many indications, including central venous pressure monitoring, multiple drug administration, parenteral nutrition, inotropic drug use, or the need for large volume fluid replacement.⁷ During the pandemic, patients were admitted to hospital with severe dehydration due to fever, diarrhoea, vomiting and nausea, that lasted for days. In addition, the development of the need for parenteral nutrition due to the interruption of oral nutrition of patients due to helmet headgear, high-flow nasal cannula, non-invasive CPAP support in intensive care, forced the insertion of a central catheter¹².

From the survey results, we concluded that although the number of catheters that participants personally inserted decreased during the pandemic period compared to the pre-pandemic period, there was no difference in the total number of catheters inserted. The percentage of participants who said they would place a catheter

Table 3: Comparison of anatomical site preferences used for catheterisation

Anatomic region preference		Pre-pandemic Period (n = 247)	Pandemic Period (n = 247)	p
General anatomic region preference	Internal jugular v.	145 (63.6)	83 (36.4)	0.001*
	Femoral v.	32 (21.5)	117 (78.5)	
	Subclavian v.	70 (59.8)	47 (40.2)	
Intubated patients	Internal jugular v.	148 (61.7)	92 (38.3)	0.001*
	Femoral v.	20 (15.9)	106 (84.1)	
	Subclavian v.	79 (61.7)	49 (38.3)	
Patients using noninvasive CPAP-High flow mask	Internal jugular v.	107 (66.5)	54 (33.5)	0.001*
	Femoral v.	65 (31.0)	145 (69.0)	
	Subclavian v.	75 (61.0)	48 (39.0)	

^k *Ki-kare test: values are given as n (%); *P < 0.05 Statistically significant*

Table 4: Comparison of PPE used by the participants during catheterisation

PPE used	Pre-pandemic Period (n = 247)	Pandemic Period (n = 247)	P
Sterile gloves	242 (51.5)	228 (48.5)	0.001*
Nonsterile gloves	33 (31.7)	71 (68.3)	
Double-layer surgical gloves	8 (10.1)	71 (89.9)	
Surgical mask	204 (57.8)	149 (42.2)	
N95 mask	16 (6.3)	237 (93.7)	
Goggles	20 (10.1)	178 (89.9)	
Face Shield	13 (5.9)	208 (94.1)	
Bone	157 (43.1)	207 (56.9)	
Non sterile Box	66 (45.8)	78 (54.2)	
Sterile box	140 (52.6)	126 (47.4)	
Coverall	9 (5.1)	168 (94.9)	

^k *Ki-kare test: values are given as n (%); *P < 0.05 Statistically significant difference between groups*

Table 5: Comparison of indications for catheter insertion by the participants

Indications for catheter insertion	Pre-Pandemic Period (n = 247)	Pandemic Period (n = 247)	p
All to whom admitted to the ICU	29 (36.3)	51 (63.7)	0.002*
Central venous pressure monitoring	117 (55.2)	95 (44.8)	
Parenteral nutrition	177 (53.5)	154 (46.5)	
Inotropic drug infusion	203 (50.6)	198 (49.4)	
Sedative drug infusion	41 (39.0)	64 (61.0)	
Infusion of other drugs	209 (50.4)	206 (49.6)	
Other indications	22 (50.0)	22 (50.0)	

^k *Ki-kare test: values are given as n (%); *P < 0.05 Statistically significant difference*

in every patient admitted to the pandemic ICU, when considering the indications for catheter insertion, increased during the pandemic period compared to the pre-pandemic period. This suggests that participants were reluctant to

catheterise, but catheterisation did not decrease. Similarly, in the study by Deganello et al., the rate of catheterisation in patients admitted to intensive care at the beginning of the pandemic was lower, but the catheterization rate was increased following months.¹³ The researchers explained the situation as follows; although the insertion of a CVC into the patient requires close contact with the patient, the number of contacts with the patient is reduced in the long term because the catheter is a long-lasting device.

As COVID-19 is transmitted primarily via respiratory droplets and contact routes, the healthcare providers are at high risk of transmission. It was suggested to wear PPE, and the use of alternative tools to reduce patient contact, such as the use of a video laryngoscope for intubation that require close proximity to the patient during application.^{14,15}

In the present study, when participants were asked about the PPE they wore during central catheter insertion, it was found that participants were dressed according to the COVID-19 guidelines. Therefore, the use of protective equipment increased significantly during the pandemic period compared with the pre-pandemic period. It was concluded that physicians who do not follow COVID-19

patients in their intensive care units are also careful about the use of protective equipment.

The increased use of PPE, such as N95 masks, goggles, visors, overall gowns, is an expected behaviour but double-layer anti-contamination gloves is an indication that concern about bloodborne transmission was presumed too high. However, the use of non-sterile gloves was also found to be significantly higher than before the pandemic. The use of surgical masks and sterile surgical gowns among participants has decreased compared to the pre-pandemic period. The increase in the use of N95 masks with the pandemic explains the decrease in the use of surgical masks. However, the decrease in the use of sterile surgical gowns is interesting. In our survey, participants were not asked a question to explain this situation, but we think that the wearing of overalls at the entrance to the ICU may have reduced the preference for the use of sterile box gowns.

The studies and guidelines on this subject recommend that ICU staff should wear non-sterile gloves, overalls, N95 mask and beret after hand hygiene; and during the interventional procedure it is recommended to wear sterile box gowns, sterile gloves and cover the patient with sterile drapes.¹⁶

Central venous catheters are also used in almost all intensive care patients, and there is concern that the use of central veins in the head and neck may increase the risk of transmission to healthcare workers.¹⁷ When examining the anatomical regions in which participants performed catheterisation, it was found that it was the subclavian vein which was preferred for catheterisation in the pre-pandemic period, whereas during the pandemic the femoral vein was preferred, and the difference was statistically highly significant. This situation was found to be consistent with the guidelines which recommend performing invasive interventions away from the patients' airway such as central venous access after the pandemic.⁹ Similarly, the femoral vein was the most preferred anatomical site for central venous catheterisation in the study by Liu et al.¹⁸ A case report by Singh et al. during the pandemic stated that femoral access from a lower level would be more beneficial in preventing transmission¹⁹. Although this study refers to CVC, midline and peripheral arterial catheters were recommended as alternatives to central venous access when the need for central venous access and concerns about transmission were discussed during the pandemic.¹²

Guidelines published during the pandemic specifically recommended ultrasound-guided intervention for faster and safer central venous catheterization.^{5,6,15,20} The participants in our study opined that the use of USG did not increase significantly in the pandemic period as

compared to the prepandemic period. The participants preferred to use the method they were most familiar with.

CVC is one of the vital invasive procedures performed in patients admitted to ICU. Although central venous access is a vital procedure, the proximity of the insertion site to the airway and the limited mobility in the PPE worn by healthcare workers made it a challenging intervention. Therefore, during the pandemic process, the indications, methods of application and application alternatives were extensively included in the guidelines.

5. CONCLUSION

The results of our study show that intensive care physicians in our country were reluctant to use the subclavian route for the central venous catheterization in Corona patients, and preferred femoral veins instead, due to concerns about contamination, but the frequency of central venous catheterization was not affected by the COVID pandemic.

6. Data availability

The numerical data generated during this research is available with the authors.

7. Acknowledgement

We gratefully thank all participants of the study for their nice cooperation.

8. Conflict of interest

The study utilized the hospital resources only, and no external or industry funding was involved.

9. Authors' contribution

AZTC was the sole author of this manuscript. She was responsible for the study design, data collection, manuscript writing, statistical analysis, and critical revisions.

10. REFERENCES

1. Wu F, Zhao S, Yu B, Chen YM, Wang W, Song ZG, et al. A new coronavirus associated with human respiratory disease in China. *Nature*. 2020 Mar;579(7798):265-269. [PubMed] DOI: [10.1038/s41586-020-2008-3](https://doi.org/10.1038/s41586-020-2008-3)
2. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet*. 2020 Feb 15;395(10223):497-506. [PubMed] DOI: [10.1016/S0140-6736\(20\)30183-5](https://doi.org/10.1016/S0140-6736(20)30183-5)
3. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A Novel Coronavirus from Patients with Pneumonia in China, 2019. *N Engl J Med*. 2020 Feb 20;382(8):727-733. [PubMed] DOI: [10.1056/NEJMoa2001017](https://doi.org/10.1056/NEJMoa2001017)
4. Rodriguez-Morales AJ, Cardona-Ospina JA, Gutiérrez-Ocampo E, Villamizar-Peña R, Holguin-Rivera Y, Escalera-Antezana JP, et al. Clinical, laboratory and imaging features of COVID-19: A systematic review and meta-analysis. *Travel Med Infect Dis*. 2020 Mar-Apr;34:101623. [PubMed] DOI: [10.1016/j.tmaid.2020.101623](https://doi.org/10.1016/j.tmaid.2020.101623)

5. Clinical management of COVID-19. [cited 2023 Aug 18]. Available from: <https://www.who.int/teams/health-care-readiness/covid-19>
6. Central venous access in adults: General principles - UpToDate. [cited 2023 Mar 3]. Available from: <https://www.uptodate.com/contents/central-venous-access-in-adults-general-principles>
7. Tse A, Schick MA. Central Line Placement. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK470286/>
8. Practice Guidelines for Central Venous Access 2020: An Updated Report by the American Society of Anesthesiologists Task Force on Central Venous Access. *Anesthesiology*. 2020 Jan;132(1):8-43. [PubMed] DOI: [10.1097/ALN.0000000000002864](https://doi.org/10.1097/ALN.0000000000002864)
9. Pittiruti M, Pinelli F, Giuseppina Annetta M, Bertoglio S, GBiasucci D, Biffi R, et al. Considerations on the use of vascular access devices in patients with COVID-19 (and some practical recommendations). *GAVeCeLT*. 2020. [FreeFullText]
10. Benali M, Trabelsi B, Abdouli H, Yedes A, Elhadj Kacem H, Fki M. Ultrasound guidance versus anatomical landmarks for subclavian vein catheterization: a prospective study. *Tunis Med*. 2022 juillet;100(7):520-524. [PubMed]
11. Dixit P, Sirohiya P, Ratre BK. Ultrasound-guided central venous catheterization amid the COVID-19 outbreak: 'Revisiting protocols.' *Trends Anaesth Crit Care*. 2020;34:42-3. DOI: [10.1016/j.tacc.2020.06.009](https://doi.org/10.1016/j.tacc.2020.06.009)
12. Vailati D, Montrucchio G, Cerotto V, Capozzoli G, Gori F, Petrini F, et al. Choice and management of vascular access in the context of COVID-19 outbreak in Italy: Recommendations from clinical practice. *J Vasc Access*. 2022 Jan;23(1):18-23. [PubMed] DOI: [10.1177/1129729820968415](https://doi.org/10.1177/1129729820968415)
13. Deganello E, Gastaldo F, Masiero S, Fasson M, Colopi RI, Giroto L, et al. The impact of the SARS-CoV-2 epidemic outbreak on the vascular access team operations after conversion to COVID-19 dedicated hospital. *J Vasc Access*. 2022 Sep;23(5):710-717. [PubMed] DOI: [10.1177/11297298211005254](https://doi.org/10.1177/11297298211005254)
14. Technical specifications of personal protective equipment for COVID-19. World Health Organization. Available from: https://www.who.int/publications/i/item/WHO-2019-nCoV-PPE_specifications-2020.1
15. Phua J, Weng L, Ling L, Egi M, Lim CM, Divatia JV, et al. Intensive care management of coronavirus disease 2019 (COVID-19): challenges and recommendations. *Lancet Respir Med*. 2020 May;8(5):506-517. [PubMed] DOI: [10.1016/S2213-2600\(20\)30161-2](https://doi.org/10.1016/S2213-2600(20)30161-2)
16. Scoppettuolo G, Biasucci DG, Pittiruti M. Vascular access in COVID-19 patients: Smart decisions for maximal safety. *J Vasc Access*. 2020 Jul;21(4):408-410. [PubMed] DOI: [10.1177/1129729820923935](https://doi.org/10.1177/1129729820923935)
17. Ilonzo N, Rao A, Soundararajan K, Vouyouka A, Han D, Tadros R, et al. The importance of a centralized line service during the COVID-19 pandemic. *J Vasc Surg*. 2020 Aug;72(2):403-404. [PubMed] DOI: [10.1016/j.jvs.2020.05.016](https://doi.org/10.1016/j.jvs.2020.05.016)
18. Liu P, Lui D, Cheema SM, Hussain ST, Husain T, Malina M. O31 Central venous access in ventilated COVID-19 patients: a vascular surgery perspective. *Br J Surg*. 2021 Jul 30;108(Suppl 5):znab282.036.
19. Singh K, Bharti AK, Dubey PK. Use of 'Low approach' femoral central venous cannulation during COVID 19 pandemic. *Am J Emerg Med*. 2021 Nov;49:406-407. [PubMed] DOI: [10.1016/j.ajem.2021.02.010](https://doi.org/10.1016/j.ajem.2021.02.010)
20. Brass P, Hellmich M, Kolodziej L, Schick G, Smith AF. Ultrasound guidance versus anatomical landmarks for internal jugular vein catheterization. *Cochrane Database Syst Rev*. 2015 Jan 9;1(1):CD006962. [PubMed] DOI: [10.1002/14651858.CD006962.pub2](https://doi.org/10.1002/14651858.CD006962.pub2)