Ultrasound detection of pneumothorax caused by improper ultrasound-guided central vein puncture

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Introduction

Ultrasound (US)-guided central venous (CV) puncture has become widely used due to the availability of small high-resolution US devices. Since US-guided CV catheterization can be performed while confirming the location of the puncture needle and the structure around the vein, there have been many reports on the high level of safety, but complications have been happened by overconfidence of US images. US devices are also used for evaluation of lung diseases. We report a case of pneumothorax caused by CV port placement that was detected quickly by US.

Case Report

A 60-year-old woman was scheduled diagnostic laparoscopy and CV port placement under general anesthesia. For CV port placement, the assistant obtained a short axis view of the right subclavian vein with US, and the operator performed puncture using the out-of-plane method. The needle was inserted up to its base without US image of the needle tip. Although the needle tip was also not visualized on the second puncture, an image showing compression of the subclavian vein by the needle was obtained and the guidewire was placed by the penetration method. Then the CV port was implanted by the usual process, and there was no change in ventilation and oxygenation.

We performed lung ultrasonography because pneumothorax was suspected due to the puncture procedure. The US image showed a lack of lung sliding and a barcode sign (Fig. 1) at the right anterior thoracic region, therefore we diagnosed as a pneumothorax. Then we tried to find out a lung point (Fig. 2) to estimate the severity of the pneumothorax, but no lung point was found in the lateral thoracic region. This US scan indicated a severe pneumothorax, therefore a chest tube was quickly placed. Her chest radiograph on supine position before the tube placement also showed right pneumothorax (Fig. 3).

Fig. 1 M-mode image at the right anterior thoracic region. Since the movement of pleura by breathing (lung sliding) was lost, it has showed a “barcode sign” (stratosphere sign).

Fig. 3 Chest radiograph in a supine position showed a deep sulcus sign and collapsed right lung.

Fig. 2 The “lung point” (reprinted from ref. 1). The fleeting appearance of a lung pattern (lung sliding) replacing a pneumothorax pattern (absent lung sliding plus horizontal lines) in a particular location of the chest wall. In this case, no lung point was found in the lateral thoracic region, thus we diagnosed severe pneumothorax.

Discussion

When performing US-guided CV catheterization, serious complications can occur without US images of the puncture needle tip. Inexperienced operators using US-guided CV catheterization often focus too much on the US image and advance the needle without watching the tip at all times. Advancing the needle without visualizing the tip, in other words “blind” US-guided subclavian vein catheterization, entails a high risk of serious complications. Safe puncture is not possible without a good understanding of the characteristics of US-guided puncture. To visualize the target vein and puncture needle on the US image is important (Fig. 4). This can be achieved by correct handling of US probe and puncture needle. It is risky to just focus on the US images.

Fig. 4 The relations of the probe placement, needle and vessel

Iatrogenic pneumothorax occurs in 0–3.3% of catheterization cases even under ultrasound guidance. US has both high sensitivity (88%) and specificity (100%)²⁾ for pneumothorax diagnosis and can detect pneumothorax that cannot be diagnosed with chest X-ray (occult pneumothorax)³⁾. Pneumothorax can also be more rapidly diagnosed with ultrasound compared to chest X-ray⁴⁾. In the present patient, US diagnosis of severe pneumothorax while waiting for the chest X-ray results enabled treatment to be started without delay.

Conclusion

Attention must be given to possible complications such as pneumothorax that can occur if US-guided CV puncture is performed improperly. Pneumothorax is easily diagnosed by lung ultrasound, thus US should be used to check for pneumothorax after performing CV catheterization.