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A Comparative Study of the Convinience of External Juglar Vein Cannulations Versus Internal Juglar Vein Cannulations in Patients Undergoing Elective Surgical Procedures in a Tertiary Care Hospital

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Abstract
Introduction:
Internal jugular vein (IJV) and subclavian vein cannulations are the most common in clinical practise. Although the success rates for IJV and subclavian veins are good, problems do occur. The approach to the subclavian vein via the External Jugular Vein (EJV) is seldom taught and practised. The practitioners have been inhibited from implementing this strategy due to their concern of frequent failures.
Aim:
To examine the success rate, number of tries, and complications related with IJV and EJV catheterizations.
Method:
A total of 160 patients, requiring central venous catheterisation for various surgical procedures were randomly divided into two groups. Patients in group I (n=80) underwent right IJV catheterisation and patients in group E (n=80) underwent right EJV catheterisation. The number of attempts for cannulation, success or failure of catheterisation and any complications associated with the procedure or in the post-operative period were noted in each group. The data was compared between the two groups by using Chi-square test and Student's Independent samples t-test.
Result:
The right IJV was successfully cannulated in 90% of the patients, while the right EJV was successfully cannulated in 70% (p≤00.05). The same anaesthesiologist performed all cannulations. Catheter mispositioning was observed in eight patients in Group E and five patients in Group I. Pneumothorax occurred in two individuals and carotid artery puncture occurred in three patients in group I.
Conclusions:
The IJV had a higher success rate than the EJV. IJV had a higher complication rate of pneumothorax and carotid artery damage than EJV.

Keywords: *Central Venous Catheter; EJV catheterisations; IJV catheterisations; Complications.*

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I. INTRODUCTION

Central Venous Catheter (CVC) cannulations are commonly used in major surgical procedures for intravenous fluid infusion, inotrope administration, central venous pressure monitoring, and the diagnosis and treatment of air embolism[1]. In daily clinical practise, IJV and subclavian vein cannulations are commonly performed. Carotid artery puncture and pneumothorax are the most prevalent problems associated with IJV cannulation [2]. Though carotid artery cannulations with subclavian vein cannulations are uncommon, pneumothorax has been recorded on a regular basis. Though the EJV is commonly used for peripheral venous cannulation, the use of a CVC in EJV is underutilised and should be done more frequently [3]. A catheter-through-cannula design for external vein cannulation was found to be better than catheter through needle approach (central placement rates were 72% and 60% for catheter through cannula and catheter through needle, respectively). Complications were fewer in both the approaches and never serious [4]. A single prominent EJV is seen in approximately 90% of the people arising at the angle of the jaw, arising from smaller tributaries in the face and scalp. It then courses obliquely and superficially across the Sternocleidomastoid (SCM) muscle and terminates beneath the clavicle in the subclavian vein. The presence of valves and venous plexuses may cause problems in threading catheters into the EJV. The vein is only loosely fixed in the subcutaneous tissues and is

not easily distensible; thus, venepuncture of EJV may be often difficult. The EJV approach to the subclavian vein is less taught and less practiced than the approach to the IJV and subclavian vein. The fear of frequent failures has discouraged the practitioners from using this approach. There are studies in which EJV cannulations are described with a good success rate and minimal complications [5,6]. This study was designed to assess the feasibility of routine cannulation of EJV in clinical practice. In this study, the success rate, number of attempts, and complications associated with the IJV were compared with the EJV catheterisations.

II. MATERIALS AND METHODS

This prospective observational study was conducted at Narayan Medical College & Hospital Jamuhar, Sasaram, Bihar from April 2022 to March 2023. An informed consent was taken from all the participants, after explaining the main objectives of the study and the possible complications associated with the procedure. The study was entirely observational in nature. All major surgery patients received central lines on a regular basis, according to the authors. The lines were often inserted in the EJV, IJV, and subclavian vein. This study simply summarised the data collected during normal cannulation of these cases. There was no additional intervention planned (apart from what is done in daily clinical treatment). As a result, no Institutional Ethics Committee approval was requested. During the trial, however, the Helsinki standards were observed. The sample size was calculated after taking anticipated success rate of EJV at 98% [7] and the success rate of IJV cannulation using anatomical landmarks at 85% [8]. With an alpha error of 0.05, power of 80% and enrolment ratio of 1 a total sample size of 142 was needed with 71 patients in each group. To compensate for the drop out a total of 160 patients were taken with 80 patients in each group.

Inclusion criteria:
A total of 160 patients, requiring CVC for various surgical procedures were included in the study.

Exclusion criteria:
Infection at puncture site, deranged coagulation profile, contralateral pneumothorax, trauma to clavicle and upper ribs, distorted anatomy of the neck or clavicle and cervical spine trauma.

All patients were subjected to detailed clinical history, and a complete general physical and systemic examination. Routine investigations such as complete hemogram, kidney function tests (serum urea, serum creatinine), liver function tests {serum albumin, serum bilirubin, alkaline phosphatase, Serum Glutamic Pyruvic Transaminase (SGPT), Serum Glutamic Oxaloacetic Transaminase (SGOT)}, urine examination, coagulation profile, electrocardiogram and chest X-ray (PA view) were carried out in all the patients. The patients were randomly divided into two groups, by sealed envelope technique. Patients in group I (n=80) underwent right IJV catheterisation and patients in group E (n=80) underwent right EJV catheterisation. All cannulations were done by the same anaesthesiologists who had more than 10 years of experience. The two groups were studied with respect to the success or failure to do IJV or EJV cannulations, number of attempts, and any complications associated with the procedures. A certofix trio V 715 (7 french gauge 15 cm) central line (B Braun) was used. Each skin puncture was defined as an attempt. A maximum of three attempts were allowed for either approach. In case a failure to cannulate EJV, an attempt was made to catheterise the IJV while in case of failure to cannulate the IJV an attempt was made to cannulate the subclavian or EJV depending on the comfort of the attending physician. A chest radiograph was done in all patients in the post-operative period to confirm the position of CVC and the development of any complication as pneumothorax or haemothorax. All CVC were done by the same anaesthesiologist who had more than 10 years of experience. Patients were placed in supine position with head turned to the left side, with a towel roll placed in between interscapular region. The anterolateral portion of the neck was cleaned with povidone-iodine solution followed by an alcohol-based solution. The procedure site was draped with a sterile towel. In IJV approach, a landmark technique was used via the anterior approach. The triangular area at the base of the neck created by the separation of the two heads of the SCM muscle was identified. The carotid artery pulse was located in this triangle; by palpation. The carotid artery was gently retracted towards the midline and away from the IJV. The probe needle was then inserted at the apex of the triangle (with bevel facing up) and the needle was advanced toward the ipsilateral nipple at a 45° angle from the skin. If the vein was not entered by a depth of 5 cm, the needle was drawn back and advanced again in a more lateral direction. During the cannulations of the EJV, with the patient in supine position, the head was rotated to the left and the anterior border of the right SCM muscle was identified. The EJV was then identified as it crossed the SCM. Venous distension was achieved by a second operator who placed a forefinger parallel and immediately superior to the clavicle, where the EJV dives beneath the clavicle. The probe needle was then passed into the EJV till free aspiration of the blood was obtained. At this juncture the guidewire was passed. In case of free passage of guidewire, the central venous catheter was threaded over the guide wire. If there was a resistance to the path of the guide wire, the procedure was abandoned and alternative

route of CVC was attempted. A modified Seldinger technique was used for all cannulations. The optimal length of the catheter was determined by overlaying the catheter from the puncture site to second intercostal space.

III. Statistical Analysis

SPSS version 15.0 was used. Chi-square test was used for comparing qualitative variables, while the student's independent samples t-test was used to compare means. A $p \leq 0.05$ denoted significance.

IV. Results

There was no statistically significant difference in the demographic profile of the two groups [Table/Fig-1]. It was observed that most (77.5%) of the IJV cannulations were performed successfully without any complications in the first attempt. However, there was a lower rate of success with EJV cannulations. The most common cause of failure with EJV cannulations was inability, of the guidewire to pass on its way to superior vena cava, possibly due to bicuspid venous valves and inherent angulations along its passage. It was observed that 63.75% cannulations were possible on first attempt in the EJV. Thirty percent of the patients could not be cannulated in the EJV while as only 10 % of patients could not be cannulated in the IJV [Table/Fig-2]. In case a failure to cannulate EJV, an attempt was made to catheterize the IJV while in case of failure to cannulate the IJV an attempt was made to cannulate the subclavian or EJV depending on the comfort of the attending physician.

Demographic data	Group E N=80	Group I N=80	p-value
MF: ratio	3:1	3.7:1	0.38
Age (years)	54.54±9.33	56.17±7.19	0.21
Weight (kg)	65.19±6.21	66.24±7.33	0.32
Height (cm)	158.21±7.25	160.18±8.36	0.11

[Table/Fig-1]: Demographic profile.

Group E: External jugular vein cannulations, Group I: IJV cannulations, NS: Not significant

Attempts	Group E		Group I	
	N=80	Percentage	N=80	Percentage
First	51	63.75	62	77.5
Second	4	5.00	7	8.75
Third	1	1.25	3	3.75
Unsuccessful	24	30.00	8	10.00

[Table/Fig-2]: Frequency distribution of number of attempts.

Pearsons chi-square: 10.88; p: 0.012. The result is significant at a p-value 0.05. Group E: External jugular vein cannulations, Group I: IJV cannulations

Comparison of overall successful and failed attempts is given in [Table/Fig-3] and the overall complication rate is given in[Table/Fig-4].

Result	Group E		Group I	
	N=80	Percentage	N=80	Percentage
Successful	56	70	72	90
Failure	24	30	8	10

[Table/Fig-3]: Comparison of successful attempts of external jugular vein and IJV (n=160).

Pearsons chi-square: 12.35; p: 0.00044. The result is significant at a p-value 0.05.
Group E: External jugular vein cannulations, Group I: IJV cannulations

Complication	Group E		Group I	
	Numbers	Percentage	Numbers	Percentage
Malposition	8	10	5	6.25
Pneumothorax	0	0	2	2.50
Carotid artery puncture	0	0	3	3.75

[Table/Fig-4]: Comparison of complications in two groups.

Group E: External jugular vein cannulations, Group I: IJV cannulations.

Malpositions were common with external jugular vein cannulations, while as pneumothorax and carotid artery puncture was seen frequently with IJV cannulation

V. Discussion

During numerous surgical operations, central lines are often utilised to administer intravenous fluids and inotropes. Subclavian and IJV cannulations are regularly performed, however femoral vein cannulations are rarely performed because to the higher risk of infection. The EJV is underutilised in clinical practice because of the frequent failures associated with guide wire insertion [5,6]. Various anatomical factors may lead to difficulty in cannulations of EJV as the presence of two bicuspid venous valves, one at the junction of subclavian, the other approximately 4 cm upstream [9] and the presence of a terminal end of a venous plexus instead of a single channel in about 4% of the patients [10,11]. Various body manoeuvres have been attempted to facilitate the passage of guide wire and improve the success of EJV cannulations [7]. Though the subclavian vein has been found to have an ease for insertion, a negligible complication rate of carotid artery cannulations and an increased level of patient comfort, it may be associated with the occurrence of a pneumothorax, haemothorax, subclavian artery puncture and haematomas at the puncture site. Delayed complications as catheter embolization, venous thrombosis, endocarditis, myocardial perforation and pulmonary embolus have been reported [12]. It may be also associated with a lower incidence of catheter related infection and thrombosis than femoral or IJV cannulations [13]. The major advantages of EJV are, negligible rate of complications, in terms of carotid artery puncture and the development of pneumothorax. The primary aim of the present study was to compare the success rate, number of attempts, and complications associated with the IJV with the EJV catheterisations. Most of the IJV cannulations were performed successfully (with ease) in the first attempt, in this study. However, only 70% EJV cannulations were performed successfully in the first attempt. Out of the 56 patients who had a successful EJV placement, it was seen that malposition's occurred in 8 patients (10%). All the patients with successful CVC (with no misplacement) had a satisfactory CVP trace whereas in 8 patients with misplacements of the central venous line did not have a satisfactory CVP trace. It could have a result of the extra thoracic placement of the CVP line. During the percutaneous central venous catheterisation through the EJV in children [14] the incidence of local neck haematoma was 7% in contrast to the present study where in none of the patients had developed any localised neck haematomas. This may have been as a result of a single physician (with more than 10 years of experience who was involved in the cannulations of EJV) in the present cases. The incidence of misplacement in present study was 10% which was similar to the study done by Cruzeiro PC et al., who found the incidence of misplacements at 12.5% [14]. The success rate of CVC from EJV has been reported to range from 73% to 100% in various studies [3,15]. The success rate in the present study was 70% with a failure rate of 30%. This was comparable to the failure rate that has been mentioned by Magoon R et al., (success rate of 80%), Lahtinen P et al., (success rate of 68%) and Mitre CI et al., (success rate of 80% from surface anatomy group and 73% without the use of surface anatomy using ultrasound) [7,16,17]. Though the presence, of various anatomical factors such as presence of two bicuspid venous valves, and presence of venous plexus instead of a single channel at the terminal end may contribute to the failures, during EJV cannulations, still it remains a safe alternative in a majority of patients with coagulopathy. Also, the incidence of carotid artery puncture [18], subclavian artery puncture, [12,18] pneumothorax and haemothorax [19-21] is negligible with EJV.

VI. Conclusion

The IJV had a higher success rate than the EJV. IJV had a higher complication rate of pneumothorax and carotid artery damage than EJV. Central venous cannulation malposition's were more prevalent with EJV cannulations.

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