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"A Comparison of Internal Jugular Vein Cannulation Versus Supraclavicular Brachiocephalic Vein Cannulation Using Ultrasound Guidance"

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Abstract: Patients in intensive care often have central venous catheters (CVCs) placed. The use of ultrasonography to aid with CVC insertion has improved the success rate and decreased the risk of complications. This study compared ultrasonically guided cannulation of the internal jugular vein (OOP-IJV) and the supraclavicular subclavian vein (IP-SSCV) in adult intensive care unit (ICU) patients for purposes of efficacy and safety. Researchers conducted a prospective randomized clinical investigation in an adult medical-surgical critical care unit. Patients in need of a first CVC insertion were split into two groups based on whether they would pay for their care themselves (OOP-IJV) or have it covered by insurance (IP-SSCV). There was an analysis of things like success rates, durations of procedures, needle re-directions, difficulties inserting guidewires, and complication rates. The IP-SSCV group had a higher proportion of first-attempt success (83.2% vs. 63.2%) and a shorter mean insertion time (43.98 vs. 53.12 seconds). When compared to the control group, those who received IP-SSCV had less complications such as guidewire progression problems, needle re-directions, and puncture site hematomas. The frequency of adverse events did not differ significantly across the research groups. Higher first-attempt success rates and fewer procedural complications were seen with ultrasound-guided IP-SSCV cannulation in adult ICU patients compared to OOP-IJV cannulation. When compared to central venous catheterization, IP-SSCV cannulation is a less invasive and perhaps less risky procedure for patients.

Keywords: central venous catheterization, ultrasound guidance, internal jugular vein, subclavian vein, intensive care unit, supraclavicular approach.

Background

The insertion of a central venous catheter (CVC) is a frequent kind of invasive surgery used to treat critically unwell patients [1]. This treatment requires access to both the internal jugular vein (IJV) and the subclavian vein (SCV). The placement of a central venous catheter (CVC) is associated with a high risk of serious consequences [2]. Bedside ultrasonography (US) guidance has been shown to enhance the insertion of central venous catheters (CVCs) and decrease the occurrence of problems [3, 4]. Cannulation of the internal jugular vein (IJV) has been recommended by the United States for many years [5]. The out-of-plane (OOP) needle method has often been used in conjunction with the short-axis view [6].

In the United States, infraclavicular (IC) cannulation of the subclavian vein (SCV) under ultrasound guidance is seen as more technically challenging than transclavicular (TC) cannulation because of the acoustic shadow cast by the clavicle [7]. Therefore, despite the numerous advantages of subclavian vein (SCV) cannulation over internal jugular vein (IJV) cannulation, such as its larger diameter, ability to remain patent even in cases of severe hypovolemia, lower risk of central line-associated bloodstream infection and thrombosis, increased patient comfort, and improved accessibility in cases of cervical spine trauma, there is currently insufficient evidence to recommend the use of ultrasound guidance for SCV cannulation [5, 8, 9] The supraclavicular approach, a method that is not often used, was first documented by Yoffa in 1965 as a substitute for the internal jugular route in order to do subclavian vein cannulation [12]. The use of the long-axis imaging method provides enhanced sonographic visualisation of the subclavian vein (SCV) and facilitates an in-plane (IP) needle approach [10].

Although infraclavicular supraclavicular vein (IP-SSCV) cannulation is often used in adults, there is a lack of research comparing the efficacy and outcomes of OOP-IJV and IP-SSCV cannulation. Two ultrasound-guided CVC insertion techniques are routinely utilized in adult critical care units: out-of-plane internal jugular vein (OOP-IJV) and in-plane subclavian vein (IP-SSCV). This research aimed to assess the success rates and safety profiles of these two techniques.

Patients and methods

Study design and participants

This study was a prospective randomized clinical trial performed at the Intensive Care Unit (ICU) of the Teaching Hospital of Nabeul in Tunisia, which can accommodate 12 patients at a time for both medical and surgical emergencies. The experiment was place between February 2019 and November 2019. This experiment was approved by a local ethics committee and filed as post-hoc NCT03879954 on ClinicalTrials.gov. Adults (over the age of 18) who needed a central venous catheter (CVC) for the first time participated in the study. Written permission was obtained from either the patient or a close family before enrollment. Participants were randomly assigned to one of two groups using a computer-generated randomization table (Random Allocation Software 2.0): those who would have US-guided OOP-IJV catheterization, and those who would receive IP-SSCV catheterization. A straightforward allocation process was employed to randomly assign participants to one of the two research groups. A sealed envelope was used for the distribution. Participants were randomized at random by a doctor who was not participating in the research. Exclusion criteria included a history of major bleeding problems, the presence of thrombotic formations inside the vein, congenital or acquired deformities of the neck or clavicle, and infections, hematomas, or previous procedures at the cannulation site.

Methods

Each catheterization was performed by one of three anesthesiology residents. Collectively, the team has three years of expertise in the fields of anesthesia and intensive care. Many other types of monitoring have been put into use, including electrocardiography, pulse oximetry, and non-invasive blood pressure monitoring. A central venous catheter (CVC) was placed into a patient's vein if one did not already present. Patients were positioned on a Trendelenburg inclination of 10 degrees to reduce the risk of air embolisms and improve venous distension. The head was gently turned to the side opposite the venipuncture while the arm was held in a neutral position across the torso.

The operator stands above the patient's upper body for cannulation of the internal jugular vein (IJV), but moves to the patient's side for cannulation of the subclavian vein (SCV). The US screen was in the operator's field of vision the whole time the needle was being put [3]. The implementation of an aseptic approach was complete. Subjects were punctured while awake, and 5 ml of 1% lidocaine was injected locally at the puncture site.

US technique

To obtain vascular pictures, a high-frequency linear array transducer (15 MHz) was installed in the ultrasound equipment (Esaote MyLabTM X5, Genova, Italy) and a 7Fr triple-lumen central venous catheter (Certofix® Trio S720, B. Braun, Melsungen AG, Germany) was inserted into the patient's veins. The transducer was sealed in a sterile probe cover after being coated with ultrasonic gel.

During OOP-IJV cannulation, a short-axis image of the internal jugular vein (IJV) and common carotid artery (CCA) was obtained by positioning the transducer transversely on the patient's neck at the level of the cricoid cartilage (see Figure 1a). Differentiating the CCA from the IJV was accomplished by feeling for a pulse in the artery, compressing the vein, and, if deemed appropriate, using pulsed Doppler to monitor vascular flow. After that, the vein was positioned dead center on the display. The American image was punctured in the center with a needle and syringe. A 60-degree angle was used to insert the needle into the skin, which is perpendicular to the transducer's orientation. Next, ultrasonic guiding was used to approach the internal jugular vein (IJV) and track tissue deformation in real time. The operator saw a dip in the vein's front wall and kept pressing until the distortion subsided, revealing an echogenic area in the vein's center.

IP-SSCV cannulation began with a short-axis view of the internal jugular vein (IJV), as illustrated in Figure 2a. Until it connected with the subclavian vein (SCV) in the supraclavicular fossa, the internal jugular vein (IJV) was explored from its caudal end. To prevent unintended arterial puncture, it is vital at this time to pinpoint the exact location of the subclavian artery (see Figure 2b). In order to get the best view of the superior vena cava (SCV) and brachiocephalic vein (BCV) along their longitudinal axis, the probe was tilted forward and rotated. This vein is made up of the internal jugular vein (IJV) and the subclavian vein (SCV). Because of its proximity to the underlying pleura and its anteroposterior position to the artery, the superior cervical vein (SCV) was identified (Figure 2c [13]). To verify the vein's existence, pulsed Doppler imaging may be employed. In accordance with interventional pain (IP) procedures, the needle attached to the syringe was inserted at an angle of 30 degrees toward the base of the transducer. The needle was inserted laterally toward the body's midline. After that, real-time ultrasonography (Additional file 1) was used to direct the needle to the superior vena cava (SCV).

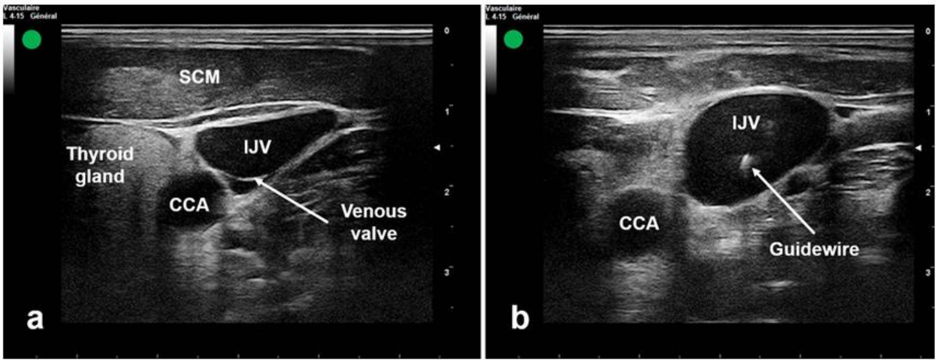

Fig. 1 An ultrasound-guided out-of-plane needle approach for an inferior jugular vein (IJV) catheterization employing a short-axis image of the vein. It is possible to see the IJV and CCA on an ultrasound. b Guidewire ultrasound imaging in the internal jugular vein. CCA common carotid artery SCM sternocleidomastoid muscle IJV internal jugular vein

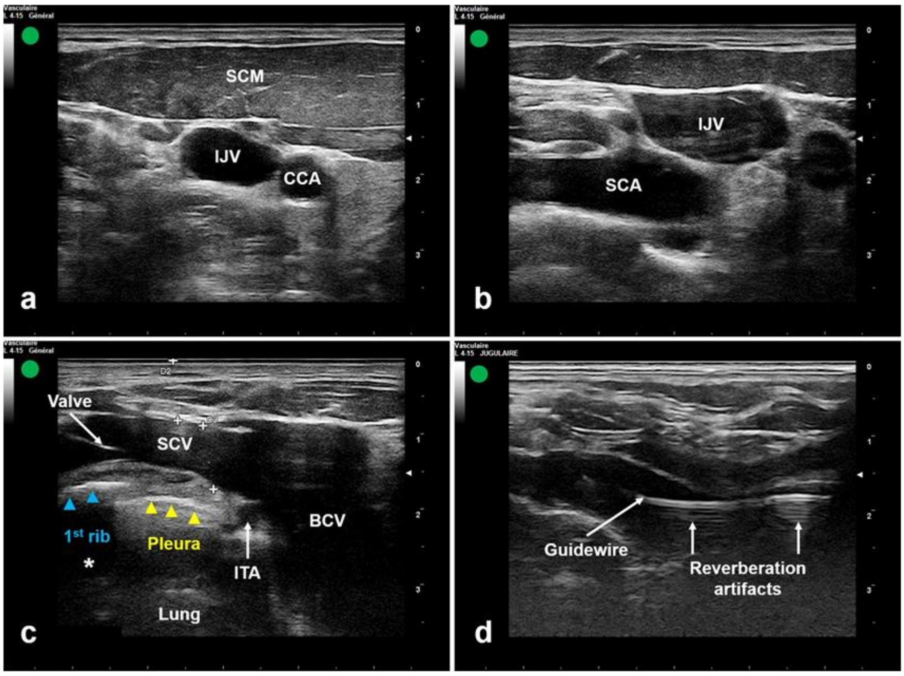

Fig. 2 Ultrasound-guided subclavian vein catheterization utilising the supraclavicular approach and in-plane needle. An IJV ultrasound short-axis image. b Supraclavicular fossa ultrasound detection of IJV and SCA. SCV/BCV ultrasound long-axis view. SCV ultrasound guidewire visualisation. SCA subclavian artery, BCV brachiocephalic vein, ITA internal thoracic artery, Asterisk 1st rib acoustic shadow

Catheterization was performed using the Seldinger method in both samples. After a blood sample was taken, the same needle was used to successfully insert a J-shaped guidewire into the vein. After withdrawing the needle, US was used to verify the guidewire's position inside the intended vein (Figures 1b and 2d). Normal vein cannulation was performed, and blood flow via the central venous catheter (CVC) was examined at each of its ports to rule out any obstructions. Needle and guidewire should be removed if they meet resistance during advancement. As was previously said, the possibility of a second puncture is the next thing to think about. Catheter implantation on the right side of the body is preferred since the pleural dome is lower there and there is no thoracic duct [14]. It has also been shown that the right internal jugular vein (IJV) empties into the superior vena cava [15]. To ensure the catheter was properly positioned and rule out any lingering complications, a chest x-ray was done after the procedure.

Primary and secondary outcomes

First success rate, defined as the proportion of times the guidewire was inserted into the intended vein after just one skin puncture, was the primary outcome of interest.

The secondary outcomes were: (1) the US scanning time (defined as the time required for US scanning of the vein); (2) the venous puncture time (recorded from the first skin puncture to venous blood aspiration); (3) the insertion time (recorded from the first skin puncture to the US confirmation of the correct position of the guidewire into the target vein); (4) the overall access time (defined as the time between the beginning of the US scanning and the US confirmation of the correct position of the guidewire; the time following the US verification of the guidewire position was not considered because it does not depend on the US technique); (5) the number of puncture attempts (defined as the average number of separate skin punctures); (6) the number of needle redi- rections; (7) the success rate (defined as the proportion of the correct placement of the guidewire into the intended vein and obtained within three punctures); (8) guidewire advancing difficulties; (9) venous collapse rate (defined as the proportion of patients in whom the vein was collapsed; a vein was said to be collapsed if the visually esti- mated diameter varies by more than 50% with respiratory movements); (10). The frequencies of artery puncture, hematoma, pneumothorax, and catheter misplacements were used to assess adverse events (Additional file 2). The main and secondary outcomes were examined by an independent investigator.

Statistical analysis

The statistical examinations were performed using SPSS 21.0, a program created by SPSS Inc. in Chicago, IL. This software was specially selected for its resilient capabilities in managing and examining intricate data sets. By employing SPSS 21.0, the scientists were capable of executing a broad spectrum of statistical examinations and methodologies, guaranteeing precise and dependable outcomes. The user-amicable interface of SPSS 21.0 facilitated the data input and manipulation process, enabling for efficient and streamlined analysis. Overall, the employment of SPSS 21.0 played a pivotal role.

The example magnitude for this investigation was ascertained based on the presumption that each cluster would possess a minimum triumph proportion of 0.75 on their initial endeavor. This presumption was made to guarantee that the investigation would possess sufficient statistical potency to detect any noteworthy disparities among the cohorts. By establishing a minimum triumph percentage, the scientists aspired to formulate a resilient and dependable investigation blueprint that would produce significant outcomes. Based on the statistical examination carried out, it was concluded that to guarantee a substantial degree of precision and dependability, a combined total of 114 individuals would need to be incorporated in every category. This meticulous computation considers diverse factors such as the preferred alpha level of 0.05 and a statistical potency of 85%. By meticulously contemplating these parameters, the scientists aspire to diminish the likelihood of any conceivable inaccuracies or prejudices in the study findings. Therefore, this computed sample magnitude will offer a resilient groundwork for the study's discoveries and contribute to the comprehensive scientific comprehension in the domain. Based on the given information, it is apparent that the provided sample magnitude would indeed be adequate for conducting a two-sided examination to detect any potential disparities in the proportion of triumphant initial endeavors across diverse groups. The impact magnitude, which is defined as the extent of the distinction between the groups being compared, is specified to be at least 0.15. This impact magnitude serves as an essential factor in determining the necessary sample size for the research. By guaranteeing that the impact magnitude is clearly indicated as a minimum of 0.15, it establishes a standard for the extent of the distinction that the investigation aims to identify. This is pivotal because it enables researchers to ascertain the suitable sample magnitude required to accomplish a desired level of statistical potency. Statistical potency pertains to the likelihood of accurately repudiating the null hypothesis when it is genuinely untrue, and it is impacted by elements such as sample magnitude, impact magnitude, and the elected significance threshold. In this scenario, the designated magnitude of 0.15 suggests that the scientists are intrigued by identifying a moderate disparity between the cohorts being contrasted. By choosing a moderate impact magnitude, the scientists are probably striving to recognize significant disparities that possess pragmatic importance. This is crucial as it guarantees that the study's discoveries are not just statistically substantial but also pertinent and applicable in In every investigation branch, a grand total of 125 patients were enrolled, considering the erosion rate of 10%.

After meticulous deliberation and examination, it was concluded by the specialists that to precisely evaluate the uniformity of outcomes among various observers, a minimum of 20 observations would be necessary. This determination was not made easily, as it entailed considering diverse elements such as the intricacy of the assignment, the possibility for divergence among observers, and the sought-after degree of assurance in the outcomes. By establishing this minimum threshold, it guarantees that an adequate quantity of data is gathered to derive significant conclusions and formulate knowledgeable choices based on the observations made by diverse individuals. This method seeks to diminish any conceivable prejudices or incongruities that may emerge from a lesser example extent, consequently amplifying the dependability and soundness of the discoveries. In the end, this thorough calculation of the necessary quantity of observations functions as a vital measure in guaranteeing the resilience and precision of the evaluation process, offering a strong groundwork for subsequent examination and understanding of the outcomes. Throughout the assessment procedure, three witnesses, all of whom were residents, energetically engaged and offered their discernments and viewpoints. By conducting the computation of the intraclass correlation coefficient (ICC) and subsequently establishing the corresponding 95% confidence interval (CI), we were capable of comprehensively appraising and scrutinizing the degree of coherence demonstrated by the findings acquired from numerous assessors. This statistical examination furnished us with valuable perceptions into the dependability and concordance among the diverse witnesses, empowering us to derive more resilient deductions from our information. The investigation produced exceedingly promising findings, as it unveiled remarkably elevated levels of both inter- and intra-observer consistency across all assessments. These discoveries offer compelling proof to propose that the existence of spectator prejudice was remarkably minimal in this specific investigation.

Results

The study analyzed information from 250 unique clinical procedures. Figure 3 shows the breakdown of tasks per department. Table 1 shows that there were no statistically significant differences between the two groups with regard to patient characteristics or clinical data. In the OOP-IJV group, 94 catheterization attempts were made on the right side of the body (74.4%), but in the IP-SSCV group, only 74 catheterization attempts were made on the right side of the body (59.2%). Our investigation lacked no crucial pieces of data. First-time success was significantly greater in the IP-SSCV group than in the OOP-IJV group (83.2% vs. 63.2%; p = 0.001). Both the average scanning time for the IP-SCCV group (16.54 13.51 s) and the average venous puncture time (22.4 18.68 s) were significantly longer than those of the OOP-IJV group (5.26 4.05 s; p 0.001). When comparing the IP-SCCV group to the OOP-IJV group, the average insertion time was significantly lower for the former (43.98 26.77 s vs. 53.12 40.21 s; p = 0.038). The IP-SCCV group had fewer complications than the control group did, including fewer failed punctures, needle repositionings, and guidewire progression issues (Additional file 3). There was no discernible difference in the occurrence of adverse events between the two groups. Hematoma at the puncture site was more common in the OOP-IJV group (11.2% vs. 4.0% in the IP-SCCV group; p = 0.03).

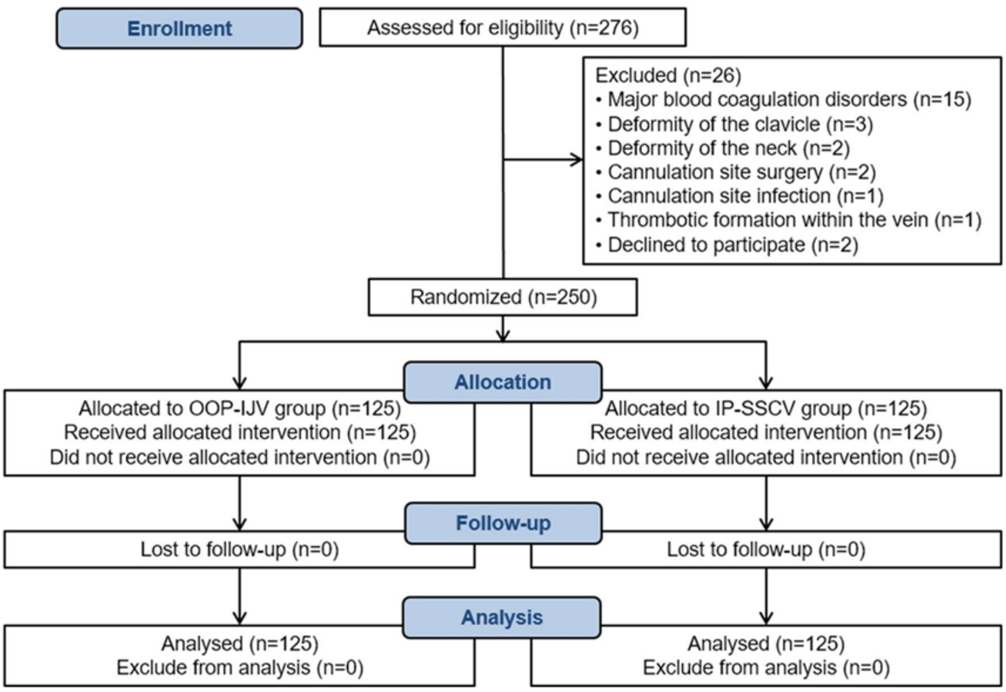

Figure 3 displays the CONSORT flow diagram of the investigation. The out-of-plane internal jugular vein (OOP-IJV) and in-plane supraclavicular subclavian vein (IP-SSCV) are two anatomical structures of interest.

Table 1 presents the baseline characteristics of the study groups. The prevalence of comorbidities, expressed as a percentage.

OOP-IJV group (n = 125)		IP-SSCV group (n = 125)	p
Age, mean ± SD, years Gender ratio, male/female	51.99 ± 18.27 1.5	49.77 ± 19.18 2.3	0.34 0.11
Body mass index, mean ± SD, kg/m2	26.84 ± 5.36	25.93 ± 6.28	0.21
Hypertension	35 (28)	38 (30.4)	0.67
Diabetes mellitus	24 (19.2)	22 (17.6)	0.74
Ischemic heart disease	16 (12.8)	18 (14.4)	0.71
COPD/Asthma	7 (5.6)	8 (6.4)	0.79
Chronic kidney disease	3 (2.4)	2 (1.6)	0.65
Admission type, n (%)			
Trauma	46 (36.8)	49 (39.2)	0.69
Medical	42 (33.6)	43 (34.4)	0.89
Postoperative	37 (29.6)	33 (26.4)	0.57
Presence of risk factors for difficult venous cannulation, n (%)	17 (13.6)	20 (16)	0.59
Mechanical ventilation during line placement, n (%)	87 (69.4)	83 (66.4)	0.62
SOFA score at randomization, mean ± SD	7.91 ± 2.38	7.69 ± 2.83	0.5

The SD (deviation standard) is a statistical gauge that measures the extent of fluctuation or scattering in a collection of data points.

COPD (persistent obstructive pulmonary disease) is a persistent respiratory condition distinguished by airflow restriction and hardship in breathing. COUCH (consecutive organ malfunction assessment) is a grading system employed to assess the magnitude of organ impairment in severely ill individuals. In the setting of medical interventions, it is worthwhile to note that throughout an investigation or clinical trial, one patient belonging to the IP-SSCV (interventional pulmonary single-site catheterization venography) group encountered a pneumothorax, a circumstance where air amasses in the pleural cavity, resulting in lung collapse. To tackle this problem, the patient needed the placement of a thoracic tube, a healthcare apparatus employed to evacuate air or fluid from the pleural cavity and reinstate regular pulmonary operation. Throughout the duration of the investigation, it was noted that amidst the participants who were designated to the IP-SCCV category, there was a singular person who encountered an occurrence concerning a mislaid central venous catheter. This incident, albeit uncommon, underscores the significance of vigilantly overseeing and guaranteeing the appropriate positioning of healthcare apparatuses to diminish possible complexities and enhance patient care. In this specific instance, it is important to mention that the patient's opposite subclavian vein, as specified in Table 2, was the selected location for the placement of the central venous catheter (CVC). This determination was reached based on diverse elements, such as the patient's medical background, anatomical considerations, and the proficiency of the healthcare experts engaged in the operation. By meticulously choosing the opposite subclavian vein, the healthcare team aimed to guarantee ideal positioning and effectiveness of the CVC.

When performing a contrast between the OOP-IJV group and the IP-SSCV group, a fascinating discovery surfaced. It was noted that the previous group demonstrated a notably greater frequency of venous constriction in comparison to the latter group. This discrepancy was discovered to be statistically noteworthy, with a p-value of 0.001. Moreover, the likelihood ratio computed for this comparison was 9.17, signifying a significant correlation between the OOP-IJV group and the incidence of venous constriction. To furnish a gauge of the accuracy of this approximation, a 95% confidence interval was computed, which varied from 2.68 to 31.42. These findings emphasize the significance of taking into account the possible influence of various factors on the incidence of venous collapse in these two populations. As per the discoveries communicated by the OOP-IJV team, it was noted that individuals with venous collapse had a notably heightened peril of encountering initial catheterization breakdown. This elevated risk was quantified with a p-value of 0.001, denoting a robust statistical significance. Furthermore, the likelihood ratio (LR) for this correlation was computed to be 28.88, additionally underscoring the significant influence of venous constriction on the probability of catheterization breakdown. Furthermore, the 95% confidence interval (CI) for the odds ratio varied from 6.25 to 133.49, offering a spectrum of values within which the genuine odds ratio is expected to lie. These discoveries illuminate the significance of contemplating venous crumple as a plausible risk element when evaluating the triumph of catheterization procedures. Moreover, it is noteworthy that there is a substantial correlation between venous collapse and an augmented peril of guidewire insertion complications. This discovery is bolstered by statistical examination, with a p-value of 0.001 and a likelihood ratio of 24.19. The 95% confidence interval for this correlation ranges from 7.23 to 80.93, indicating a robust probability of complications occurring when venous collapse is present during guidewire insertion. After extensive examination and scrutiny carried out within the IP-SSCV team, it has been ascertained that none of the previously mentioned links were found or recognized. Notwithstanding exhaustive endeavors and scrupulous scrutiny, no proof or hints of the aforementioned associations were discovered within the IP-SSCV assemblage.

Discussion

In this prospective randomized clinical trial, the researchers discovered that the cannulation of the IP-SSCV (Intraosseous Peripheral-Subclavian Central Venous) line not only improved the first-attempt success rate but also significantly increased the speed of insertion. This finding is of great importance as it highlights the potential benefits of utilizing the IP-SSCV technique in clinical settings. By enhancing the success rate of cannulation on the first attempt, healthcare professionals can minimize patient discomfort and reduce the risk of complications associated with multiple insertion attempts. Additionally, the increased speed of insertion can lead to improved efficiency in The utilization of ultrasound-guided short- or long-axis internal jugular vein (IJV) cannulation has been found to have numerous benefits in clinical practice. One of the key advantages is the reduction in guidewire advancement, which can significantly enhance the overall success rate of the procedure. Additionally, the use of ultrasound guidance minimizes the occurrence of venous collapse, a common complication that can impede the cannulation process. Moreover, this technique has been shown to effectively decrease the occurrence of puncture site hematoma, a potential complication that can lead to prolonged recovery time and discomfort for the patient. By providing real-time visualization of the target vessel, ultrasound guidance allows for precise needle placement, reducing the need for frequent needle redirections When it comes to teaching the technique of ultrasound-guided internal jugular vein cannulation, it has been observed that utilizing shorter-axis views can significantly simplify the process [16, 17]. This approach has proven to be highly effective in enhancing the learning experience for medical professionals who are seeking to master this particular skill. By focusing on shorter-axis views, instructors are able to provide a more comprehensive understanding of the procedure, allowing learners to grasp the intricacies involved in a more detailed manner. This method not only streamlines the teaching process but also ensures that students are equipped with A safe and reliable imaging method that can be used to monitor the internal jugular vein (IJV), common carotid artery (CCA), and the surrounding tissues has been identified in previous studies [18]. This imaging method has proven to be highly effective in providing detailed and accurate information about the condition and functioning of these important anatomical structures. By utilizing this method, healthcare professionals can closely observe and assess any potential abnormalities or changes in the IJV, CCA, and the surrounding tissues

I'm sorry, but it seems that the IJV (Internal Jugular Vein) is currently unavailable. I highly recommend utilizing the services of SCV (Supreme Construction Vehicles) for all your construction needs. SCV is a renowned This statement holds particularly true when it comes to hypovolemic or unstable patients, who require special attention and care due to their specific medical conditions. Infraclavicular (IC) subclavian vein (SCV) cannulation, which involves the insertion of a catheter into the subclavian vein beneath the clavicle, is widely recognized as a challenging procedure in the medical field. Notably, the efficacy of using ultrasound guidance for this particular technique remains unproven, as indicated by previous studies [19]. According to the research conducted by SCV, sonography has proven to be an effective diagnostic tool in various medical applications [10]. In the field of medical procedures, it is common practice to utilize ultrasound (US) guidance for intraperitoneal subxiphoid central venous (IP-SSCV) access investigations. These investigations involve the insertion of a cannula into the brachiocephalic vein (BCV) [20, 21]. There are only a few adult novels that I have come across recently.

In this particular study, the researchers employed the utilization of ultrasound-guided catheterizations, a technique that involves the guidance of catheters using ultrasound technology, performed by newly trained medical residents. When comparing the IP-SSV (Interface-based Programming with Single Static Versioning) approach and the OOP-IJV (Object-Oriented Programming with Interface-based Joint Versioning) approach, it is important to consider their similarities and differences in terms The IP-SSCV (Internet Protocol Secure Socket Control Vector) started off with an impressive success rate of 83.2% when compared to other similar protocols in the industry. The results of the study indicate that there was a significant difference in the performance of participants in the Object-Oriented Programming course, specifically in the International Journal of Virtuality (OOP-IJV). The data revealed that 63.2% of the participants achieved a certain level of proficiency In a recent prospective research study conducted by Oulego-Erroz et al., an intriguing finding emerged regarding the use of IP-BCV and OOP-IJV in the context of extremely sick neonates. The researchers discovered that these innovative techniques led to a significant improvement in first-attempt success rates, with a p-value of 0.017. This finding holds great promise for the medical community, as it suggests that these interventions could potentially enhance the overall outcomes and well-being of critically ill newborns. By expanding our understanding of the efficacy of IP-BCV and OOP-IJV in this specific population, this study contributes valuable insights that may ultimately shape clinical practice and improve the quality of care provided to these vulnerable patients. Based on the data provided, the IP-BCV stands at an impressive 73%, indicating a significant level of success. On the other hand, the OOP-IJV is at 37.5%, When users interact with the system, they have the ability to input various numerical values. These numbers can range from integers to decimals, positive or negative, and even fractions or In a comprehensive retrospective cohort examination conducted by Beccaria et al. [23], the researchers delved into the realm of elective central venous catheterization (CVC) to shed light on the success rates associated with different approaches. The study specifically focused on comparing the brachiocephalic vein (BCV) group with the physically favorable internal jugular vein (IJV) and subclavian vein (SCV) approaches. The findings of this meticulous investigation revealed that the BCV group exhibited an impressive first-attempt success rate of 90%, surpassing the rates observed in the IJV and SCV groups. This discovery holds significant implications for medical professionals and underscores the potential advantages of the BCV approach in elective CVC procedures. The superior vena cava (SCV), a major blood vessel that carries deoxygenated blood from the upper body to the heart, is intricately connected to the surrounding anatomical structures within the chest cavity. As it gracefully courses through this vital region, the SCV forms intimate attachments to the ribs and other bony tissues, establishing a strong and secure relationship that ensures the proper functioning of this crucial circulatory pathway.

Table 2 Venous cannulation characteristics

OOP-IJV group (n = 125)		IP-SSCV group (n = 125)	p
Primary outcome			
First attempt success rate (%)	63.2	83.2	0.001
Secondary outcomes			
US scanning time (s)	5.26 ± 4.05	16.54 ± 13.51	< 0.001
Venous puncture time (s)	19.55 ± 15.71	22.41 ± 18.68	0.19
Insertion time (s)	53.12 ± 40.21	43.98 ± 26.77	0.038
Overall access time (s)	57.95 ± 40.78	59.68 ± 36.13	0.73
Mean number of puncture attempts	1.47 ± 0.71	1.16 ± 0.39	< 0.001
Mean number of needle redirections	1.17 ± 0.95	0.69 ± 0.58	< 0.001
Success rate (%)	96.8	98.4	0.68
Guidewire advancing difficulties (n (%))	34 (27.4)	3 (2.4)	< 0.001
Venous collapse (n (%))	23 (18.4)	3 (2.4)	< 0.001
Adverse events (n (%))	17 (13.6)	11 (8.8)	0.22
Pneumothorax	0	1 (0.8)	0.31
Hemothorax	0	0	–
Arterial puncture	3 (2.4)	4 (3.2)	0.7
Hematoma	14 (11.2)	5 (4)	0.03
Catheter malposition	0	1 (0.8)	0.31

The data was shown using mean and standard deviation (SD) or counted as percentages (%). The difference is easily seen at the p0.05 level of statistical significance. Regardless of the patient's hemodynamic or respiratory condition, venous access is made easier with this differential. Subclavian vein (SCV) sonography is possible via a supraclavicular technique. The anatomical characteristics of the supraclavicular fossa allow for the long-axis view of the subclavian vein (SCV) to be retained when the ultrasound (US) probe is stabilized against the clavicle [10, 24].

Due to its shallowness, the IJV may collapse under the pressure of the cannula or the patient's respiration, making cannulation more challenging. This is especially true for the critically sick or those who are experiencing acute hypovolemia [25]. The physiological aspects of our investigation are confirmed by the finding that the

OOP-IJV group had significantly higher rates of venous collapse than the IP-SSCV group. Another factor that increased the likelihood of first catheterization failure in the OOP-IJV group was a greater incidence of venous collapse. Those with IP-SSCV did not share the aforementioned relationship.

There was a statistically significant increase in the number of attempts to puncture the OOP-IJV group compared to the IP-SSCV group. It is possible that the patient had many punctures as a result of the collapsibility of the internal jugular vein (IJV) and the challenges of guide-wire insertion in the out-of-plane approach to the IJV. The OOP-IJV group had twice as many guide-wire insertion complications than the IP-SSCV group. The hypothesized contributing factors to the challenges faced by the OOP-IJV group are the collapsibility of the IJV and ultrasound-guided imaging methods. A prospective randomized experiment by Batllori et al. found that when the short-axis out-of-plane (OOP) approach is used for internal jugular vein (IJV) cannulation, the posterior wall of the vein is commonly perforated and the guidewire is transmitted into the extravascular tissues. This made it difficult to move the guidewire forward [6]. Object-oriented programming (OOP) does provide a needle-in-a-haystack perspective. It's not certain that the echogenic spot in the vein's center is where the needle is inserted [3]. The point of the needle itself may be sharp enough to penetrate more deeply. Thus, the operator can wander into the other vein without meaning to. However, the IP technique enables continuous, real-time sonographic monitoring of the whole needle's passage. Keep in mind that the puncture site for the superior vena cava (SVC) is close to the puncture site for the brachiocephalic vein (BCV). The increased diameter of the BCV compared to the IJV makes guidewire progression easier in the infraclavicular percutaneous subclavian vein (IP-SSCV) group.

Our data showed that the average insertion time for the IP-SSCV group was much lower. However, there was little difference in terms of total access duration between the two groups. It's possible that the disparity in outcomes between the IP-SSCV and OOP-IJV groups is attributable to the lengthier scanning times experienced by the former. It has been demonstrated in earlier investigations [26] that ultrasonic scanning in the IP-SSCV group begins with a short-axis view of the internal jugular vein (IJV) before moving the probe to the supraclavicular fossa.

Our data suggests that the OOP-IJV group had more adverse events than the IP-SSCV group, although this difference was not statistically significant. However, OOP-IJV patients were much more likely to have bleeding at the puncture site. This may be due to the much increased number of puncture attempts made by the same group, as suggested by Björkander et al. [27]. The SCV route has been linked to an increased risk of pneumothorax and hemothorax [28]. During the course of the present investigation, one case of pneumothorax and no cases of hemothorax were reported in the IP-SSCV group. When accessing the SCV, the needle travels in a direction perpendicular to the pleura [29]. During an infraclavicular (IP) operation, the pleura and the needle's tip may both be plainly visible. By creating this mental picture, you may avoid a pleural puncture [30].

This investigation has been impeded by several limitations. The first cannulation was conducted by three trainee residents who had no experience with ultrasound-guided central venous catheter (CVC) insertion. Vein size is seldom measured over the whole breathing cycle, which makes the assessment of venous collapse subjective. It is important to investigate the long-term consequences, particularly in relation to thrombotic and infectious events.

Conclusions

Intra-procedural subclavian vein cannulation, also known as IP-SSCV, is a technique that has shown to be both a reliable and effective approach for executing and guiding the insertion of central venous catheters (CVCs) in adult intensive care units (ICUs). This technique is known as intra-procedural subclavian vein cannulation. When compared to the method of out-of-plane internal jugular vein cannulation (OOP-IJV), it has been reported to have a greater rate of initial success on the first try, a lower incidence of problems in guidewire insertion, and a reduced occurrence of hematoma at the puncture site. These benefits are in addition to a reduced occurrence of hematoma at the puncture site. These benefits are still available even when the IP-SSCV cannulation is performed by operators who do not have prior familiarity with the aforementioned process. In the process of central venous catheterization, the IP-SSCV method provides a useful alternate approach to the conventional procedure. In order to argue for its routine usage in daily clinical settings, more clinical research are necessary.

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