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CASE REPORT

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Ultrasound-guided central venous catheterization via internal jugular vein in a patient with subcutaneous neck emphysema: A case report

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Abstract

In patients with subcutaneous neck emphysema, ultrasound images of the internal jugular vein are unclear due to air bubbles. Central venous catheterization can be safely achieved by pushing the accumulated air laterally using an ultrasound probe.

KEYWORDS

central venous catheterization, emphysema, internal jugular vein, ultrasound

1 | INTRODUCTION

Central venous catheterization is often required for central venous pressure monitoring, administration of drugs that are likely to induce phlebitis if administered into the peripheral veins, temporary cardiac pacemaker placement, administration of fluid to treat hypovolemia and shock, and aspiration of air emboli, and in patients with poor peripheral veins. It is a basic technique performed by numerous physicians, including anesthesiologists, in hospitals.[1] The landmark technique, a traditional method for performing central venous catheterization, poses the risk of arterial puncture or cannulation, venous injury, nerve injury, and pneumothorax or hemothorax; moreover, it can be difficult to perform in patients with anatomic variations.[2,3] Ultrasound-guided central venous catheterization has been proven to be safer than conventional methods since its introduction. Currently, various academic societies for anesthesiologists recommend the use of ultrasound to guide central venous catheterization.[4–8] Central venous catheterization may be required in various patients, including those with subcutaneous emphysema. Subcutaneous emphysema is relatively common in the intensive care unit and the operating room. However, the presence of subcutaneous air reflects the ultrasonic signal, which interferes with the formation of images of the relevant structure and makes it impossible to clearly identify the relevant anatomic structure

with ultrasound.[9,10] As a result, it is difficult to perform ultrasound-guided central venous catheterization via the internal jugular vein in patients with subcutaneous neck emphysema. The general process of ultrasound-guided central venous catheterization is well known due to the abundance of images available; however, there is scarce information on ultrasound-guided central venous catheterization using the internal jugular vein in patients with subcutaneous neck emphysema. To the best of our knowledge, this is the first case report on a method that enables clinicians to safely perform ultrasound-guided central venous catheterization via the internal jugular vein in patients with subcutaneous neck emphysema by shifting air laterally using an ultrasound probe.

2 | CASE PRESENTATION

The patient was a 61-year-old man (height, 163 cm; weight, 65 kg) with an unremarkable medical history, except for hypertension and diabetes. He was detected with a mass in the right upper chest on a chest radiograph during a routine medical examination in 2011. The patient had no associated symptoms. He underwent regular chest radiography at a private outpatient clinic every year from 2011 to 2019. In 2019, the chest radiograph showed that the chest mass was larger, but the patient still had no symptoms associated with the mass. He was transferred to Gyeongsang National University Hospital for further clinical evaluation and examination by the physician at the private clinic. Computed tomography (CT) and magnetic resonance imaging (MRI) were performed at Gyeongsang National University Hospital. The chest CT and thoracic spine MRI showed a 7.4-cm mass in the posterior mediastinum and a huge enhancing mass (size: 7 cm) in the right intervertebral foramen and paraspinal area at the T2-T3 level. He was therefore scheduled to undergo removal of two neurogenic tumors, located in the right upper lung lobe and second thoracic vertebra at Gyeongsang National University Hospital. First, the patient underwent video-assisted thoracoscopic surgery to remove the neurogenic tumor in the right upper lung. The chest tube was removed 6 days after the operation, after which subcutaneous neck emphysema was observed. As the subcutaneous emphysema was mild, we only observed the patient. Second, 2 days after the subcutaneous neck emphysema was observed, he was scheduled to undergo a second thoracic vertebra hemilaminectomy to remove the neurogenic tumor present there. A central venous catheter was needed to be inserted for transfusion and drug injection before the surgery. An operator with an assistant prepared for the central venous catheterization via the internal jugular vein. The patient was positioned in the Trendelenburg position. To enable ultrasound-guided placement of the catheter, an appropriate amount of gel was applied to the linear ultrasonic probe, all air between the linear ultrasonic probe and the skin was removed, and the structures around the right neck were investigated. However, due to shadowing on the ultrasound, the right internal jugular vein could not be found (Figure 1A). We searched for the right internal jugular vein around the Sedillot's triangle, which is a traditional cutaneous puncture site for catheter placement, but the structures were difficult to confirm. Doppler images were also not clearly observed. Because subcutaneous air bubbles are known to interfere with ultrasound transmission, we thought that moving the air bubbles around the neck would make the image clearer. Thus, we pushed the subcutaneous air bubbles around the puncture site at the right neck in the lateral direction using a linear ultrasonic probe. This enabled clear visualization of the anatomic structures including the right internal jugular vein on the ultrasound images (Figure 1B). According to the ultrasound-guided protocol with out-of-plane method, it was possible to safely perform central venous catheterization via the right internal jugular vein (Figure 1C) using a 7-French double-lumen central venous catheter (Bioline next, Ewha group). Then, to confirm the effectiveness of this method, ultrasound images of the Sedillot's triangle on the left neck, which was not used for central venous catheterization, were checked. Subcutaneous air bubbles were observed (Figure 1D); however, clear images of all the structures, including the left internal jugular vein, were obtained after the subcutaneous air bubbles were moved laterally by applying pressure with a linear ultrasonic probe (Figure 1E). General anesthesia for this operation was maintained using target-controlled infusion with propofol and remifentanil. The operation required 3 h and was uneventful. The patient was discharged 6 days after the operation; 3 weeks later, the chest radiograph showed no specific findings. At present, the patient is healthy and has no complications. We obtained informed consent regarding this case report from the patient. The ethical approval was waived by the institutional review board of Gyeongsang National University Hospital (GNUH 2020-05-017).

3 | DISCUSSION

Subcutaneous emphysema occurs when air enters the tissues under the skin. This most often occurs in the chest wall or neck but can also occur in other parts of the body. The overall incidence of subcutaneous emphysema ranges from 0.43% to 2.34%.[11] An absolute difference of acoustic impedance between soft tissues (approximately 1.6 Mrayls) and air (approximately 0.0004 Mrayls) occludes the scattering of ultrasound signals and interferes with composing images of deep body structures, because 99% of ultrasound gets reflected.[9] Because the air bubbles in patients with subcutaneous emphysema are usually self-limiting, there is no need for invasive treatment to remove the air unless a large amount of air causes the patient to develop dyspnea or aggravates

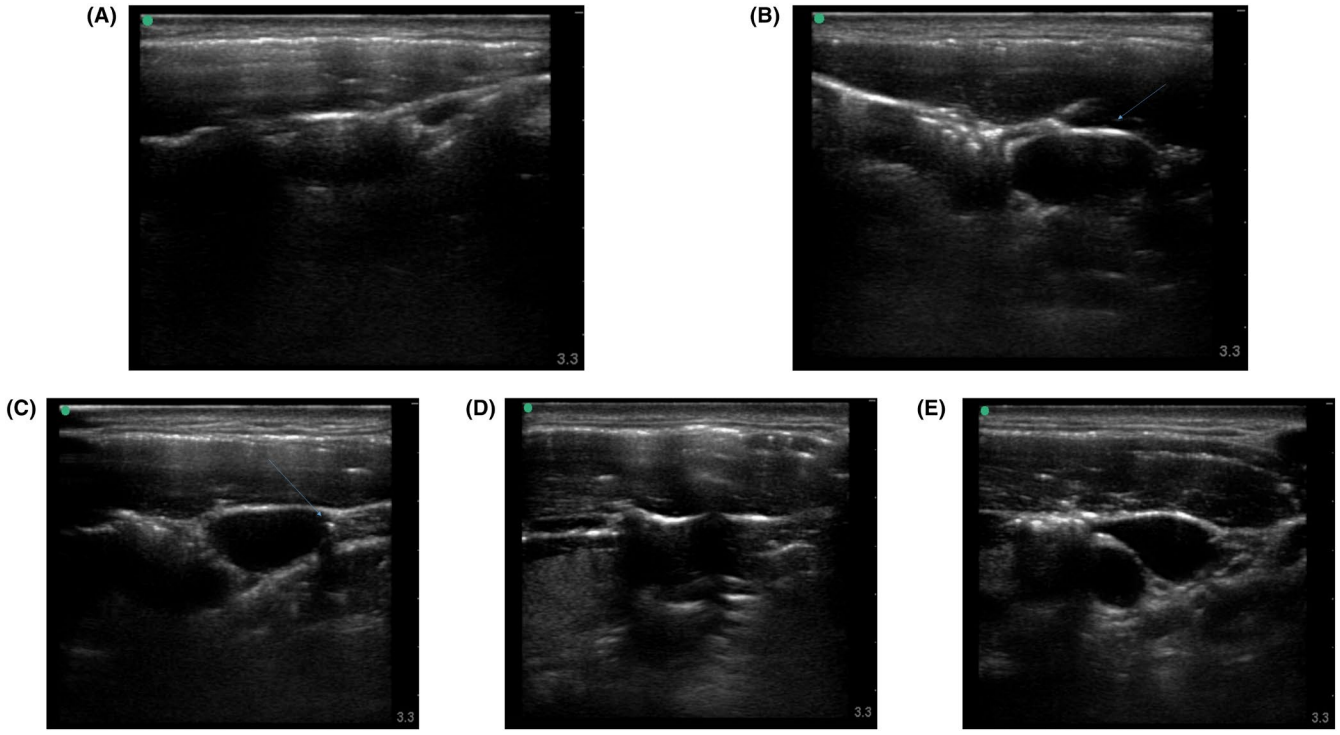

FIGURE 1 (A) Ultrasound image of the subcutaneous emphysema in the right neck. (B) After moving the air to the lateral side of the right neck, the ultrasound shows a definite image of the right internal jugular vein (arrow). (C) After performing central venous catheterization via the right internal jugular vein, the ultrasound shows the hyperechoic dot (arrow) in the right internal jugular vein. (D) Subcutaneous emphysema in the left neck compared with that in the right neck, where central venous catheterization was performed. (E) After the subcutaneous air of the left neck was laterally shifted, the ultrasound shows clear images of the left internal jugular vein and common carotid artery

compression of the trachea.[12] Whether invasive air removal is required in patients with subcutaneous emphysema who need an ultrasound procedure immediately or whether the procedure should be performed without ultrasound even if the possibility of complications is high, depend on the clinical situation. Patients with subcutaneous neck emphysema who require central line placement are more likely to show changes in the anatomical structure at the puncture site due to air bubble movement; this may increase the risk of complications when using traditional central venous placement without ultrasound. If possible, the best course of action is to use ultrasound to confirm the correct anatomic structure in the patient with subcutaneous neck emphysema and then perform central venous catheterization. In this case, light pressure was used to move the air laterally and ensure clear ultrasound imaging of the structures. This enabled the clinicians to safely perform central venous catheterization via the right internal jugular vein. It is important to consider that complications can occur due to air movement. Movement can lead to the accumulation of air, which can compress the internal jugular vein, airway, and surrounding nerves. Therefore, when moving the air around the neck, it would be safe to move it in the lateral direction away from the artery, vein, and trachea. In this case, we moved the air using the probe, but we postulate that using a finger may move the air more efficiently than the probe. Using a finger can enable more accurate application of pressure to the targeted area, thus, making it possible to use less force and move the air more precisely. It may be a way to reduce the potential complications caused by the movement of air bubbles. In patients with subcutaneous emphysema, there have been reports of difficulties faced in ultrasound-guided nerve block.[13] This method can also be used for patients who need a nerve block.

In conclusion, central venous catheterization can be safely achieved by pushing the accumulated air laterally using an ultrasound probe in patients with subcutaneous emphysema of the neck. However, a further study involving more clinical cases is needed to confirm the benefits and potential risks associated with this method. We believe that this method would be helpful for patients with subcutaneous neck emphysema who require ultrasound-guided central venous catheterization via the internal jugular vein.

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Published with written consent of the patient.

CONFLICT OF INTEREST

None declared.

AUTHORS CONTRIBUTION

SIB and J-TS: contributed to conceptualization. SIB and SBC: contributed to data curation. SIB: contributed to formal analysis and investigation. SIB, SHL, K-EP, and YH: contributed to project administration. SIB, SHL, K-EP, YH, and SK: contributed to resources. J-TS: contributed to supervision and validation. SIB and SBC: contributed to visualization. SIB, SBC, and J-TS: contributed to writing—original draft. SIB, SBC, SHL, K-EP, YH, and J-TS: contributed to writing—review and editing.

ETHICAL APPROVAL

The case report was approved by the institutional review board of Gyeongsang National University Hospital (GNUH 2020-05-017).

RESEARCH REPORTING GUIDELINES

The authors have read and prepared the manuscript according to the CARE Checklist (2013).

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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