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CLINICAL INFORMATION

Ultrasound-guided central venous catheterization – ''Syringe-Free'' approach

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Internal jugular vein cannulation;
Oblique view

Abstract
Background and objectives: Central venous catheterization of the internal jugular vein is a commonly performed invasive procedure associated with a significant morbidity and even mortality. Ultrasound-guided methods have shown to improve significantly the success of the technique and are recommended by various scientific societies, including the American Society of Anesthesiologists. The aim of this report is to describe an innovative ultrasound-guided central line placement of the internal jugular vein.
Technique: The authors describe an innovative ultrasound-guided central line placement of the internal jugular vein based on an oblique approach – the ''Syringe-Free'' approach. This technique allows immediate progression of the guide wire in the venous lumen, while maintaining a real-time continuous ultrasound image.
Conclusions: The described method adds to the traditional oblique technique the possibility of achieving a continuous real-time ultrasound-guided venipuncture and a guide wire insertion that does not need removing the probe from the puncture field, while having a single operator performing the whole procedure.

PALAVRAS-CHAVE
Ultrassonografia;
Intervenção;
Veias jugulares;
Cateterização;

Cateterização venosa central guiada por ultrassom – abordagem ''Syringe-Free''

Resumo
Justificativa e objetivos: A cateterização venosa central da veia jugular interna é um procedimento invasivo realizado frequentemente e associado a morbilidade significativa e até mesmo

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Veia central;
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Abordagem oblíqua

mortalidade. Os métodos guiados por ultrassonografia têm demonstrado uma melhora do sucesso deste procedimento e são recomendados por várias sociedades científicas, incluindo a *American Society of Anesthesiologists*. O objetivo deste artigo é descrever uma abordagem inovadora de cateterização venosa central guiada por ultrassonografia ao nível da veia jugular interna.
Técnica: Os autores descrevem técnica ecoguiada inovadora de cateterização venosa central da veia jugular interna, baseada numa abordagem oblíqua – a abordagem ''*Syringe-Free*''. Esta técnica permite uma progressão imediata do fio-guia ao longo do lúmen venoso, mantendo uma visualização ecográfica em tempo real e contínua.
Conclusões: A técnica descrita acrescenta à técnica oblíqua tradicional a possibilidade de, com um único operador, conseguir uma punção venosa central com visualização ecográfica contínua e em tempo real associado à inserção do fio-guia sem necessidade de afastamento do transdutor de ultrassonografia do campo de punção.

Introduction

The central venous catheter (CVC) insertion is an invasive procedure commonly performed not only within anesthesiology, but also in multiple specialties ranging from oncology to emergency medicine.[1]

The traditional anatomic landmark technique for placing central venous lines, however valuable, has been linked to a number of procedure-related complications such as arterial puncture or cannulation, venous injury, pneumothorax and hemothorax.[2,3] Comparatively, ultrasound-guided methods have shown some advantages; namely, a decrease in the number of inadvertent arterial puncture or cannulation, less incidence of pneumothorax, higher success rates and favorable cost–benefit ratios.[1,4–6] Its use is therefore recommended by various scientific societies, including the American Society of Anesthesiologists.[6–9]

Among anesthesiologists, the most frequently selected site for central access is the internal jugular vein (IJV). Techniques described include the traditional ultrasound transverse and longitudinal approaches, as well as an alternative oblique view.[10–13] In relation to the latter, different variants have been illustrated; specifically, medial-oblique, lateral-oblique and medial-transversal techniques.[13–15] The referred ultrasound-guided methods share the fact that the operator can confirm the location of the vessel by aspirating blood. However, subsequently, the operator has to disconnect the syringe in order to pass the guide wire through the needle or pass it through a guide wire syringe device. Regardless of which method is used, this requirement increases the possibility of needle dislocation (with all the associated implications, such as arterial puncture, needle tip exteriorization from the venous lumen, and nerve injury). In addition, it requires the presence of a second operator in order to achieve a continuous ultrasound imaging from the skin puncture until the complete guide wire insertion.

This paper describes an innovative ultrasound-guided CVC placement in the IJV that is based on the oblique view, but only requires a single operator and provides real-time continuous ultrasound imaging. This procedure is achievable by using the lateral-medial variant approach with the guide wire adapted to the needle from the beginning of the procedure.

Technique

The patient is placed in a 15° Trendelenburg position with a slight head rotation to the side opposite to the operator. The authors recommend placing the ultrasound screen on that side, so that the operator can look up directly at the screen within the same field of vision used to advance the needle. Aseptic technique for preparation is mandatory. Also, the high frequency linear probe and respective cable should be isolated with an appropriate sterile sleeve. The guide wire is adapted to the puncture needle before initiating the procedure (Fig. 1).

As described by Phelan and Hagerty,[13] in order to visualize the carotid artery and the IJV, the probe is placed in a plane transversal to the neck at the level of the sternal and clavicular heads of the sternocleidomastoid (SCM) muscle. When compared to the carotid artery, the IJV generally appears to be non-pulsating, is larger and more superficial, has a thinner vessel wall, and is more easily compressed. It is imperative to correctly position the probe so that the structures on the right side of the ultrasound image correspond to the same side on the patient. Once the described image is obtained, the probe should be rotated 45° clockwise or counterclockwise (whether the target is the right or the left IJV, respectively) to achieve an oblique orientation. The catheterization is performed in this position, in which the vessels emerge as ovoid hyperechoic structures covered by the SCM muscle. The skin is punctured with the needle (adapted to the guide wire) at the lateral cephalic border of the probe, and is advanced in plane toward the IJV. This allows a complete observation of the needle's trajectory. In addition, the cephalic–caudal orientation of the needle will benefit the subsequent progression of the guide wire. As soon as the needle penetrates the vessel lumen, the guide wire is introduced under direct continuous ultrasound visualization (Fig. 2). Once correct introduction and progression of the wire are confirmed, the needle is removed and the procedure is completed in the traditional manner.

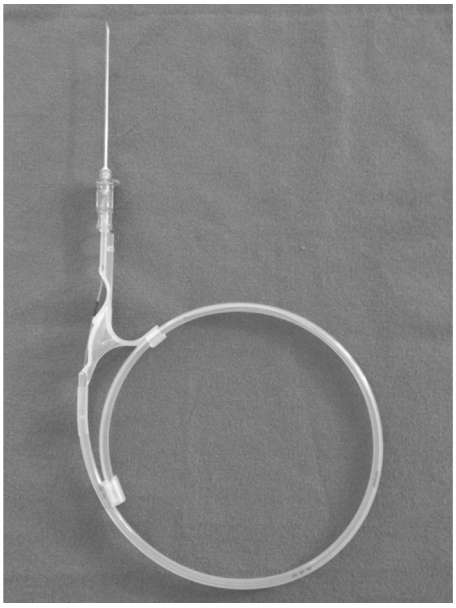

Figure 1 Guide wire adapted to the puncture needle since the beginning of the procedure.

Advantages

This technique includes the recognized advantages of the oblique approach (visualization of both the artery and the vein, as well as of the entire needle), and at the same time allows a continuous visualization of the entire procedure, potentially increasing its safety. In addition, this continuous visualization is achieved without the need of a second operator, since it does not require someone to disconnect the syringe before the guide wire insertion is completed. All the other previously described different techniques performed by a single operator require this critical period of interrupting the ultrasound image, since the operator has to let go of the ultrasound probe in order to have a free hand for the syringe disconnection and subsequent guide wire insertion. With the ''Syringe-Free'' approach this does not happen because the guide wire is adapted to the puncture needle from the beginning. Moreover, the physician is in control of the entire process and may correct in real time, as needed, the needle tip position, the alignment and the progression of the wire. Complications associated with this stage, such as cephalic progression of the wire or perforation of the posterior or medial wall of the IJV, are therefore reduced.

The catheterization of the IJV with this method has been successfully employed in the past year. It has been performed by the authors, who regularly use ultrasound in regional anesthesia and central venous catheterization.

Limitations

This technique comprises some limitations. In most cases, the carotid artery is found to be in the same trajectory as the needle, which could lead to the idea that there is a greater risk of carotid artery puncture. However, the needle is inserted in-plane and at a superficial level, which in theory allows an easy track of the needle. Nevertheless, it is mandatory that this technique is executed by an experienced operator who is skilled in manipulating and interpreting ultrasound imaging, in order to achieve a continuous observation of the needle tip. If these conditions are met, the risk of carotid artery puncture is minimized and the confirmation by blood aspiration becomes unnecessary, since the operator is able to visualize the needle entering the lumen of the IJV. Furthermore, based on their experience, the authors found that the needle's lumen fills up with blood after the venous puncture. It should be noted that in hypovolemic patients the execution of the technique becomes more challenging, given the smaller diameter of the IJV. For novice ultrasound users and/or non-expert sonographers, ultrasound may give a false sense of security, and the constant visualization of the needle and its tip might not be achieved. Therefore, the main limitation of the described procedure is associated with the operator's level of experience in ultrasound manipulation.

The authors have found another challenge in the implementation of this technique related to the fact that not all central venous catheterization sets provide a stable connection between the needle hub and the dispenser unit of the guide wire. The authors usually use the Certofix®

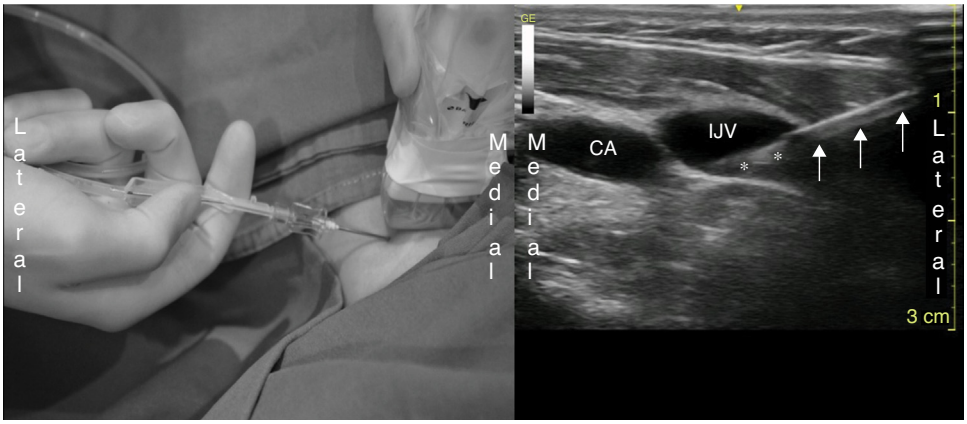

Figure 2 ''Syringe-Free'' approach and corresponding sonographic image. CA, carotid artery; IJV, internal jugular vein; * *, guide wire; ↑ ↑ ↑, needle.

Duo (B-Braun, Melsungen AG, Germany) central venous catheterization set, whose guide wire dispenser can be stably connected to the needle. Thus, the technique can be performed without undue difficulty. However, if this connection is not secure, the ''Syringe-Free'' approach is not recommended.

Conclusions

The authors suggest this ''Syringe-Free'' approach for ultrasound-guided CVC placement, which surpasses the already described advantages of the oblique technique[13] as it allows real-time continuous ultrasound imaging carried out by a single operator. It is now imperative to provide evidence through randomized prospective studies on the benefit of this technique, mainly with respect to its safety, success rate and time of execution.

Conflicts of interest

The authors declare no conflicts of interest.

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