

World Journal of *Critical Care Medicine*

World J Crit Care Med 2021 July 9; 10(4): 61-162



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Bimonthly Volume 10 Number 4 July 9, 2021

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ABOUT COVER

Editorial board member of *World Journal of Critical Care Medicine*, Maria Kapritsou, MSc, PhD, RN, Chief Nurse, Nurse, Postdoc, Anaesthesiology, Hellenic Anticancer "Saint Savvas" Hospital, Day Care Clinic "N. Kourkoulos", Athens 11544, Greece. mariakaprit@gmail.com

AIMS AND SCOPE

The primary aim of the *World Journal of Critical Care Medicine (WJCCM, World J Crit Care Med)* is to provide scholars and readers from various fields of critical care medicine with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

WJCCM mainly publishes articles reporting research results and findings obtained in the field of critical care medicine and covering a wide range of topics including acute kidney failure, acute respiratory distress syndrome and mechanical ventilation, application of bronchofiberscopy in critically ill patients, cardiopulmonary cerebral resuscitation, coagulant dysfunction, continuous renal replacement therapy, fluid resuscitation and tissue perfusion, hemodynamic monitoring and circulatory support, ICU management and treatment control, sedation and analgesia, severe infection, etc.

INDEXING/ABSTRACTING

The WJCCM is now indexed in PubMed, PubMed Central, China National Knowledge Infrastructure (CNKI), China Science and Technology Journal Database (CSTJ), and Superstar Journals Database.

RESPONSIBLE EDITORS FOR THIS ISSUE

Production Editor: *Li-Li Wang*; Production Department Director: *Xiang Li*; Editorial Office Director: *Li-Li Wang*.

NAME OF JOURNAL

World Journal of Critical Care Medicine

ISSN

ISSN 2220-3141 (online)

LAUNCH DATE

February 4, 2012

FREQUENCY

Bimonthly

EDITORS-IN-CHIEF

Kam-Lun Ellis Hon

EDITORIAL BOARD MEMBERS

<https://www.wjgnet.com/2220-3141/editorialboard.htm>

PUBLICATION DATE

July 9, 2021

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INSTRUCTIONS TO AUTHORS

<https://www.wjgnet.com/bpg/gerinfo/204>

GUIDELINES FOR ETHICS DOCUMENTS

<https://www.wjgnet.com/bpg/GerInfo/287>

GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH

<https://www.wjgnet.com/bpg/gerinfo/240>

PUBLICATION ETHICS

<https://www.wjgnet.com/bpg/GerInfo/288>

PUBLICATION MISCONDUCT

<https://www.wjgnet.com/bpg/gerinfo/208>

ARTICLE PROCESSING CHARGE

<https://www.wjgnet.com/bpg/gerinfo/242>

STEPS FOR SUBMITTING MANUSCRIPTS

<https://www.wjgnet.com/bpg/GerInfo/239>

ONLINE SUBMISSION

<https://www.f6publishing.com>

Retrospective Study

Emergency service results of central venous catheters: Single center, 1042 patients, 10-year experience

Abuzer Coskun, Sakir Ömür Hıncal, Sevki Hakan Eren

ORCID number: Abuzer Coskun 0000-0003-4824-7021; Sakir Ömür Hıncal 0000-0002-2116-7710; Sevki Hakan Eren 0000-0003-1686-7234.

Author contributions: Coskun A and Eren SH contributed to study design, concept, writing the manuscript, and revising the final form; Coskun A and Hıncal SÖ contributed to data collection and manuscript revision; all authors contributed to writing and discussion management; all authors contributed to data management and manuscript revision, data collection, interpretation of data, and revising of the manuscript; Coskun A contributed to data collection and revision; Hıncal SÖ contributed to data collection and statistical analysis; Eren SH contributed to critical revision; Coskun A suggested the idea, as a chair of the department provided general support and substantial contribution to concept and design, and acquisition of data; all authors read and approved the final manuscript.

Institutional review board

statement: Ethical approval was obtained from the Local Ethics Committee of Cumhuriyet University Faculty of Medicine with the date of 04/12/2012 and

Abuzer Coskun, Sakir Ömür Hıncal, Emergency Medicine Clinic, SBU Istanbul Bağcılar Training and Research Hospital, Istanbul 34200, Turkey

Sevki Hakan Eren, Department of Emergency, Gaziantep University Medical Faculty, Gaziantep 27410, Turkey

Corresponding author: Abuzer Coskun, MD, Associate Professor, Doctor, Emergency Medicine Clinic, SBU Istanbul Bağcılar Training and Research Hospital, Central Quarter Dr. Sadık Ahmet Street, Bağcılar, Istanbul 34200, Turkey. dr.acoskun44@hotmail.com

Abstract

BACKGROUND

Central venous catheterization is currently an important procedure in critical care. Central catheterization has important advantages in many clinical situations. It can also lead to different complications such as infection, hemorrhage, and thrombosis. It is important to investigate critically ill patients undergoing catheterization.

AIM

To evaluate the characteristics, such as hospitalization, demographic characteristics, post-catheterization complications, and mortality relationships, of patients in whom a central venous catheter was placed in the emergency room.

METHODS

A total of 1042 patients over the age of 18 who presented to the emergency department between January 2005 and December 2015 were analyzed retrospectively. The patients were divided into three groups, jugular, subclavian, and femoral, according to the area where the catheter was inserted. Complications related to catheterization were determined as pneumothorax, guidewire problems, bleeding, catheter site infection, arterial intervention, and sepsis. Considering the treatment follow-up of the patients, three groups were formed as outpatient treatment, hospitalization, and death.

RESULTS

The mean age of the patients was 60.99 ± 19.85 years; 423 (40.6%) of them were women. Hospitalization time was 11.89 ± 16.38 d. There was a significant correlation between the inserted catheters with gender ($P = 0.009$) and hospitalization time ($P = 0.040$). Also, blood glucose, blood urea nitrogen, creatinine, and

the decision number of 08/12/2012.

Informed consent statement: The studied group as the study was retrospective in nature, and no specific intervention was described by the author's methodology. The medical research center waived the informed consent for the project.

Conflict-of-interest statement: The authors declare that they have no conflict of interest.

Data sharing statement: No additional data are available.

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Manuscript source: Invited manuscript

Specialty type: Critical care medicine

Country/Territory of origin: Turkey

Peer-review report's scientific quality classification

Grade A (Excellent): 0
Grade B (Very good): 0
Grade C (Good): C, C
Grade D (Fair): 0
Grade E (Poor): 0

Received: February 26, 2021

Peer-review started: February 26, 2021

First decision: April 6, 2021

Revised: April 29, 2021

Accepted: May 20, 2021

Article in press: May 20, 2021

Published online: July 9, 2021

P-Reviewer: Ferreira GSA

S-Editor: Gao CC

serum potassium values among the biochemical values of the patients who were catheterized were significant. A significant association was observed in the analysis of patients with complications that develop according to the catheter region ($P = 0.001$) and the outcome stage ($P = 0.001$). In receiver operating characteristic curve analysis of hospitalization time and mortality area under curve was 0.575, the 95% confidence interval was 0.496-0.653, the sensitivity was 71%, and the specificity was 89% ($P = 0.040$).

CONCLUSION

Catheter location and length of stay are important risk factors for catheter-borne infections. Because the risk of infection was lower than other catheters, jugular catheters should be preferred at entry points, and preventive measures should be taken by monitoring patients closely to reduce hospitalization infections.

Key Words: Emergency service; Central venous catheter; Complications; Infection; Mortality

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Core Tip: A total of 1042 patients were included in this retrospective study. All central venous catheters were inserted in the emergency room. This study included 10 years of experience in our emergency department. In receiver operating characteristic curve analysis of hospitalization time and mortality, sensitivity was 71%, and specificity was 89% ($P = 0.040$). Complications in the subclavian vein and femoral vein were observed more frequently in the long term. Jugular vein catheterization can be preferred primarily due to the difficulties in application and due to the low number of complications.

Citation: Coskun A, Hincal SÖ, Eren SH. Emergency service results of central venous catheters: Single center, 1042 patients, 10-year experience. *World J Crit Care Med* 2021; 10(4): 120-131

URL: <https://www.wjgnet.com/2220-3141/full/v10/i4/120.htm>

DOI: <https://dx.doi.org/10.5492/wjccm.v10.i4.120>

INTRODUCTION

Emergency services are dynamic clinics where acute and emergency aspects of diseases and injuries affecting patients of all age groups are prevented. Resuscitation, primary care, diagnosis, and treatment of emergency cases are performed. Due to the nature of acute illnesses and injuries and their independence from each other, when they will come to emergency services and their number cannot be predicted[1]. Acute procedures should be done as soon as possible in terms of the density, variety, and patient circulation of emergency services.

Intravenous applications in emergency rooms act as a lifeline in saving the life of the patient. For this reason, the process must be done quickly and safely. In a study conducted on patients with penetrating injuries in the emergency department, timely and effective intravenous interventions were reported to increase survival rates[2].

Central venous catheterization (CVC) is an important intervention that is widely used today. Emergency services have a large variety of patient populations where central venous interventions are frequently applied. CVC is necessary for the use of vasoactive or irritant drugs, in insufficient peripheral intravenous routes, rapid infusion of intravenous fluids, parenteral alimentation, frequent therapeutic plasmapheresis, and transvenous pacemaker placement. In addition, CVC is used for hemodialysis and hemodynamic monitoring during major surgery[3].

A central venous catheter is to be placed percutaneously. The main routes of catheterization are the internal jugular vein (IJV), subclavian vein (SCV), and femoral vein (FV). The placement of a catheter in the IJV is gaining in popularity and is preferred in children[4]. Various complications may develop in CVC, such as pneumothorax, hemothorax, venous thrombosis, vertebral and cervical artery injuries, artery puncture, bleeding, arrhythmia, catheter dysfunction such as catheter blockage or

L-Editor: Filipodia

P-Editor: Wang LL



catheter breakage, infection, cardiac tamponade, respiratory tract obstruction, and chylothorax[5,6].

Each catheter region to be used has its advantages and disadvantages. IJV catheterization is often used in intensive care units on mechanically ventilated comatose patients. SCV catheterization is not preferred in these patients due to the risk of sudden pneumothorax[7]. The most important disadvantage of IJV catheterization is the difficulty of detecting the skin and restricting neck movements. The risk of pneumothorax, hemothorax, and vena cava superior injury is much less. At the same time, the development of thrombosis and narrowing of the IJV is much less due to the lack of catheter angulation, which is monitored in the SCV[8].

The aim of this study was to analyze the different catheter insertion sites, diagnoses, complications, length of hospitalization, catheter-related local infection, and bacteremia in terms of morbidity and mortality in patients who were followed up in the emergency service.

MATERIALS AND METHODS

Study design and population

In this retrospective study, 1042 patients over 18-years-old who were admitted to the emergency room between January 2005 and December 2015 were analyzed. CVC was implanted in patients whose general condition was poor, whose vascular access could not be opened in the emergency room, who needed dialysis and fluid resuscitation, who suffered traffic accidents, falls, burns, malignancy, or acute and chronic renal failure, and who needed blood or cardiopulmonary resuscitation. The exclusion criteria were applied to all patients with severe bleeding diathesis and an indication other than infection in the area where the catheter was to be placed. All patients were divided into three groups: jugular, subclavian, and femoral according to the area of the catheter placed. These catheters were divided into right and left. Seven groups were formed according to complications after catheterization: pneumothorax, guidewire problems, bleeding, catheter location infection, arterial interference, sepsis, and no complications. Patients who were planned to have a catheter application were divided into subgroups according to their diagnosis. The subgroups were renal diseases (acute and chronic renal failure), respiratory diseases (asthma, chronic obstructive pulmonary diseases, pulmonary embolism), endocrine diseases (hypoglycemia, diabetic ketoacidosis, hyperosmolar coma, thyroid crises), multiple organ failure, gastrointestinal bleeding and perforations, cerebrovascular diseases (cerebrovascular infarcts, intraparenchymal hemorrhages, epidural and subdural hemorrhages, cerebral edema, subarachnoid hemorrhages), trauma to the thorax (thoracic open injury, severe pneumothoraces, severe lung parenchymal injuries), traffic accidents (inside and outside the vehicle), malignancies in poor general condition, life-threatening gunshot injuries, cardiac diseases (myocardial infarction, heart failure, cardiac tamponade, cardiomyopathies), cardiovascular diseases (aortic dissection and aneurysms), severe injuries as a result of falls, second and third-degree burns with a large surface area, extremity amputation, penetrating-cutting tool injuries, and cardiopulmonary resuscitation. It could be done in more groups, but the most common diagnoses requiring catheter indication were included in the emergency department.

Sixteen groups were also identified according to the services where catheterized patients were hospitalized. These services were emergency services, infectious diseases, general internal medicine, nephrology, gastroenterology, intensive care unit, cardiology, neurosurgery, thoracic surgery, chest diseases, general surgery, cardiovascular surgery, neurosurgery, plastic surgery, burn unit, and neurology services.

Patients were observed from hospitalization until discharge. Outpatients were followed up retrospectively with an automation system for 3 mo after they were discharged, and those who did not come to the hospital were questioned by phone. Diagnoses, admission dates, contact information, demographic, clinical, and laboratory data are included in the registry system of our hospital. As a result, all patients were reached *via* call and/or hospital records.

Central venous catheter

Kits prepared for central venous catheter application in the emergency department were used. Components of these kits included: The needle included an injector to allow passage of the guidewire, double or triple catheter, guidewire, plastic sheath in which the guidewire was placed, dilator, 3/0 silk sharp needle suture, and scalpel. A

central venous catheter procedure was performed under local anesthesia. The patient was placed in the supine position. The jugular vein catheter was positioned with the head slightly down. For the SCV catheter, the arms were extended to the sides parallel to the body. For the FV catheter, the legs were kept open at a certain angle. During the procedure, the patient was monitored, and heart rhythm was followed. The sterility of the area where the catheter will be applied was provided with 10% povidone-iodine. Lidocaine was used for local anesthesia. The Seldinger technique was used for central venous catheter application[9]. Main lines of central venous catheter application after anesthesia was achieved included: (1) sterilizing the procedure area; (2) proper positioning of the thick needle to which the guidewire will be sent; (3) inserting the guidewire into the vein lumen by applying slight negative pressure; (4) advancing the guidewire into the vein lumen; (5) dilating the path through which the catheter will pass; (6) inserting the catheter into the vein with the help of a guidewire; (7) adequate progression and fixation of the catheter in the vein; and (8) closing in a sterile manner. Lung radiography and ultrasonography were performed for central venous catheter complications.

Catheter-related infection was determined according to the "Centers for Disease Control" criteria[10]. Catheter tip colonization was accepted if more than 15 colony-forming units microorganisms were produced from the catheter tip. Local signs for catheter-induced local infection (induration, edema, heat increase, purulent yeast arrival) and the reproduction of microorganisms in catheter tip culture were noted.

Criteria used in determining the location of the central venous catheter

In the emergency department, ultrasonography was not commonly used until 2018. For this reason, none of the 1042 patients could be subjected to catheter placement accompanied by ultrasonography. Accompanied by ultrasonography, we were unable to learn about complications that may occur as a result of catheter placement. But for catheter placement, all patients were applied with some criteria. These criteria are as follow.

Jugular catheters: Elderly, cachectic, superficial vein structure, lack of coagulopathy barrier, lack of local wound infection, low risk of pneumothorax, rapid venous return, and direct compression in bleeding. Right or left catheter placement was performed according to the current condition of the patient and the experience of the clinician.

Subclavian catheters: Obesity, the dressing was comfortable, the placement procedure was possible while ensuring airway control, there was no local infection, no coagulopathy, and the right or left catheter was placed according to the experience of the clinician.

Femoral catheters: Fast intervention with high success rate, no local infection, no coagulopathy, no division during cardiopulmonary resuscitation and/or intubation, no risk of pneumothorax, no Trendelenburg position, cachectic patients and according to the experience of the clinician, right or left catheters were placed. However, due to the current location of the inguinal region, jugular or subclavian catheters were preferred more because of the high risk of infection, although sterility was taken into consideration.

Laboratory design: Hemogram and biochemical blood samples of the patients were taken at the emergency service. Hemogram was measured using Sysmex DI-60 CBC Analyzer (Istanbul, Turkey). Biochemistry was analyzed by Beckman Coulter Automated AU-680 (Beckman Coulter, Inc., Fullerton, CA, United States). Hemogram and biochemistry results were studied between 45-60 min.

Statistical analysis

The data obtained from the study were analyzed with the SPSS 20 (SPSS Inc., Chicago, IL, United States) package program. Kolmogorov-Smirnov test was performed while investigating the normal distributions of the variables. Descriptive statistics were presented as mean \pm SD or median (minimum-maximum) for continuous variables and as the number of cases and percentage (%) for nominal variables. When examining the differences between groups, Mann-Whitney *U* and Kruskal-Wallis *H* tests were used because the variables did not come from the normal distribution. ² analysis was used when examining the relationships between groups of nominal variables. Receiver operating characteristic curve analysis was performed to predict the development of mortality. While interpreting the results, values below the significance level of 0.05 were considered statistically significant.

RESULTS

The mean age of the patients was 60.99 ± 19.85 years (minimum 18-maximum 99); 423 (40.6%) of them were women. The mean age of jugular vein catheter patients was 60.74 ± 20.20 years, and 339 (40%) were female. The mean age of SCV catheter patients was 59.66 ± 19.17 years, and 42 (27.3%) were female. The mean age of FV catheter patients was 63.67 ± 18.57 years and 42 (42%) were women. Hospitalization time was 11.89 ± 16.38 d. The patients who were catheterized were not statistically significant with age ($P = 0.939$), but there was a significant correlation with gender ($P = 0.009$) and hospitalization time ($P = 0.040$). Also, blood glucose, blood urea nitrogen, creatinine, and serum potassium were statistically significant from the biochemical values of the patients who were catheterized. The relationship with other biochemical values could not be determined. Among the hemogram parameters, it was statistically significant with hemoglobin and mean corpuscular hemoglobin concentration, and no correlation was found with other values (Table 1).

In the analysis of the patients by catheter site, gender ($P = 0.004$), developing complications ($P = 0.009$), and final decision stage ($P = 0.001$) were statistically significant. While 174 (16.7%) of all patients were treated on an outpatient basis, 783 (75.1%) of them were found to be cured, and 85 (8.2%) died ($P = 0.001$, Table 2).

In the analysis of patients with their diagnosis according to the catheterized region, in general, the right IJV catheter was inserted most often. In addition, the right FV in multiple organ failure, the left SCV in chest injuries, burns, piercing-cutting tool injuries, and cardiopulmonary resuscitation, and the right SCV in cardiovascular diseases were the most common catheter-inserted vein (Table 3).

The analysis of the patients according to the services they received while hospitalized after being catheterized is shown in Table 4.

In receiver operating characteristic curve analysis of hospitalization time and mortality, the area under curve was 0.575, the 95% confidence interval was 0.496-0.653, the sensitivity was 71%, and the specificity was 89% ($P = 0.001$) (Figure 1).

DISCUSSION

Intravenous catheters, one of the indispensable tools in modern medical practices, are applied for specific purposes and can be used for a long time. Although central venous catheters provide great benefits for patients, they also cause significant mortality and morbidity due to both mechanical and infectious complications[11,12]. In emergencies and critical patient follow-up, CVC is often needed. However, there are important points to be considered in CVC. First of all, it should be preferred to use a central vein with a large flow rate and high current. For this purpose, percutaneous IJV, SCV, and FV are used in CVC[4]. Right IJV is preferred primarily because of its straight connection with the superior vena cava and its short distance to the right atrium[7]. Left IJV should be the next choice because it reaches the superior vena cava by angulation twice, and catheterization is technically difficult. If there are coagulation and bleeding disorders, SCV catheterization is high risk, and in these cases, extrathoracic veins such as IJV or FV should be used[3,7,8]. Mickley[8] stated that the right IJV should be used if possible for central venous interventions and hemodialysis catheters. Central vein catheterization is a generally accepted protocol using the original Seldinger technique[9]. The Seldinger technique was used in all cases, and the rules of asepsis were adhered to. Right IJV was observed in 56.7% of the cases, left IJV in 14.8%, right SCV in 6.5%, left SCV in 8.4%, right FV in 7.4%, and left FV in 6.1%.

CVC can cause some complications. Early complications include arterial puncture, development of hematoma, nerve injury, pneumothorax, hemothorax, difficulty in cannulation, and arrhythmia. No complications were observed in 92.9% of our patients, most of whom had IJV intervention. In addition to expected complications such as pneumothorax and hemothorax, complications such as brachial plexus injury due to SCV catheterization or massive retroperitoneal hemorrhage due to femoral catheterization can be seen[13,14]. Pneumothorax was seen in 4 (0.4%) cases, one right subclavian and three left subclavian cases. All of these patients were cachectic and in poor general condition. Catheter dysfunction is caused by catheter malposition, catheter kinking, or catheter compression[15,16]. Bending and breaking of the guidewire in the vein was detected in a total of 2 (0.2%) patients, one in the left SCV and the other in the right FV. In preventing early catheter dysfunction, IJV catheterization may be an advantage in priority. In total, 8 (0.8%) of the patients had bleeding, 30 patients (2.9%) had artery puncture, 1 patient had hematoma, and 2 patients had

Table 1 Basal and laboratory features of the inserted catheters

Catheter area inserted	All patients, n = 1042, mean ± SD	Jugular, n = 743, mean ± SD	Subclavian, n = 155, mean ± SD	Femoral, n = 144, mean ± SD	P value
Baseline characteristics					
Age, yr	60.99 ± 19.85	60.74 ± 20.20	59.66 ± 19.17	63.67 ± 18.57	0.939
Sex, female/male	423/619	339/449	42/112	42/58	0.009
Hospitalization time	11.89 ± 16.38	12.50 ± 16.03	11.00 ± 20.08	9.73 ± 13.39	0.040
Laboratory finding					
Biochemistry					
BS, mg/dL	139.45 ± 101.56	145.21 ± 112.63	120.35 ± 55.74	130.30 ± 72.49	0.008
BUN, mg/dL	42.77 ± 41.29	51.11 ± 44.40	19.65 ± 13.91	24.58 ± 26.42	0.001
Creatinine, mg/dL	2.62 ± 2.89	3.20 ± 3.14	0.99 ± 0.68	1.37 ± 1.68	0.001
TBIL, mg/dL	0.87 ± 0.84	0.82 ± 0.63	0.80 ± 0.88	1.22 ± 1.43	0.485
AST, mg/dL	37.65 ± 47.22	32.56 ± 25.60	40.04 ± 60.05	61.38 ± 90.77	0.508
ALT, mg/dL	35.81 ± 49.37	30.31 ± 26.18	38.58 ± 67.59	61.21 ± 91.95	0.710
ALP, mg/dL	108.57 ± 64.10	104.95 ± 56.71	104.66 ± 59.33	131.48 ± 93.90	0.569
Na, mmol/L	138.61 ± 5.38	138.68 ± 5.33	138.22 ± 5.07	138.68 ± 5.96	0.125
K, mmol/L	5.00 ± 1.03	5.13 ± 1.10	5.07 ± 0.71	4.79 ± 0.70	0.027
Cl, mmol/L	100.23 ± 6.23	100.18 ± 6.11	100.41 ± 6.95	100.29 ± 6.04	0.778
Amylase	89.98 ± 49.88	87.93 ± 47.66	91.64 ± 53.25	98.78 ± 56.30	0.419
CRP, mg/dL	4.44 ± 8.12	3.53 ± 5.14	4.32 ± 7.65	9.26 ± 15.90	0.925
Hemogram					
WBC, × 10 ³ /UL	10.57 ± 4.51	10.26 ± 3.59	10.32 ± 4.05	12.49 ± 7.72	0.228
Hb, g/dL	13.77 ± 2.07	13.63 ± 2.12	14.09 ± 1.77	14.16 ± 1.98	0.017
Hct, %	42.17 ± 6.62	42.07 ± 6.78	42.23 ± 5.80	42.62 ± 6.65	0.737
MCV, fL	87.74 ± 6.29	87.71 ± 6.42	87.45 ± 6.18	88.24 ± 5.70	0.927
MCH, pg	29.37 ± 2.36	29.30 ± 2.41	29.48 ± 2.29	29.67 ± 2.20	0.905
MCHC, g/dL	33.25 ± 1.36	33.19 ± 1.37	33.47 ± 1.29	33.29 ± 1.36	0.002
RDW, %	14.69 ± 1.73	14.74 ± 1.79	14.45 ± 1.50	14.66 ± 1.61	0.082
PLT, × 10 ³ /μL	248.22 ± 80.14	248.71 ± 76.33	256.88 ± 76.01	236.42 ± 100.38	0.073
MPV, fL	8.48 ± 1.01	8.54 ± 1.03	8.33 ± 1.06	8.34 ± 0.86	0.085

ALP: Alkaline phosphatase; ALT: Alanine aminotransferase test; AST: Aspartate aminotransferase test; BS: Blood sugar; BUN: Blood urea nitrogen; Cl: Chlorine; CRP: C-reactive protein; Hb: Hemoglobin; Hct: Hematocrit; K: Potassium; MCH: Mean corpuscular hemoglobin; MCHC: Mean corpuscular hemoglobin concentration; MCV: Mean corpuscular volume; MPV: Mean platelet volume; Na: Sodium; PLT: Platelet; RDW: Red cell distribution width; SD: Standard deviation; TBIL: Total bilirubin; WBC: White blood cell.

difficulty catheterizing. In similar studies, the incidence of carotid artery puncture was reported between 2.0%-9.9% during catheterization of IJV[5]. Most of the difficulties in arterial puncture and cannulation observed in our catheterization-related cases were obesity, short neck, elderly, and poor general condition as the main cause of these early complications.

During jugular catheterization, complications such as Horner Syndrome, arrhythmia, and cardiac tamponade have been reported, as well as the development of carotid-jugular arteriovenous fistula due to carotid puncture[17,18]. In a total of 4 (0.4%) cases, no other complications were observed except arrhythmia. It is recommended to monitor the patient during the jugular site catheterization and to take a chest radiograph after the application[19]. Both examinations are routinely performed

Table 2 Analysis of the inserted catheter area according to gender, complication, and final situation

	Catheter area inserted						Total, n (%)	P value	
	R jugular, n (%)	L jugular, n (%)	R subclavian, n (%)	L subclavian, n (%)	R femoral, n (%)	L femoral, n (%)			
Gender									
Female	248 (42.0)	73 (47.4)	20 (29.4)	23 (26.1)	30 (39.0)	29 (45.3)	423 (40.6)	0.009	
Male	343 (58.0)	81 (52.6)	48 (70.6)	65 (73.9)	47 (61.0)	35 (54.7)	619 (59.4)		
Complication									
No	583 (98.6)	149 (96.8)	63 (92.6)	75 (85.2)	49 (63.6)	46 (71.9)	965 (92.6)	0.001	
Pntx	0	0	1 (1.5)	3 (3.4)	0	0	4 (0.4)		
GW	0	0	0	0	1 (1.3)	1 (1.6)	2 (0.2)		
Bleeding	2 (0.3)	0	0	4 (4.5)	1 (1.3)	1 (1.6)	8 (0.8)		
WI	2 (0.3)	1 (0.6)	1 (1.5)	1 (1.1)	2 (2.6)	6 (9.4)	13 (1.2)		
AI	4 (0.7)	4 (2.6)	2 (2.9)	3 (3.4)	11 (14.3)	3 (4.7)	27 (2.6)		
Sepsis	0	0	1 (1.5)	2 (2.3)	13 (16.9)	7 (10.9)	23 (2.2)		
Decision									
OPT	104 (17.6)	28 (18.2)	12 (17.6)	14 (15.9)	9 (11.7)	7 (10.7)	174 (16.7)		0.001
DWH	484 (81.9)	121 (78.6)	46 (67.6)	58 (63.6)	35 (45.5)	41 (64.1)	783 (75.1)		
Mortality	3 (0.5)	5 (3.2)	10 (14.7)	18 (20.5)	33 (42.9)	16 (25.0)	85 (8.2)		
Total	591 (100)	154 (100)	68 (100)	88 (100)	77 (100)	64 (100)	1042 (100)		

AI: Arterial intervention; DWH: Discharged with healing; GW: Guide wire; L: Left; Pntx: Pneumothorax; OPT: Outpatient treatment; R: Right; WI: Wound infection.

in our cases. Also, in cases with arrhythmia, the guidewire was withdrawn to a certain extent, the procedure was interrupted, and major complications were prevented.

The average staying time of temporary catheters should not exceed 3-4 wk for IJV and SCV catheters and 2 wk for femoral catheters[5]. The average length of stay in our study did not exceed 2 wk. The length of stay of the catheter is associated with both thrombotic complications and the risk of infection[20].

In the study of Cook *et al*[21], it was stated that changing catheters at short intervals did not decrease the frequency of colonization and infection. Because catheter insertion is a traumatic procedure and there is a risk that asepsis conditions may deteriorate during catheter insertion, installing a new catheter in itself poses a risk of catheter-related infection. It is known that there is a directly proportional relationship between catheter insertion time and catheter colonization and catheter-related infection[22,23]. Chen *et al*[24] found that the stay of the catheter for more than 7 d was significant in terms of catheter-related infection.

Infections developing in CVC for various reasons lead to very serious complications including patient mortality[25]. Early infection is associated with contamination during catheter insertion, skin infection, or catheter pathway infection. Late infection is often accompanied by endoluminal catheter contamination[26]. Two types of infections are observed: local infection and systemic infections. *Staphylococcus aureus* (*S. aureus*) and *S. epidermiditis* are the most common microorganisms isolated during catheter-related bacteremia. This risk increases in the presence of wound infection. The risk of infection is higher with FV catheters than with SCV and IJV catheters[27]. In our study, wound infection due to catheters was detected in 13 (1.2%) cases. Localized infection findings were observed in 8 (0.7%) FV, 3 (0.3%) IJV, and 2 (0.2%) SCV. Although *S. aureus* and *S. epidermiditis* grew in the samples taken from the wound site, there was no growth in the samples taken from the catheter tip. Blood cultures were not routinely sent from the patients. We think that there was no growth in the catheter tip cultures, care for sterility while inserting the catheter, careful and regular dressing of the insertion site, and not using the catheters for more than 3 wk.

Table 3 Analysis of inserted catheter sites according to diseases

Diagnosis	Catheter area inserted						Total, n (%)
	R jugular, n (%)	L jugular, n (%)	R subclavian, n (%)	L subclavian, n (%)	R femoral, n (%)	L femoral, n (%)	
Renal diseases	228 (38.5)	43 (27.9)	1 (1.5)	2 (2.3)	6 (7.8)	5 (7.8)	285 (27.3)
Respiratory diseases	45 (7.6)	8 (5.1)	3 (4.4)	3 (3.4)	16 (20.8)	6 (9.4)	81 (7.8)
Endocrine diseases	34 (5.8)	7 (4.5)	1 (1.5)	0	4 (5.2)	0	46 (4.4)
Multiple organ insufficiency	0	0	1 (1.5)	2 (2.3)	12 (15.6)	7 (10.9)	22 (2.1)
Gastrointestinal system bleeding	56 (9.5)	12 (7.8)	2 (2.9)	0	0	3 (4.7)	73 (7.0)
Gastrointestinal system perforations	27 (4.6)	2 (1.3)	2 (2.9)	0	5 (6.5)	1 (1.6)	37 (3.6)
Cerebrovascular diseases	61 (10.3)	16 (10.4)	0	1 (1.1)	4 (5.2)	3 (4.7)	85 (8.2)
Thoracic traumas	1 (0.2)	0	7 (10.3)	14 (15.9)	0	0	22 (2.1)
Traffic accidents	12 (2.0)	7 (4.5)	1 (1.5)	2 (2.3)	0	0	22 (2.1)
Malignancies	30 (5.1)	7 (4.5)	4 (5.9)	1 (1.1)	4 (5.2)	4 (6.3)	50 (4.8)
Firearm injury	5 (0.8)	3 (1.9)	3 (4.4)	4 (4.5)	1 (1.3)	1 (1.6)	17 (1.6)
Cardiac diseases	39 (6.6)	22 (14.3)	1 (1.5)	1 (1.1)	5 (6.5)	13 (20.3)	81 (7.8)
Cardiovascular diseases	1 (0.2)	2 (1.3)	3 (4.4)	3 (3.4)	6 (7.8)	0	15 (1.4)
Falls	26 (4.4)	15 (9.7)	12 (17.6)	7 (8.0)	3 (3.9)	6 (9.4)	69 (6.6)
Burns	22 (3.7)	9 (5.8)	18 (26.5)	27 (30.7)	8 (10.4)	12 (18.8)	96 (9.2)
Amputation	1 (0.2)	1 (0.6)	0	2 (2.3)	0	0	4 (0.4)
Penetrating tool injury	3 (0.5)	0	8 (11.8)	11 (12.5)	1 (1.3)	1 (1.6)	24 (2.3)
Cardiopulmonary resuscitation	0	0	1 (1.5)	8 (9.1)	2 (2.6)	2 (3.1)	13 (1.2)
Total	591 (100)	154 (100)	68 (100)	88 (100)	77 (100)	64 (100)	1042 (100)

L: Left; R: Right.

Blot *et al*[28] found that *S. aureus*, coagulase negative *Staphylococcus*, and *Pseudomonas aeruginosa* were the most frequently isolated agents in catheter-related infections and catheter colonization. Chen *et al*[24] often isolated Gram-positive cocci and yeasts in cases of catheter-related infection. In the study of Yapar *et al*[29], 14 of 97 patients using long-term CVC had a catheter-related infection, 28.5% of the agents were coagulase negative *Staphylococcus*, 21.4% *S. aureus*, 21.4% *Acinetobacter* species, and 14.5% *Klebsiella pneumoniae*. It has been reported that 7.1% are *Pseudomonas* species, and 7.1% are *Escherichia coli*. Although catheter-related blood infections vary according to the size of the hospital, the unit, and the type of catheter, studies have reported that it ranges between 2.5% and 14.5% [25]. In our study, sepsis developed due to infection in 23 (2.2%) patients. Most of these patients were detected in 13 (1.2%) cases in the right FV and 7 (0.7%) cases in the left FV. All of these cases consisted of obese, poor general condition, and intensive care patients. In 6 (0.6%) of these blood culture cases, *S. aureus*, 3 (0.3%) coagulase negative *Staphylococcus*, 2 (0.2%) *Pseudomonas aeruginosa*, 3 (0.3%) *Acinetobacter* species, 7 (0.7%) *Escherichia coli*, and 2 (0.2%) Gram-positive cocci were found to reproduce. While 174 (16.7%) of all patients were treated on an outpatient basis, 783 (75.1%) of them were found to be cured, and 85 (8.2%) died. The reason for the high mortality rate is that the general condition of patients with catheters inserted is poor, the coma score is low, and most patients need care.

CONCLUSION

CVC is an indispensable application especially for emergency services and brings with

Table 4 Analysis of the inserted catheter areas according to the services where the patients were hospitalized

Hospital services	Catheter area inserted						Total, n (%)
	R jugular, n (%)	L jugular, n (%)	R subclavian, n (%)	L subclavian, n (%)	R femoral, n (%)	L femoral, n (%)	
Emergency department	94 (15.9)	27 (17.5)	12 (17.6)	14 (15.9)	10 (13.0)	10 (15.6)	167 (16)
Infectious diseases service	11 (1.9)	2 (1.3)	1 (1.5)	1 (1.1)	3 (3.9)	4 (6.3)	22 (2.1)
General internal medicine service	173 (29.3)	45 (29.2)	5 (7.4)	1 (1.1)	9 (11.7)	8 (12.5)	241 (23.1)
Nephrology service	99 (16.8)	21 (13.6)	0	3 (3.4)	7 (9.1)	5 (7.8)	135 (13)
Gastroenterology service	29 (4.9)	7 (4.5)	0	0	0	2 (3.1)	38 (3.6)
Intensive care unit	40 (6.8)	10 (6.5)	13 (19.1)	17 (19.3)	31 (40.3)	20 (31.3)	131 (12.6)
Cardiology service	12 (2.0)	3 (1.9)	1 (1.5)	2 (2.3)	1 (1.3)	1 (1.6)	20 (1.9)
Brain surgery service	24 (4.1)	7 (4.5)	5 (7.4)	7 (8.0)	2 (2.6)	3 (4.7)	48 (4.6)
Thoracic surgery service	4 (0.7)	4 (2.6)	6 (8.8)	13 (14.8)	4 (5.2)	2 (3.1)	33 (3.2)
Chest diseases service	18 (3.0)	7 (4.5)	0	1 (1.1)	1 (1.3)	1 (1.6)	28 (2.7)
General surgery service	46 (7.8)	3 (1.9)	8 (11.8)	9 (10.2)	7 (9.1)	4 (6.3)	77 (7.4)
Cardiovascular surgery service	10 (1.7)	0	7 (10.3)	10 (11.4)	1 (1.3)	1 (1.6)	29 (2.8)
Orthopedics and traumatology service	10 (1.7)	13 (8.4)	10 (14.7)	6 (6.8)	0	2 (3.1)	41 (3.9)
Plastic and reconstructive surgery service	4 (0.7)	2 (1.3)	0	4 (4.5)	0	1 (1.6)	11 (1.1)
Neurology service	17 (2.9)	3 (1.9)	0	0	1 (1.3)	0	21 (2.0)
Total	591 (100)	154 (100)	68 (100)	88 (100)	77 (100)	64 (100)	1042 (100)

L: Left; R: Right.

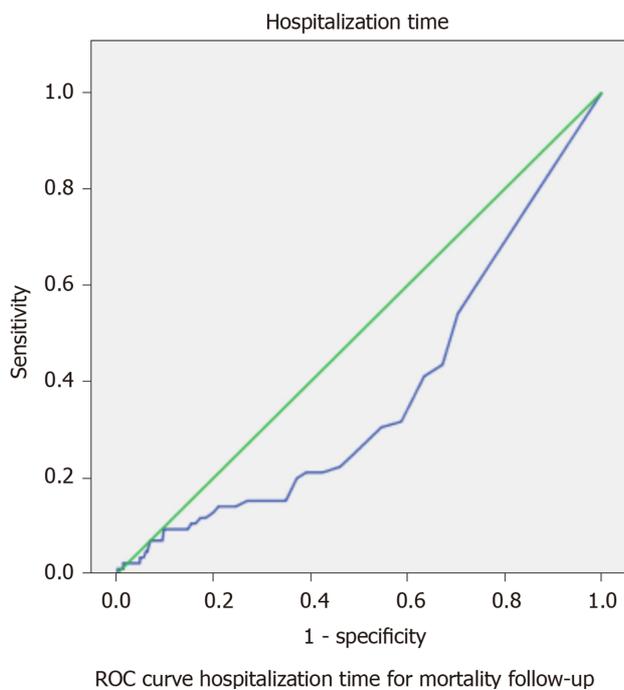


Figure 1 Mortality analysis of hospitalization time. ROC: Receiver operating characteristic.

it the risk of many complications. Complications in the subclavian and FVs are more common in long-term use. Jugular vein catheterization can be preferred primarily due to the difficulties in application and the low number of complications. In addition, prevention of risk factors with infection control policies and measures developed can significantly reduce catheter-related infection rates.

ARTICLE HIGHLIGHTS

Research background

Risk assessment in patients with a central venous catheter is necessary to prevent some unwanted consequences associated with invasive procedures.

Research motivation

The impact on the clinical, morbidity, and mortality of patients with central venous catheters in the emergency room population is worth investigating.

Research objectives

We aimed to determine whether there is a definite risk factor in short-term emergency room stay as the primary outcome of patients with central venous catheters and as a secondary outcome whether there is long-term morbidity and mortality at the time of hospitalization.

Research methods

In this study, 1042 patients who were admitted to the emergency department between 2005 and 2015 were analyzed, retrospectively. The patients in whom a central venous catheter was placed in the study were divided into three groups as jugular, subclavian, and femoral. Complications, diagnosis, and hospital stay after catheter insertion were evaluated.

Research results

The mean age of the patients was 60.99 ± 19.85 years; 423 (40.6%) of them were women. Hospitalization time was 11.89 ± 16.38 d. The mean age of the patients with jugular catheters was 60.74 ± 20.20 years, and 339 (40%) of them were women. The mean age of subclavian catheter patients was 59.66 ± 19.17 years, and 42 (27.3%) of them were women. In femoral catheters, the mean age was 63.67 ± 18.57 years, and 42 (42%) were women. There was a significant relationship between the inserted catheters with gender ($P = 0.009$) and hospitalization time ($P = 0.040$). The biochemical values of the placed catheters were statistically significant with blood glucose, blood urea nitrogen, creatinine, and serum potassium. A significant association was observed in the analysis of patients according to complications ($P = 0.001$) and outcome stage ($P = 0.001$). While 174 (16.7%) of all patients were treated on an outpatient basis, 783 (75.1%) of them were found to be cured, and 85 (8.2%) died. In receiver operating characteristic curve analysis of hospitalization time and mortality, the area under curve was 0.575, the 95% confidence interval was 0.496-0.653, the sensitivity was 71%, and the specificity was 89% ($P = 0.040$).

Research conclusions

The jugular vein is safer and more comfortable for patient compliance between central venous catheters. Femoral vein catheters are at higher risk for infection. Changing central catheters frequently does not reduce the risk of infection and complications.

Research perspectives

Subclavian catheters have a high risk of hemopneumothorax in cachectic patients. Jugular catheters are safe. However, it is not preferred due to the discomfort of the patients and the limited neck movements. It is difficult to attach a jugular catheter to short and obese patients. Also, artery puncture is common. Femoral catheters are the group with the highest infection rate.

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