

Regional Anesthesia and Nerve Blocks its Beyond

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Introduction

Central venous catheter misplacement is common (approximately 7%) after right subclavian vein catheterisation. To avoid it, ultrasound-guided tip navigation may be used during the catheterisation procedure to help direct the guidewire towards the lower superior vena cava. We aimed to determine the number of central venous catheter misplacements when using the right supraclavicular fossa ultrasound view to aid guidewire positioning in right infraclavicular subclavian vein catheterisation. We hypothesised that the incidence of catheter misplacements could be reduced to 1% when using this ultrasound technique. One hundred and three adult patients were prospectively included. After vein puncture and guidewire insertion, we used the right supraclavicular fossa ultrasound view to confirm correct guidewire J-tip position in the lower superior vena cava and corrected the position of misplaced guidewires using real-time ultrasound guidance. Successful catheterisation of the right subclavian vein was achieved in all patients. The guidewire J-tip was initially misplaced in 15 patients, either in the ipsilateral internal jugular vein (n = 8) or in the left brachiocephalic vein (n = 7). In 12 patients it was possible to adjust the guidewire J-tip to a correct position in the lower superior vena cava. All ultrasound-determined final guidewire J-tip positions were consistent with the central venous catheter tip positions on chest X-ray. Three out of 103 catheters were misplaced, corresponding to an incidence (95%CI) of 2.9 (0.6–8.3) %. Although the hypothesis could not be confirmed, this study demonstrated the usefulness of the right supraclavicular fossa ultrasound view for real-time confirmation and correction of the guidewire position in right infraclavicular subclavian vein catheterisation.

Central venous catheterisation is one of the most common invasive procedures within anaesthesia and critical care. The preferred access sites are the internal jugular and subclavian veins. Subclavian vein catheterisation is associated with a lower rate of central line-associated blood stream infection and thrombosis; this approach might therefore be preferred in medium/long-term use to reduce infection and patient discomfort or to obtain a second line for other treatments in patients where the internal jugular vein is non-patent (e.g. due to thrombosis) or already occupied (e.g. by a temporary dialysis catheter or an extracorporeal membrane oxygenation cannula). The use of real-time ultrasound guidance increases success rates and decreases mechanical complications for both internal

jugular and subclavian vein catheterisations. However, central venous catheter (CVC) misplacement remains more common for the subclavian vein, especially after a right-sided catheterisation, for which the reported mean incidence of CVC misplacement is approximately 7%.

Risks and Complications

A misplaced CVC increases the risk of premature failure due to venous thrombosis, reduces the area of use and may lead to rare but significant complications such as venous perforation, haemothorax, cardiac tamponade and cardiac arrhythmia. Verification of a correctly positioned CVC tip is therefore a primary aspect of safety and quality of central venous catheterisation. Intracavitary ECG is the preferred method for intraprocedural assessment of the proper location of the CVC tip according to the 2016 infusion therapy standards of practice and the current European Society of Anaesthesiology guidelines on peri-operative use of ultrasound for vascular access. This method, however, requires appropriate modifications of the basic technique in patients with atrial fibrillation and is not applicable in patients with a pacemaker or with other arrhythmias. Furthermore, intracavitary ECG is not available in all departments. Confirmation of the catheter tip position by post-procedural chest X-ray remains common and is acceptable practice in the absence of technology used during the catheterisation procedure. Disadvantages with chest X-ray include patient exposure to ionised radiation, increased workload for both ICU and radiology staff, and costs.

Ultrasound-guided tip navigation is another feasible intraprocedural method for avoiding CVC misplacement. The use of the right supraclavicular fossa ultrasound view to confirm correct guidewire J-tip position in the lower superior vena cava (SVC) during CVC insertion has been demonstrated for right internal jugular vein catheterisation and right supraclavicular subclavian vein catheterisation in a small pilot study. The method requires an ultrasound probe with a scanning depth that exceeds approximately 10 cm (to allow for visualisation of the guidewire J-tip in the lower SVC, thereby avoiding misplacements into the azygos vein). A micro-convex probe couples good image resolution with high scanning depth. It also has a convenient convex and small exploration surface, allowing it to be easily used in narrow anatomical regions, such as below the clavicle and in the right supraclavicular fossa.

Anesthesia in Pain Management

To the best of our knowledge, no prior study has evaluated the use of the right supraclavicular fossa ultrasound view for correct guidewire positioning in right infraclavicular subclavian vein catheterisation, which is probably the preferred approach in adult patients. We therefore aimed to demonstrate the usefulness of a micro-convex probe and the right supraclavicular fossa ultrasound view to aid guidewire positioning in right infraclavicular subclavian vein catheterisation in this prospective observational study. We hypothesised that the incidence of CVC misplacement could be reduced to 1% when using this ultrasound technique.

This prospective single-centre observational study was approved by the Swedish Ethical Review Authority. Although observational, the Authority requested written informed consent, which we obtained from all patients, either before enrolment or afterwards if the patient was unable to consent initially due to general anaesthesia, critical illness or unconsciousness. The Authority approved that deceased patients gave presumed consent, as the study was an

observation of a procedure that is clinical practice at our institution.

We included consecutive patients aged >18 y with an indication for CVC placement and under the care of one of three intensivists responsible for the study. All three had experience in ultrasound-guided catheterisation of the right subclavian vein using micro-convex probes (experience ranged from a few hundred to 30 subclavian line insertions). We performed the catheterisations in operating theatres, in the ICU or in a dedicated vascular access room. A pre-procedural ultrasound scan of the right subclavian vein was performed on all patients eligible for inclusion. We excluded patients if they already had a central line/pacemaker/similar device in place (due to risk for misinterpretation of the ultrasound image in those patients); if the subclavian vein could not be visualised (e.g. in those with subcutaneous emphysema of the chest wall); or if the subclavian vein was deemed inappropriate for cannulation by the operator (thrombosis within the vessel, tumour compressing the vessel or narrow vessel due to hypovolaemia in combination with severe respiratory insufficiency).