

## Ultrasound-guided Aspiration of the Iatrogenic Pneumothorax Caused by Paravertebral Block -A Case Report-

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Thoracic paravertebral block is performed for the treatment of patients with chronic pain, such as complex regional pain syndrome (CRPS) and post-herpetic neuralgia. Thoracic paravertebral block can result in iatrogenic pneumothorax. Because pneumothorax can develop into medical emergencies and needle aspiration or chest tube placement may be needed, early diagnosis is very important. Recently, thoracic ultrasonography has begun to be used to diagnose pneumothorax. In addition, ultrasound-guided aspiration can be an accurate and safe technique for treatment of pneumothorax, as the needle position can be followed in real time. We report a case of iatrogenic pneumothorax following thoracic paravertebral block for the treatment of chronic pain due to CRPS, treated successfully by ultrasound-guided aspiration. (Korean J Pain 2012; 25: 33-37)

### Key Words:

aspiration, paravertebral, pneumothorax, ultrasonography.

Thoracic paravertebral block is performed for the treatment of patients with chronic pain, such as complex regional pain syndrome (CRPS) and post-herpetic neuralgia. Complications after paravertebral block include hypotension, vascular puncture, pleural puncture and pneumothorax [1].

Pneumothorax can occur either spontaneously or traumatically. Iatrogenic pneumothorax is a type of traumatic pneumothorax and can be caused by thoracic paravertebral block, central intravenous catheterization, thoracentesis and lung biopsies. As pneumothorax can develop into

medical emergency, early diagnosis is very important for patients and physicians. The standard diagnostic method for the detection of pneumothorax is computed tomography (CT), but chest x-ray (CXR) is commonly used as a first line diagnostic test. However, CT and CXR can require time to perform, and carry the risk of radiation exposure. Ultrasound is more easily available in pain management as a diagnostic and practical tool. Ultrasound examination of the chest is simple, economical, and free of radiation, and ultrasound has been described as a more accurate method than CXR for the detection of pneumo-

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thorax [2,3].

Managements of pneumothorax can include observation, simple aspiration, or tube thoracotomy, depending on the size of the pneumothorax, symptoms, presence of continued air leak, and evidence of a tension pneumothorax.

We describe a case of iatrogenic pneumothorax caused by thoracic paravertebral block, which was treated by ultrasound-guided needle aspiration.

## CASE REPORT

A 45-year-old female patient with CRPS visited the clinic for management of neuropathic pain of the left upper extremity. She had suffered from allodynia and hyperalgesia of the left upper extremity for two years. We had managed her symptoms with cervical epidural block and thoracic paravertebral block. During this visit, a left unilateral thoracic paravertebral block at the second thoracic vertebral level was performed in the sitting position with a 22-gauge Tuohy needle by the loss of resistance technique. Twenty milliliter of 0.4% lidocaine and 0.125% bupivacaine was injected.

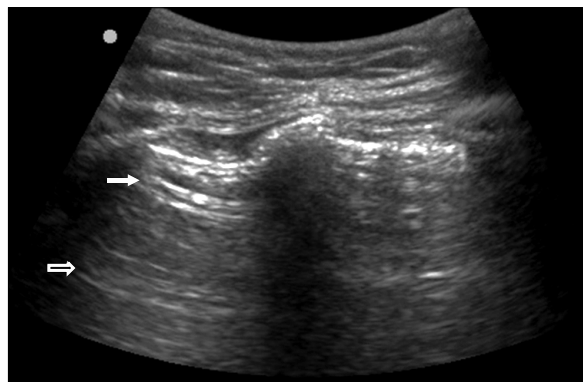
Three hours later, the patient returned to the clinic complaining of left chest pain and mild dyspnea. Stethoscopy of both sides of the thorax revealed slightly decreased breath sounds of respiration on the left. CXR confirmed the presence of pneumothorax in the left lung



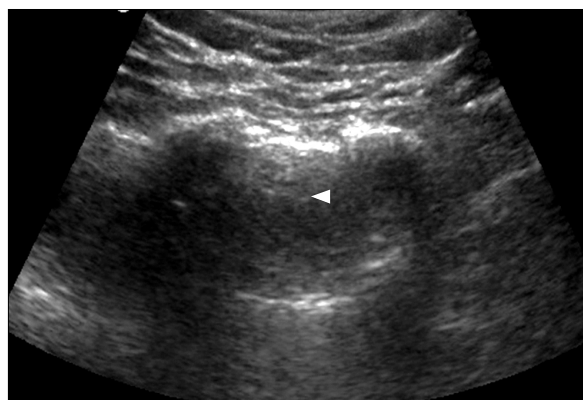
**Fig. 1.** Initial chest x-ray shows pneumothorax in left hemithorax (white arrow) and partially collapsed left lung.

(Fig. 1). Ultrasonography was then performed. With the patient in the supine position, a curved transducer (3–5 Hz) was placed on the left anterior chest wall longitudinally on the second intercostal space. This procedure revealed absence of the lung sliding sign and comet-tail artifact at the pleural line (Fig. 2).

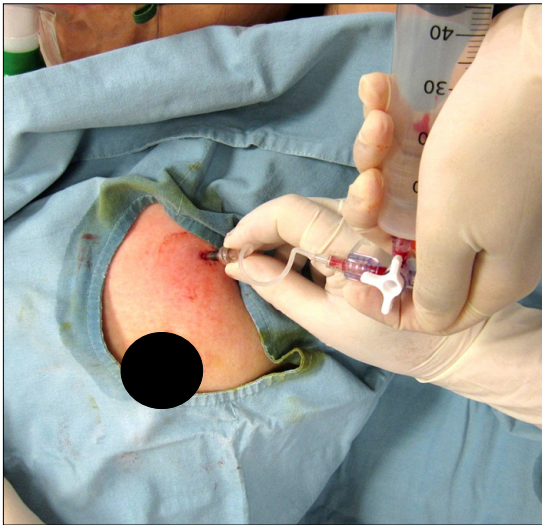
Needle thoracotomy was performed in the left second intercostal space on the midclavicular line with an 18 gauge intravenous cannula by ultrasound-guided out-of-plane approach (Fig. 3). Aspiration with 50 ml syringe and 3 ways valve was started (Fig. 4). Following aspiration, CXR was performed to confirm successful treatment of the pneumothorax (Fig. 5). After rechecking the CXR, the patient received oxygen therapy for two days to avoid re-expansion of the pneumothorax. Chest discomfort and dyspnea were gone within two hours after aspiration. She



**Fig. 2.** Initial ultrasound images of the second intercostal space. White arrow indicates parietal pleura without lung sliding sign. Blanked arrow indicates horizontal artifacts.



**Fig. 3.** Ultrasound image during aspiration of air in the interpleural space. Arrowhead indicates the needle tip below the parietal pleura.



**Fig. 4.** A picture which shows aspiration using 18 gauge angiocatheter, 3 ways valve and 50 ml syringe. A angiocatheter is placed in the second intercostal area. A large block dot indicate the nipple of patient.

was discharged with no symptoms or complications.

## DISCUSSION

Thoracic paravertebral block is the technique of injecting local anesthetics into the paravertebral space containing the thoracic spinal nerves and thoracic sympathetic chain. This technique can be used for postoperative pain control and for control of chronic pain such as that resulting from CRPS and post-herpetic neuralgia, as well as pain caused by rib fracture. The standard technique of paravertebral space location is by loss of resistance to air or saline and fluoroscopy-guided block or ultrasound-guided block can be performed [4]. In this case, we performed the paravertebral block by the blind technique, because our clinic does not allow for the performance of every paravertebral block with fluoroscopic or ultrasound guidance. It is recommended that physicians to use fluoroscopy-guided block or ultrasound-guided block, whenever possible.

Paravertebral block can result in complications; hypotension occurs in 4.6% of cases, vascular puncture in 3.8%, pleural puncture in 1.1% and pneumothorax in 0.5% [1]. The frequency of pneumothorax after paravertebral block is relatively lower than that of other complications. However, as pneumothorax can develop into a medical



**Fig. 5.** Chest-x ray after air aspiration shows shows decreased size of pneumothorax (arrowhead).

emergency, such as respiratory distress, early diagnosis is very important for patients and physicians.

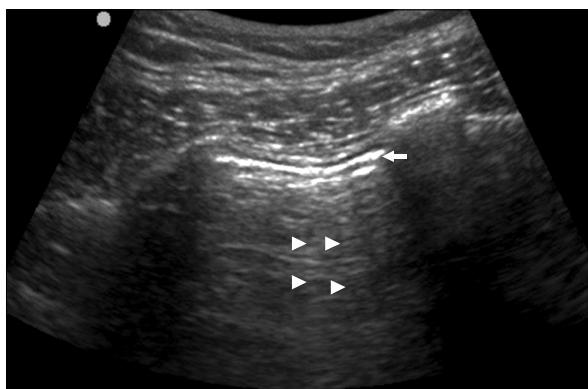
Various procedure, such as thoracic paravertebral block, central intravenous catheterization, thoracentesis, and lung biopsies, can result in iatrogenic pneumothorax. The standard diagnostic tool for pneumothorax is CT, but CXR is commonly used to diagnose pneumothorax and to exclude other diseases. However, radiologic examination, such as CT or CXR, can require time to perform, and carries the risk of radiation exposure.

In many pain clinics, the increase in the use of ultrasound has given physicians an excellent diagnostic technique, with the ease of use of ultrasound machines and the easy interpretability of ultrasound image. Ultrasound examination of the chest is non-invasive, economical and free of radiation, and the ultrasound machine is usually placed at the bedside, allowing for its immediate employment. Thoracic ultrasonography is increasingly used in chest medicine. There are many clinical indications for thoracic ultrasonography, with pleural effusion the most common. Other indications are assessment of diaphragmatic function, pleural thickening and chest wall masses [5].

Ultrasound examination to detect pneumothorax should be performed in an organized fashion [6]. With patients in the supine position, the ultrasound probe is placed on the anterior chest wall longitudinally to find the ribs and pleural line. In the longitudinal view, the location of the ribs makes it possible to detect the pleural line, while in the transverse

view, the ribs and pleural line are not seen in the image. The pleural line is composed of the visceral pleura, parietal pleura and a small amount of interpleural fluid. In normal subjects, it is difficult to differentiate between the two pleural layers in an ultrasound image. A hyperechoic pleural line located between and below two ribs is either the parietal or visceral layers. The parietal pleura normally slides on the visceral pleura, in a manner synchronized with respiration (sliding sign). This sliding sign is important to exclude pneumothorax. The lung sliding sign is always correlated with the normal lung, but absence of the lung sliding sign, while suggestive, is not sufficient to confirm pneumothorax [7].

In a subject with pneumothorax, the pleural line represents only the parietal pleura, because air collection in the interpleural space prevents visualization of the visceral pleura. During ultrasound examination, two types of artifacts from the pleural line can be observed. One type is a roughly horizontal hyperechoic pleural line (horizontal artifact) and the other type is a roughly vertical hyperechoic reverberation artifact from the pleural line to the edge of the screen (comet-tail artifact). The horizontal artifact is a brightly echogenic line between the rib shadows and is made by air as a static barrier to ultrasound. The comet-tail artifact is sign of interstitial lung disease, and also signifies lung parenchyma that is absent of interposed air. Horizontal artifacts and comet-tail artifacts can be either pathologic or physiologic. Horizontal artifacts with the lung sliding sign represent the normal lung pattern, while horizontal artifacts without the lung sliding sign are a sen-



**Fig. 6.** Ultrasound image after air aspiration. This shows that lung sliding sign is seen of the pleural line (white arrow) and comet-tail artifact from the pleural line to the edge of the screen (arrowhead).

sitive sign of pneumothorax, and there are reports that the presence of the lung sliding sign and comet-tail sign is indicative of absence of pneumothorax [3,6]. In the present case, pneumothorax was diagnosed easily by CXR and was confirmed by thoracic ultrasonography. In the first ultrasound examination, we could not detect the lung sliding sign or comet-tail sign, but only the horizontal artifact (Fig. 2). After aspiration, we were able to detect the lung sliding sign and comet-tail artifact (Fig. 6).

Thoracic ultrasonography can reduce the need for CT to diagnose pneumothorax [3]. Thoracic ultrasonography is more sensitive than supine chest radiography and is as sensitive as CT in the detection of traumatic pneumothorax [8].

Managements of pneumothorax includes observation, simple aspiration, or tube thoracotomy, depending on the size of the pneumothorax, symptoms, presence of continued air leak, and evidence of a tension pneumothorax.

Yang et al. [9] reported a case of pneumothorax caused by paravertebral block. This case was successfully simply treated with observation, oxygen inhalation, and simple aspiration with a specially invented mini-tube device and subclavian catheter on an outpatient basis. Laub et al. [10] reported that treatment of iatrogenic pneumothorax with a small caliber chest tube with a 2 mm diameter is less painful and less traumatic than large tube thoracotomy. Large intercostal tube drainage has been replaced by smaller tubes and simple aspiration for iatrogenic pneumothorax, so hospitalization is not necessary in many cases. A small-diameter cannula also can be easily placed with ultrasound. In the present case, the patient was managed by simple needle aspiration using an 18-gauge small cannula, not a large large-bore chest tube.

In the case discussed here, the method of ultrasound-guided aspiration of pneumothorax is as follows. With the patient in the supine position, a curved transducer (3–5 Hz) was placed on the left anterior chest wall longitudinally on the second intercostal space to find the ribs and pleural line. Needle thoracotomy was then performed by an ultrasound-guided out-of-plane approach. An in-plane approach could be used to approach the interpleural space, but the length of our angiocatheter was too short to reach the interpleural space. With a longer angiocatheter or tube, we could perform the needle thoracotomy by an in-plane approach. During the ultrasound-guided needle aspiration, it was difficult to find the needle tip when it was advanced into air within the interpleural space. Therefore, it is im-

portant to avoid advancing the needle into the interpleural space and to keep the needle tip just below the parietal pleura to avoid lung injury. We aspirated the air within the interpleural space with a 50 ml syringe and 3-way valve to prevent reentry of the air into interpleural space. When thoracic ultrasonography showed the lung-sliding sign and comet-tail artifact, we discontinued the aspiration. Because the wound was so small, there was no need for sutures to prevent reexpansion of the pneumothorax.

To reduce the occurrence of pneumothorax during thoracic paravertebral block, the block must be performed carefully by a trained practitioner. Fluoroscopic-guided block or ultrasound-guided block is recommended for beginners. When pneumothorax occur during paravertebral block, practitioner who is near an ultrasound machine, should scan the anterior chest wall and try to find the lung sliding sign or comet-tail sign to rule out pneumothorax. Ultrasound can also be an excellent practical tool to allow aspiration of interpleural air without vascular injury, nerve injury or lung parenchymal injury. During aspiration, use of a small caliber cannula is recommended to aspirate the interpleural air to treat pneumothorax on an outpatient basis and to reduce hospitalization time.

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