Journal of Clinical Anesthesia (2006) **18**, 167–172

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Journal of Clinical Anesthesia

Original contribution

Ultrasound-guided central venous cannulation: is there a difference between Doppler and B-mode ultrasound?

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Received 5 May 2004; accepted 15 December 2005

Keywords:
Catheterization: central venous/adverse effects/methods;
Doppler;
Vein: internal jugular;
Ultrasonography

Abstract

Study Objective: To compare the success of Doppler and B-mode ultrasound–guided internal jugular vein (IJV) catheterization with respect to body mass index (BMI).

Study Design: Prospective, randomized study.

Setting: Section for cardiovascular anesthesia of a university hospital.

Patients: 338 consenting patients were analyzed.

Interventions: Subjects receiving central venous catheters for scheduled cardiac surgery were divided into two groups. After induction of general anesthesia, the right or left IJV was assessed for midcervical cannulation approach. In the Doppler group (n = 189), a SonoGuide2 with a 5.0-MHz probe was used. In the B-mode group (n = 149), the SiteRite II ultrasound system with a 7.5-MHz transducer was used.

Measurements and Main Results: There was a significant difference in the success rate of first needle pass between the two groups: Doppler group, 91% (172/189); B-mode group, 96.6% (144/149) (P = 0.045). A BMI of 30 and greater was associated with a significantly lower first needle pass success rate in the Doppler group (Doppler group, 77.1% [27/35]; B-mode group, 97.4% [38/39]; P = 0.011). The success rates in patients with a BMI below 30 for both methods were not different (Doppler group, 94.2% [145/154]; B-mode group, 96.4% [106/110]; P = 0.567). Arterial punctures occurred three times under Doppler guidance and twice under B-mode guidance.

Conclusion: Cannulation of the IJV can be ensured and first needle pass success rate maximized by both ultrasound techniques. In patients with a BMI greater than 30, B-mode technique is superior to Doppler ultrasound.

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0952-8180/$ – see front matter © 2006 Elsevier Inc. All rights reserved.
doi:10.1016/j.jclinane.2005.12.010

1. Introduction

The indications, techniques, and complications of central venous access are well documented [1-3]. Although these catheters can be lifesaving, they are also associated with significant risks. The inherent risks depend on patient anatomy (eg, morbid obesity, cachexia, or local scarring from surgery or radiation treatment), patient setting, and comorbidities [4-6]. Most central venous access procedures are performed using anatomic surface landmarks alone. Multiple attempts and inexperienced operators have been shown to be associated with an increased risk of complications during central venous access procedures [1,2]. Also, a body mass index (BMI) greater than 30 is known as a factor. Ultrasound-guided punctures improve the success rate and minimize complication rates of central venous access procedures, even with inexperienced operators [7-9]. Two types of real-time ultrasound guidance are available: audio-guided Doppler and B-mode ultrasound. The latter seems to represent the ideal technique owing to visualization of the target vessel. However, almost the same success rates can be obtained with a conventional Doppler device [10]. The aim of this study was to compare the value of Doppler and B-mode ultrasound–guided central venous access procedures, via the internal jugular vein (IJV), regarding the difference in success rate and complications in relation to BMI.

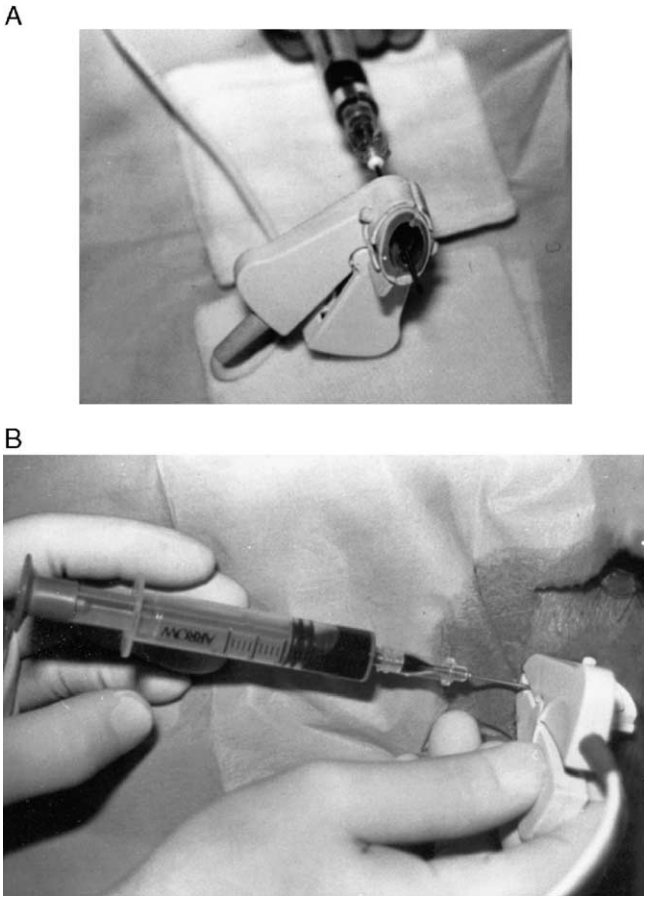

Fig. 1 A, Cannula perforating SonoCup disposable coupling gel, which is inserted in the SonoGuide2 probe. B, SonoCup Doppler probe with inserted cannula during cannulation.

Fig. 2 SonoGuide2.

2. Materials and methods

After approval for the study was granted by the local ethics committee, 340 consenting patients were enrolled into this randomized, prospective study in the section for cardiovascular anesthesia of a university hospital. Subject to the availability of the devices, 190 patients were enrolled into the Doppler group between April and July 2002, and 150 patients were recruited into the B-mode group from September to December 2002. For these elective surgeries, central venous catheter (CVC) placement is a routine procedure at our institution. Exclusion criteria were emergency patients or patients after radical neck dissection, or denial to sign written consent. In each patient, information regarding age, gender, height and weight, BMI, the side of venipuncture, number of needle advances from the subcutaneous tissue required before entering the IJV, and all complications was recorded. After induction of general anesthesia, patients were moved into the 20° Trendelenburg position for CVC insertion. The right or left IJV was assessed for midcervical cannulation approach; that is, midway between the mastoid process and the sternal notch with the head in neutral position. The ultrasound probes were positioned under sterile conditions at the level of the thyroid cartilage, and the IJV was identified.

In the Doppler group, a SonoGuide2 with a 5.0-MHz probe (Ultrasound technologies, Caldicot, UK) was used. The ultrasound probe has to be sterilized after each use. It is suitable for an 18-gauge cannula. SonoGuide2 allows single-operator procedures by controlling the device with a footswitch (Figs. 1 and 2). The probe was moved and angled to receive the best Doppler signal. When the signal

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