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Original Research Article

Efficacy of the Ultrasound in Unsuccessful Landmark Guided Internal Jugular Vein Cannulation

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Abstract

Background: Internal jugular vein cannulation is a commonly performed procedure for administering medication, fluid, and nutrition, monitoring central venous pressure, or obtaining blood samples. In the past, using the traditional landmark technique to assess the internal jugular vein for central venous procedures was associated with a lower rate of success and higher rate of complications compared to using ultrasound.

Aim and objectives: To study the efficacy of ultrasound in unsuccessful cannulation by the landmark technique.

Material and Method: This single-center prospective longitudinal observational study was conducted in the Department of Anaesthesiology at All India Institute of Medical Science, Bhopal. Thirty patients aged above 18 years, undergoing elective/emergency surgical intervention under general anesthesia, and requiring central venous cannulation as determined by the in-charge anesthesiologist of the theatre, were included. All cannulation attempts were taken by a single candidate, as decided by the in-charge anesthesiologist. Observations for attempts and causes of failure were assessed after two failed attempts of a landmark technique of cannulation.

Result: The success rate of ultrasound-guided cannulation after two failed landmark-guided attempts was 96.6%. The most commonly associated cause of failure was improper identification of landmarks.

Conclusion: The overall success rate of ultrasound-guided cannulation was 96.6% after two failed attempts of landmark-guided cannulation in difficult cases. The most common cause of failure for landmark-guided cannulation was improper identification of the landmark in patients.

Keyword: IJV, Ultrasound, Success rate.

Introduction

Cannulation of a vein is an important aspect of a patient's care as it facilitates hemodynamic monitoring, infusion of fluid, medication, blood, and blood products. [1] The most commonly used site for cannulation is the right internal jugular vein (IJV) due to its easy accessibility, straight course, and relatively lower risk of complication. The landmark technique is the most common technique used, with a

success rate varying between 85% and 95% 1 and a complication rate of 6.3%-11.3% [2]. First-pass success of the cannulation is desired due to the location of cannulation, in which vital structures reside, and multiple punctures can lead to complications. Various factors responsible for failure and complications are noted, such as anatomical variation, misidentification of the landmark, improper positioning of the patient, and right IJV collapse due to various physiological factors. [3,4] In this study, we aim to establish the efficacy of ultrasound in difficult and failed landmark-guided attempts of IJV cannulation. [5]

Material and Method

A prospective observational study titled "Efficacy of Ultrasound in Unsuccessful Landmark Guided Internal Jugular Vein Cannulation" was conducted in the Department of Anaesthesiology at AIIMS Bhopal. Thirty adult patients (age > 18 years) who were planned for elective/emergency surgical intervention and required internal jugular venous cannulation with 2 failed attempts using landmark technique were recruited for the study. Patients who were hemodynamically unstable, had known abnormal neck anatomy, previous surgery or trauma involving the neck, or prior catheterization of neck vessels were excluded.

The patients in the theater were attached with standard monitors and were administered general anesthesia with either spontaneous or controlled ventilation, as per the choice of the in-charge anesthesiologist and institutional protocol. Patient information sheets were given to all the subjects or their relatives, and the study protocol and procedure were explained thoroughly. Written informed consent for the conduct of the study was obtained. No attempt to change the anesthesia technique was made.

Patients were positioned in a 20-degree Trendelenburg position with their heads turned 30-45 degrees to the left side. The site of puncture was cleaned with betadine and spirit and draped with a sterile sheet. The cannulation attempts were done using the anatomical landmarks by the Seldinger technique [5] by a single person chosen by the incharge anaesthesiologist. The preferred site for cannulation was right IJV via the central approach after identification and marking of the landmark that is the apex of the triangle formed by the two heads of the sternocleidomastoid muscle and the clavicle.

After 2 failed attempts of the landmark guided technique, the ultrasound scan was done to assess for any anatomical variation, collapsed internal jugular vein, reverse tracing of landmark identification and neck positioning, and any narrowing or thrombus in the IJV. Another attempt of cannulation was done under ultrasound guidance at the same time. The number of attempts under ultrasound guidance and the success of the procedure were observed and noted. Aseptic precautions were taken, including the operator washing up for the procedure and wearing a sterile gown and gloves. All patients in the theater were attached to standard monitors and were administered general anesthesia with spontaneous or controlled ventilation as per the choice of the incharge anaesthesiologist and institutional protocol, and no attempt to change the anesthesia technique was made. Patients and/or their relatives were given a patient information sheet and informed consent was obtained before the study.

Result

Age range of participants in our study was 22-86 years with a mean age of 48.6333 ± 5.621 years (± 2SD). Male predominance was noted in 16 (53.3%) out of 30 participants.

After 2 failed landmark-guided attempts for cannulation, ultrasound was used, and we successfully cannulated 24 IJVs on the first attempt and 5 on the second attempt. One case was referred to an interventional

radiologist for cannulation. The final outcome was 29 (96.6%) successful cannulations out of 30 participants by the observer and anesthesiologist.

Amongst the interpreted causes of failed blind attempts, the most common was misidentification of the ideal landmark in 9/30 participants, followed by improper positioning of the patient's neck in 8/30, anatomical variations seen in 6/30 patients, physiological causes like dehydration in 6/30, and 1/30 of the cases had lumen narrowing/thrombus.

Discussion

Cannulation of the vein is an important aspect of the patient's care, it can be helpful in hemodynamic monitoring, infusion of fluid, medication, blood and blood products. The most common used site for cannulation is right internal jugular vein (IJV) because of it's easy accessibility, straight course and relatively lower risk of complication, landmark technique is reported as most common technique used, with success rate varies between 85%-95% and with complication rate of 6.3-11.3%.

In our study, 30 patients who were aged above 18 years and undergoing elective/emergency surgical intervention under general anesthesia, were included. Central venous cannulation was deemed necessary and hence intervened by the in-charge anesthesiologist of the theatre

A single candidate performed all cannulation attempts as determined by the in-charge anesthesiologist on the patients who were on mechanical ventilation. After two failed attempts using the landmark technique of cannulation, observations were made and the cause of failure was assessed.

The mean age group of our study participants were 48.6333 ± 5.621 years (± 2SD) with male predominance.

We found that after 2 failed attempts of landmark guided cannulation, ultrasound guidance cannulation was effective in 96.6% of the interventions with failure to cannulate one of the case which was further referred to the interventional radiologist.

Studies have recommended the use of ultrasound-guided technique to identify the location of the IJV before inserting the needle. However, the availability of ultrasound and the time required for the intervention may be limiting factors in some cases. [6]

The authors suggested real-time ultrasound guidance over the traditional landmark technique. In our study, we recommended the use of ultrasound for difficult cannulation, but it can be used for all cannulation depending on the availability of the ultrasound. [7]

In our study, we assessed various factors responsible for the failure of landmark-guided cannulation and found that 30% of the failed attempts were due to non or miss identification of the landmarks. This was further attempted by ultrasound guidance and success was achieved. Our study also suggested the use of ultrasound guidance in patients with poor landmarks. We also found that misidentification was the most common cause of failure. The complication rate varied with the experience of the physician, and with each increasing attempt, the risk of complication increased.

In our study, we encountered anatomical variation in 20% of subjects, which can be a major cause for failure in landmark-guided cannulation. Ultrasound guidance helped achieve successful cannulation in these cases. Anatomical variation was reported in 12% of patients in previous studies, highlighting its importance as a factor to consider in cannulation procedures. [8,9]

Limitations

There are multiple acknowledged limitations in the study which are, Firstly, this was a single-center cohort study that only included ICU patients who were on mechanical ventilation, so the findings of

the study should be applied and generalized with caution. Secondly, the sample size was relatively small, and larger registries are needed to confirm the results.

Conclusion

We concluded in our study that ultrasound can be a better modality for difficult or failed attempts of cannulation of the internal jugular vein with the landmark-guided technique. With ultrasound being more portable, user-friendly, and accessible, it can aid in successful cannulation in patients with poor landmarks or anatomical variations. Our study also emphasized the importance of proper identification and marking of landmarks to decrease the chances of failure with the landmark-guided technique.

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