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Can we predict the Position of Central Venous Catheter Tip Following Cannulation of Internal Jugular Vein?

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Abstract

Background: Chest X-ray is often done to confirm the level of central venous catheter (CVC) tip in relation to superior vena cava (SVC) and right atrium (RA) junction following placement.

Aim: To predict the CVC tip level in relation to SVC-RA junction using saline flush test.

Materials and Method: This is a prospective observational study involving 154 patients. Following placement of internal jugular vein (IJV) catheter the distal port was flushed with 10ml saline over a period of 3 seconds and observed simultaneously for the time of onset of bubbles in the RA using transthoracic echocardiography (4 chamber view).

Results: In 119 patients the bubbling during saline flush appeared immediately or up to 2 seconds. On chest x-ray the CVC tip was found within 1-2 cm range of SVC-RA junction. In 27 patients the bubbles were seen at 3 seconds and on chest x-ray the CVC tip was found > 2 cm above SVC-RA junction. In remaining 8 patients the bubbles were seen after 3 seconds and on chest x-ray the catheter was found either migrated to subclavian vein or coiled back in IJV.

Conclusion: Saline flush test can be used to predict the level of catheter tip based on time of onset of bubbles in RA which should be confirmed by large observational study.

Keywords: *Catheter; Saline flush; Echocardiography; Superior venacava; Malposition*

Abbreviations: SVC: Superior vena cava; RA: Right atrium; IJV: Internal jugular vein; CVC: Central venous catheter.

Introduction

Cannulation of a central vein is the standard clinical method for monitoring central venous pressure (CVP), administration of fluids, vasopressors, antibiotics and parenteral nutrition. To increase the success and to decrease the complication ultrasound guided technique has become the safety norm for cannulation of the internal jugular vein (IJV) [1-4]. Invariably with ultrasound assistance fewer needle passes are required for successful cannulation. In addition most investigators have shown that ultrasound guidance reduces the time required for cannulation and increases overall success rates [5].

Complications of central venous cannulation following blind technique are high with unintended arterial puncture is the most common immediate mechanical complication. The most important life threatening vascular complication following cannulation is vascular injury leading to cardiac tamponade due to malpositioned catheter tip within the heart chamber or abutting the wall of the superior venacava at a steep angle. Hence the radiographic confirmation of proper catheter tip location is often used to void this complication. Various methods such as anatomical landmarks [6,7] simple formulae [8], right atrial echo [9-11] and 2D-Echocardiography [12] have been used to ensure correct placement of CVC tip.

Materials and Methods

After approval by the institutional ethics committee and consent from patient or his/her attended, prospective observational study was conducted involving 154 patients in age group of 20–80 years (between January-December 2013) who were admitted in the medical ICU and requiring CVC for routine management. Triple lumen (certofix B Braun) CVC was placed at the angle formed by two heads of sternocleido-mastoid muscle into right IJV by trained intensivist (2 years experience with ultrasonography) under real time ultrasound guidance using seldingers technique. Catheters were fixed at 11-13 cm for males and 11-12 cm in females at angle formed by 2 heads of sternocleido-mastoid muscle. Patients with previous neck surgery and infection at insertion site were excluded from this study. After placement of the catheter the distal port was flushed with 10 ml saline over a period of 3 seconds and simultaneously observed for the time of onset of bubbles in the right atrium of the heart (4 chamber view) using transthoracic echocardiography.

Results

During the period of 1 year, 154 patients were included for the observational study. Interpretation of Saline flush test and position of catheter tip on chest x-ray has been showed in Table 1. In 119 patients the bubbling during saline flush appeared immediately or up to 2 seconds. On chest x-ray the CVC tip was found within 1-2 cm range of SVC-RA junction. In 27 patients the bubbles were seen at 3 seconds. On chest x-ray the CVC tip was found > 2 cm above SVC-RA junction. In remaining 8 patients the bubbles were seen after 3 seconds and on chest x-ray the catheter was found to be migrated to subclavian vein or coiled back in IJV.

Discussion

Central venous catheters are commonly placed in the ICU patients who require multiple vasopressor infusion, hypertonic saline and mannitol administration. The ideal position of the CVC tip when passed through IJV is around 1cm from SVC-RA junction. This SVC-RA is roughly identified on chest x-ray at the level of carina. The complications rate during CVC placement is reported to be between 2% to 15% [12].

The frequently encountered complications of CVC placement by blind technique are pneumothorax (6.6%), carotid artery puncture (6%), and hemothorax (1%) [13]. In addition overall rate of unsuccessful cannulation of the IJV is around 12%. Anomalies in anatomy may lead to difficulty in passing the needle in an appropriate direction. The landmark method fails irrespective of anatomy if the vein has been thrombosed. Obese patients with short necks are more difficult to access. Patients with clotting problems and ventilated patients may have more serious consequences from a complication associated with venepuncture [14].

Studies have showed that the use of ultrasound may increase the rate of success of central venous catheter placement and may reduce the incidence of traumatic complications [15]. The image offered by the USG allows the user to predict variant anatomy and to assess patency of target vein. In 2011, the CDC has recommended use of USG guidance to place central venous catheters to reduce the number of cannulation attempts and mechanical complications. In our study with the help of ultrasound guidance we could achieve successful cannulation in maximum number of patients at first attempt and in very few patients on 2 attempts and with no complications during the procedure. In a study by Karatikos., *et al*. [16] cannulation of the IJV was achieved in all patients by using USG and in 94.4% by using the landmark technique. Average access time (skin to vein) and number of attempts were significantly reduced in the USG group of patients compared with the landmark group and the rate of mechanical complications were all significantly low in the USG group. In a study by Kujur., *et al*. [17] they found that catheters can be fixed at a length of 12-13 cm in males and 11-12 cm in females in the right IJV to achieve correct position (Figure 1).

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Ultrasound has already been shown to improve accuracy when placing lines but we are still relying on chest x-ray to confirm the level and position of catheter tip and also to detect complication. There are multiple methods which can predict the approximate length the catheter which should be placed following cannulation. Once the catheter is placed, we are not sure that weather the catheter is in IJV, migrated to SCV (Figure 2) or coiled back in the IJV.

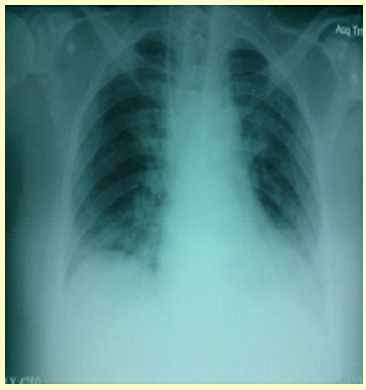

Figure 1: *Showing CVP line at normal position.*

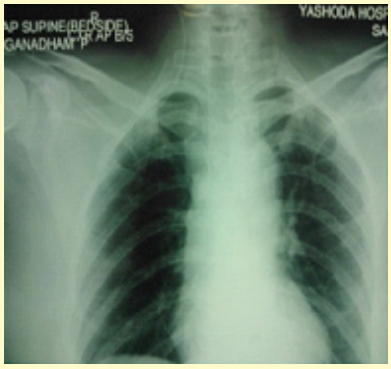

Figure 2: *Showing CVP line migrated to right subclavian line.*

In our study we did flush test following placement of catheter and simultaneously looked for onset of bubbles (figure-3) on 2D echo (4 chamber view).

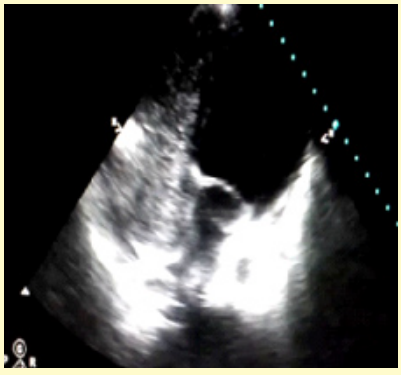

Figure 3: *Four chamber view of echocardiography showing bubbles in right atrium after saline flush test.*

This test was later compared with chest X-ray for the position and level of the CVC tip in relation to SVC-RA junction. From our study following saline flush, in 119 patients the bubbling during saline flush appeared immediately or up to 2 seconds. On chest x-ray among these 119 patients the CVC tip was found within 1-2 cm range of SVC-RA junction. This means catheter is neither migrated to subclavian vein nor coiled back and tip was at 1-2 cm range of SVC-RA junction. In 27 patients the bubbles were seen at 3 seconds and on chest x-ray the CVC tip was found > 2 cm above SVC-RA junction. In remaining 8 patients the bubbles were absent or seen after 3 seconds and on chest x-ray the catheter was found either migrated of to subclavian vein or coiled back in IJV. Based on this observation, if the onset of bubbling is at 3 seconds then in that case catheter can be pushed 1-2 cm inside to achieve correct position. If onset of bubbling takes more than 3 seconds then catheter may be in subclavian vein, then it can be pulled back and again pushed slowly which can be confirmed later again by flush test.

Conclusion

Saline flush test can be used to predict the level of catheter tip based on time of onset of bubbles in RA which should be confirmed by large observational study.

Saline Flush test	No. of patients (N = 154).	Catheter tip position in chest X-ray.
Immediate or up to 2 seconds.	119	Within 1-2 cm range of SVC-RA junction.
At 3 seconds.	27	> 2 cm above the SVC-RA junction.
More than 3 seconds/Negative flush test.	8	Migration of catheter to subclavian/coiled back in IJV.

Table 1: *Interpretation of Saline flush test and position of catheter tip in Chest X-ray.*

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Bibliography

1. Denys BG., *et al*. "An ultrasound method for safe and rapid central venous access". *The New England Journal of Medicine* 324.8 (1991): 566.
2. Denys BG., *et al*. "Ultrasound assisted cannulation of the internal jugular vein. A prospective comparison to the external landmark guided technique". *Circulation* 87.5 (1993): 1557-1562.
3. Gratz I., *et al*. "Doppler guided cannulation of the IJV: a prospective, randomized trial". *Journal of Clinical Monitoring* 10.3 (1994): 185-188.
4. Troianos CA., *et al*. "Ultrasound-guided cannulation of the internal jugular vein. A prospective randomized study". *Anesthesia & Analgesia* 72.6 (1991): 823-826.
5. Randolph AG., *et al*. "Ultrasound guidance for placement of central venous catheters: a meta-analysis of the literature". *Critical Care Medicine* 24.12 (1996): 2053-2058.
6. Ryu HG., *et al*. "Bedside prediction of the central venous catheter insertion depth". *British Journal of Anaesthesia* 98.2 (2007): 225-227.
7. Ezri T., *et al*. "Correct Depth of Insertion of Right Internal Jugular Central Venous Catheters Based on External Landmarks: Avoiding the Right Atrium". *Journal of Cardiothoracic and Vascular Anesthesia* 21.4 (2007): 497-501.
8. Czepizak CA., *et al*. "Evaluation of Formulas for Optimal Positioning of Central Venous Catheters". *Chest* 107.6 (1995): 1662-1664.
9. Joshi Anish M., *et al*. "Optimal positioning of right-sided internal jugular venous catheters: Comparison of intra-atrial electrocardiography versus Peres' formula". *Indian Journal of Critical Care Medicine* 12.1 (2008): 10-14.
10. Gebhard RE., *et al*. "The accuracy of electrocardiogram controlled central line placement". *Anesthesia & Analgesia* 104.1 (2007): 65-70.

11. Watters VA., *et al*. "Use of electrocardiogram to position right atrial catheters during surgery". *Annals of Surgery* 225.2 (1997): 165-171.
12. Domino KB., *et al*. "Injuries and liability related to central vascular catheters: a closed claims analysis". *Anesthesiology* 100.6 (2004): 1411-1418.
13. Kaye AD., *et al*. "The importance of training for ultra sound guidance in central vein catheterisation". *Middle East Journal of Anesthesiology* 21.1 (2011): 61-66.
14. Reusch S., *et al*. "Complications of central venous catheters: Internal jugular versus subclavian access - a systematic review". *Critical Care Medicine* 30.2 (2002): 454-460.
15. Reusch S., *et al*. "Complications of central venous catheter: Internal jugular versus subclavian access-a systematic review". *Critical Care Medicine* 30.2 (2002): 454-460.
16. Karakitsos D., *et al*. "Real-time ultrasound-guided catheterisation of the internal jugular vein: a prospective comparison with the landmark technique in critical care patients". *Critical Care* 10.6 (2006): 162.
17. Kujur R., *et al*. "How correct is the correct length for central venous catheter insertion". *Indian journal of critical Care Medicine* 13.3 (2009): 159-162.

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