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Original Article

Comparison of Femoral and Internal Jugular Vein Cannulation for Rapid Resuscitation during Cardiopulmonary Arrest

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ABSTRACT

Objective: To compare Femoral and Internal jugular veins for rapid fluid and drug administration during ongoing cardiopulmonary resuscitation.

Study Design: Prospective longitudinal study.

Place and Duration of Study: Intensive Care Unit, Frontier Corps Hospital, Quetta Pakistan, from Aug 2019 to Jan 2020.

Methodology: After Ethical Committee Approval, 60 consecutive critical patients of ICU were inlcuded and divided into Femoral and Internal Jugular Groups as per the catheterization they received during cardiopulmonary resuscitation. The landmark technique was used in both groups. Success rate along with complications were compared between groups.

Results: In the Femoral (F) Group, cannulation was successful in 28 patients (93.3%) out of 30 patients, whereas in the Internal Jugular (I) Group, out of 30 patients, 22(73.3%) patients were successfully cannulated. Inadvertent carotid and femoral artery punctures occurred in 6 patients (20.0%) in the Internal Jugular-Group and one patient (3.3%) in the Femoral-Group, respectively. In contrast, soft tissue injury occurred due to more than one attempt in 5 patients (16.7%) in the Internal Jugular-Group and two patients (6.7%) in the Femoral-Group.

Conclusion: The study concluded that femoral vein cannulation is superior to internal jugular cannulation for successful resuscitation in critical care patients without disruption of chest compression and, therefore, should be the method of choice in these patients.

Keywords: Cannulation, Cardiopulmonary resuscitation (CPR), Catheterization, Femoral artery, Internal jugular artery.

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INTRODUCTION

Rapid fluid and drug administration is the most important component during Resuscitation.[1] Venous access must be achieved during CPR without interrupting cardiac compressions.[2] Multiple routes are available for fluid or drug administration during resuscitation, e.g., intraosseous, peripheral, and central venous access. Central venous access is also essential in treating patients in ICU, e.g., monitoring hemodynamics, hemodialysis, total parenteral nutrition (TPN), emergency drug administration, and antibiotics administration.[3] Literature showed different techniques to achieve intravenous access in critical care patients. The landmark technique is the safest one. The landmark technique for cannulation of the internal jugular, subclavian, and femoral veins is evident from studies.[4] Limitations in central venous catheterization by other techniques, like ultrasound, involve trained staff and equipment availability.[5] As far as critical patient resuscitation is concerned, many studies are available. According to the European Resuscitation Council's guidelines and guidelines of the American Heart Association, when drugs are administered by central venous catheter, the peak concentration of drugs is higher with a shorter circulation time than the peripheral venous cannula. However, it requires stoppage of chest compression and can be challenging and associated with complications.[6,7] Central venous catheterization is essential for the resuscitation of critical patients. Limited literature compares the success rate of central venous cannulation for different sites. Femoral venous access has the benefit of minimal interference with ongoing cardiopulmonary resuscitation, and risks involved in catheterization of the internal jugular vein are also not involved. [8,9]

While the existing literature provides insights into various techniques for central venous catheterization during cardiopulmonary resuscitation, a notable gap remains in the comparative analysis of femoral and internal jugular vein cannulation success rates and associated complications in the context of rapid fluid and drug administration. This study aims to address this gap by conducting a prospective observational analysis in a critical care setting, contributing valuable data to guide optimal clinical practices during life-saving interventions.

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METHODOLOGY

The prospective longitudinal study was conducted from August 2019 to January 2020 at the Anesthesia and Critical Care Department of Frontier Corps Hospital Quetta, Pakistan after approval of the Institutional Review Board. WHO sample size calculator 2.2a was used for sample size estimation keeping success rate of femoral venous cannulation was 77% as compared to subclavian cannulation 94%.[10]

Inclusion Criteria: Patients of either gender, aged 18-75 years admiited in the Intensive Care Unit, in the defined period, requiring cardiopulmonary resuscitation were included.

Exclusion Criteria: Patients with known vascular diseases, coagulopathy, skeletal deformity, limited sites and a history of prior central catheterization were excluded.

Family members of patients gave informed consent. A specialist who did the procedure had at least five years of experience in central venous catheterization. The landmark technique was used for femoral and internal jugular catheterization and was confirmed by radiograph as a protocol by the end of resuscitation. For the landmark approach, the patient was kept in the supine position. The skin was prepared and draped with Povidone-Iodine at the apex of the triangle between the clavicular and sternal head of the sternocleidomastoid muscle. The skin was infiltrated with 1% Xylocaine (2ml) solution with a 23-gauge needle. The needle was then entered at an angle of 45 in the direction of the right nipple. The finder needle guided a 19-gauge, 10-cm needle attached to a syringe. The needle a guidewire was then passed, and the needle was removed. A catheter was threaded over the wire into the IJV. A chest x-ray confirmed CVC placement after the procedure. Arterial puncture and soft tissue injury were the two main complications, among other complications.

Statistical Package for Social Sciences (SPSS) version 25.0 was used for the data analysis. Quantitative variables were expressed as Mean±SD and qualitative variables were expressed as frequency and percentages. Chi-square test was applied to explore the inferential statistics. The *p*-value of ≤0.05 was set as the cut-off value for significance.

RESULTS

We included 60 patients in the ICU in cardiopulmonary arrest with ongoing CPR. The average age was 46.89+9.21 years. The origin of cardiac arrest was mostly traumatic, i.e. in Femoral-Group 20(66.7%) and 15(50.0%) in the Internal Jugular-Group (Table-I).

In the Femoral (F) Group, out of 30 patients, cannulation was successful in 28 patients (93.3%), whereas in the Internal Jugular Group, out of 30 patients, 22(73.3%) patients were successfully cannulated (Figure). Inadvertent carotid and femoral artery punctures occurred in 6 patients (20.0%) in the Internal Jugular (I) Group and one patient (3.3%) in the Femoral Group (F), respectively. In contrast, soft tissue injury occurred due to more than one attempt in 5 patients (16.7%) in the Internal Jugular- Group and two patients (6.7%) in the Femoral-Group (Table-II).

Table-I: Comparison of Clinico-Demographic parameters between Femoral (F) and Internal Jugular (I) Groups (n=60)

Parameters	Femoral Group (n=30)	Internal Jugular Group (n=30)	*p*-value
Age (Mean+SD)	51.26+9.21	42.53+9.22	-
Gender (M/F) (n,%)	17(56.7%) 13(43.3%)	11(36.7%) 19(63.3%)	0.03
BMI (%)			
Under weight	0(0.0%)	3(10%)	
Normal	12(40.0%)	11(36.6%)	
Over weight	18(60.0%)	16(53.3%)	
Type of Arrest (n%)			
Cardiac	10(33.3%)	5(16.7%)	
Respiratory	0(0.0%)	10(33.3%)	0.01
Traumatic	20(66.7%)	15(50.0%)	

Table-II: Comparison of Complications between Study Groups (n=60)

Complications	Femoral Group (n=30)	Internal Jugular Group (n=30)	*p*-value
Arterial puncture (%)	1(3.3%)	6(20.0%)	0.01
Soft tissue injury (%)	2(6.7%)	5(16.7%)	0.01

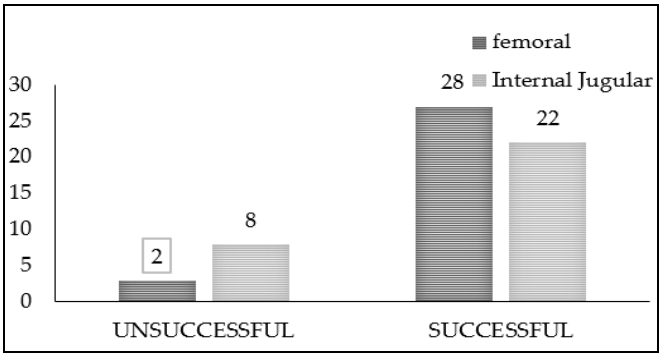

Figure: Comparison of Success Rate between Study Groups (n=60)

DISCUSSION

According to our study results, internal jugular venous catheterization led to inadvertent arterial cannulation in 6 out of 60 patients (85.7%) and soft

tissue injury in 5 patients (71.4%). Compared to Internal Jugular and subclavian access sites, the femoral veins are preferable in the case of coagulation defects, as direct pressure can be applied due to the ability to provide direct pressure at the insertion site.[11] Femoral veins are also usually preferred when other venous access sites are unavailable or in case of high risk of complications, e.g. in emergency cases and uncooperative patients.[12] The femoral veins are generally easier to access and provide dependable access for less experienced operators or when there is a concern for arterial injury at upper extremity sites because of altered local anatomy.[13] According to Beccaria *et al*. the Internal jugular vein is associated with more procedural difficulty as compared to the brachiocephalic approach (odds ratio, 0.38; 95% confidence interval, 0.19–0.76; p=0.007) after correction for potential confounders and differences between groups in failure rate (3.4% vs 3.5%) or complication rate (6.3% vs 4.1%), were not significant.[14]

A rare but potentially fatal complication of central venous cannulation in the left jugular vein is the occurrence of pericardial effusion with potential cardiac tamponade with a highly variable incidence ranging from 0.0001% to 0.14%. This complication is often due to an incorrect catheter tip position, most commonly due to a perforation of the right atrium and ventricle.[15] SCV catheterization has the benefit of fixed landmarks but may be associated with more serious complications, e.g., hemothorax or pneumothorax. Complications after the insertion of internal jugular and subclavian CVCs are quite frequent.[16] These included catheter misplacement, arterial puncture, and pneumothorax. In most arterial punctures or misplacements, a carotid and subclavian artery puncture was involved, respectively. Aortic arch injury is also one of the serious complications of subclavian venous catheterization but is quite rare.[17]

In emergencies, central venous catheterization in the femoral vein allows rapid infusion of high-volume isotonic fluids and medications that would otherwise be caustic to peripheral veins.[18,19] Choi et al. compared the femoral versus jugular route for vena cave filter insertion in critical patients and found that the majority (35 [49%]) filters were placed via the right femoral vein (left femoral vein: 22 [31%]; right internal jugular vein: 14 [20%]). The jugular approach involved a longer fluoroscopy time (mean 117±37 s[s]) than the right and left femoral approaches (mean 64±21 s, mean 67±15 s, respectively [p<0.05]).[20]

CONCLUSION

The study concluded that femoral vein cannulation is superior to internal jugular cannulation for successful resuscitation in critical care patients, without interruption of CPR and therefore should be the method of choice in these patients.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

SK: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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