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CLINICAL REPORT

Ultrasound-guided supraclavicular central venous catheterization in patients with malignant hematologic diseases

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Abstract We present two cases of central venous catheterization (CVC) in which an ultrasound-guided in-plane approach was used. Case 1 was a 60-year-old man with acute myelogenous leukemia in whom a right supraclavicular CVC was performed. He had pancytopenia (leukocytes 2,000/μL; erythrocytes 350 × 10^4/μL; platelets 5.6 × 10^4/μL), and abnormal coagulability (prothrombin time–international normalized ratio 1.35). A linear array transducer was positioned cephalad to the right clavicle and rotated 30° clockwise. The 21-gauge needle was manipulated from outside of the transducer. A CV catheter (CV legaforce EX®; Terumo Co., Japan) was placed and stitched near the right clavicle. The patient felt no discomfort caused by the catheter. Case 2 was a 64-year-old women with malignant lymphoma whose right internal jugular vein was surrounded by abnormally enlarged lymph nodes. CVC was performed by the in-plane supraclavicular approach, avoiding puncture of the lymph node. This novel CVC technique is useful to minimize the risk of complications and patient discomfort by indwelling catheter.

Keywords Central venous catheterization · Supraclavicular approach · Ultrasound

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Introduction

Although central venous catheterization (CVC) of the subclavian vein or the internal jugular vein is widely performed [1, 2], risks of arterial puncture, pneumothorax, and/or patient discomfort due to the stitched catheter around the neck disturb the CVC, especially in patients with abnormal coagulability [3, 4]. Supraclavicular CVC is not common because of its association with a higher risk of pneumothorax compared to an internal jugular vein approach. Conversely, this approach has advantages including a short distance from skin to the vein, a large target area and a straighter path to the superior vena cava [5]. We introduce the utility of a new technique for CVC, the ultrasound-guided supraclavicular in-plane approach, in patients with hemorrhagic disorder or anatomic difficult pattern.

Case reports

Case report 1

A 60-year-old man with acute myelogenous leukemia was scheduled to undergo CVC for chemotherapy. Blood data showed pancytopenia (leukocytes 2,000/μL; erythrocytes 350 × 10^4/μL; platelets 5.6 × 10^4/μL) and abnormal coagulability (prothrombin time–international normalized ratio 1.35). He also had a history of CVC in the right internal jugular vein 3 months earlier, at which time he had complained that severe discomfort due to the catheter had limited his ability to rotate his neck. Subclavicular and femoral CVC were contraindicated due to the abnormal coagulability and high risk of catheter-related infection, respectively. The brachial vein was observed under ultrasound imaging, but the optimal vein to access CVC was difficult to find.

We therefore decided to utilize a right supraclavicular approach for CVC under ultrasound guidance, and written informed consent was obtained from the patient. The patient was placed in the Trendelenburg position and the neck turned slightly to the left. Electrocardiography and pulse oximetry were monitored, and povidone was used as disinfectant. The linear array ultrasound transducer (MicroMaxx®; SonoSite, Bothwell, WA) was covered with a sterilized sheath containing an ultrasound gel. The ultrasound transducer was positioned to obtain as transverse a view of the right internal jugular vein as possible on the caudal side where the ultrasound transducer was in contact with the right clavicle. The transducer was then rotated 30° clockwise and tilted slightly to observe the caudal side (Fig. 1). A 21-gauge needle attached to a 3-mL syringe containing 1 % lidocaine was introduced at a point 5 mm outside and 3 mm caudal to the ultrasound transducer for an in-plane approach. This puncture point was located in the triangle formed by the two heads of the sternocleidomastoid muscle and the clavicle, with the needle directed toward the suprasternal notch. The needle was then advanced under ultrasound imaging, injecting lidocaine for local anesthesia. The tip and shaft of the needle were completely visible on the ultrasound image during the procedure. Immediately after the target vein was punctured and aspiration of venous blood was confirmed, the tip of the needle was directed 30° caudally while maintaining blood aspiration. The ultrasound transducer was released, and a guide wire made of nickel–titanium alloy included in a double-lumen 12-gauge central venous catheter kit (CV legaforce EX®; Terumo, Tokyo, Japan) was smoothly introduced into the vein. After confirming the positioning of the guide wire on the caudal side of the internal jugular vein by ultrasound imaging, a 12-gauge central venous catheter was indwelled by the Seldinger technique. The catheter outside the body was turned in a suitably caudal direction and stitched near the right clavicle. The operator accomplished venous puncture on the first attempt without penetration to the opposite side, and only a snap arrhythmia during the introduction of the central venous catheter was observed as a complication. The patient did not feel any discomfort or neck pain while this catheter was in use.

Case report 2

A 64-year-old woman with malignant lymphoma was scheduled to undergo CVC. Blood data showed leukocytosis (leukocytes 12,300/μL). Ultrasound imaging revealed that the right internal jugular was surrounded by abnormally enlarged lymph nodes and by the common carotid artery (Fig. 2). We avoided usual internal jugular vein puncture, which uses the out-of-plane approach, and performed CVC by the in-plane supraclavicular approach, using the same procedure for case 1. The needle was safely manipulated into the vein from the lateral side where the presence of lymph nodes was not evident, and the catheter was stitched.

Discussion

This report describes a novel supraclavicular approach for CVC using ultrasound guidance. The central vein was punctured at the most caudal region of the internal jugular

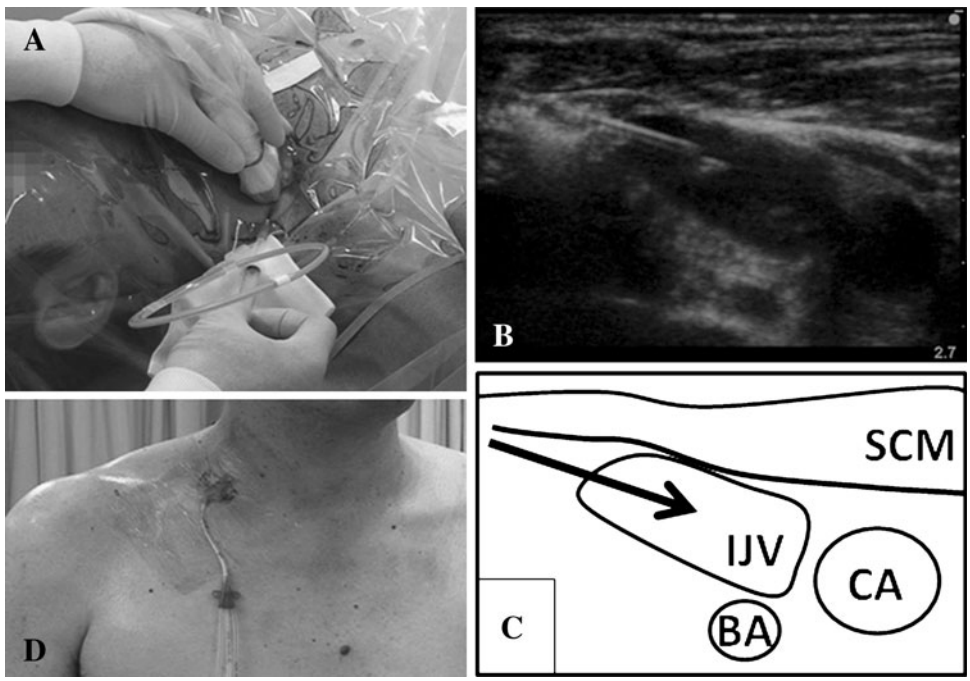

Fig. 1 Supraclavicular central venous puncture. **a** The ultrasound transducer is rotated 30° clockwise and tilted slightly to observe the caudal side, and a 21-gauge needle is introduced 5 mm outside and 3 mm caudal to the transducer. **b**, **c** Ultrasound imaging of the in-line approach (**b**) and a schematic image (**c**). *Arrow* Puncture needle. *SCM* Sternocleidomastoid muscle, *IJV* internal jugular vein, *CA* carotid artery, *BA* basilar artery. **d** The catheter was turned to the caudal side and fixed near the clavicle

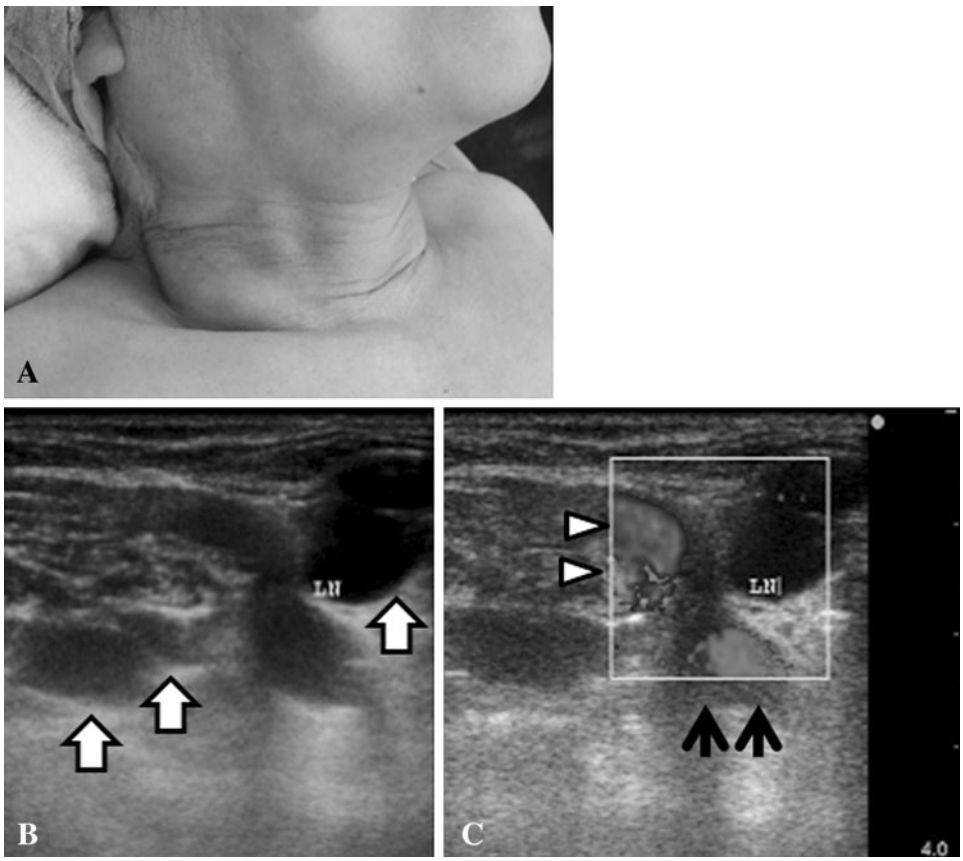

Fig. 2 Abnormally enlarged lymph nodes around the internal jugular vein. **a** Swelling of right neck, **b**, **c** Ultrasound imaging (**b**) of short axis view of the right neck and abnormally enlarged lymph nodes (*arrows*) and the color Doppler imaging (**c**) distinguishes lymph nodes from common carotid artery (*arrows*) or internal jugular vein (*arrowheads*)

vein using ultrasound guidance and the risk of puncturing the lung or artery was minimal. Fixation of the catheter near the right clavicle did not disturb neck rotation or movement of the right upper extremity, and the patients felt unhindered by the catheter. The supraclavicular site was conveniently treated with disinfectant and drape, and swelling and bleeding were easily checked, factors which would reduce the risk of catheter-related infection associated with subclavian catheterization.

A landmark-guided technique for supraclavicular CVC reported previously [5, 6] demonstrates its advantages over the subclavicular approach, namely, a shorter distance from the skin, larger diameter of the target vein, less interruption during cardiopulmonary resuscitation, and fewer complications. However, the supraclavicular approach is associated with possible risks of arterial puncture, pneumothorax, and/or damage to the phrenic nerve [6, 7], and only experienced clinicians are generally allowed to perform supraclavicular CVC. On the other hand, ultrasound imaging can facilitate the identification of vessels, muscles, nerves, and pleura around the clavicle. The diameter of the internal jugular vein in the supraclavicular region was large enough to safely and easily manipulate a needle using the in-plane technique. Bleeding is also easily controlled at this puncture point by usual astriction. A 21-gauge needle and thin un-kinked guide wire made of nickel–titanium alloy could also help to decrease the risk of bleeding, and we performed CVC in a patient with pancytopenia. These considerations suggest that the ultrasound-guided supraclavicular approach is not overly difficult and facilitates CVC in high-risk cases.

We should note the predictable disadvantages of this technique and another option for blood access. First, a needle tip has to be observed in real time during puncture, otherwise the potential risk of common carotid arterial puncture or pneumothorax would be increased. Second, a guide wire or a catheter may be placed into the cephalad direction when the angle with the needle and the internal jugular vein closes towards the vertical. Although femoral venous catheterization can be another option for patients with abnormal coagulopathy, the procedure carries a much higher risk of infection and thrombosis [1]. Ultrasound-guided axillary vein catheterization has been reported by Sandhu [8] and is considered to offer the same low risk of catheter-related infection and thrombosis as the subclavicular approach. However, a strict in-plane ultrasound-guided technique is required to avoid axillary artery puncture and injury to the brachial plexus. Compared to the axillary vein approach, the present supraclavicular

approach is obviously easier as the distance from skin to vein is shorter and vein diameter is clearly larger.

In summary, we introduce a novel CVC approach for malignant hematologic diseases in patients with pancytopenia and emphasize the utility of ultrasound-guided supraclavicular CVC. This technique may be superior to other techniques in terms of the safety of needle penetration and patient comfort.

Conflict of interest None.

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