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Case Report

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Utilization of ultrasound to confirm lesions and perform paravertebral blocks for painful pleural metastasis treatment – A report of two cases

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Abstract

Pleural metastasis-related pain poses a significant challenge in patients with cancer, often leading to severe discomfort and impaired quality of life. Thoracic paravertebral block is an effective regional anesthesia technique for managing such pain, particularly when performed under ultrasound guidance. This report illustrates the use of ultrasound for identifying metastatic lesions and guiding thoracic paravertebral blocks in two patients with pleural metastasis. The first case involved a 76-year-old woman with severe left upper back pain secondary to lung cancer metastasis. Ultrasound confirmed the presence of a lesion at the T5 level, and ultrasound-guided thoracic paravertebral block provided immediate and substantial pain relief, thereby improving sleep quality. The second patient was a 72-year-old man with intractable left upper back pain. Ultrasonography revealed a metastatic lesion at T6, and subsequent thoracic paravertebral block led to significant pain reduction and improved pain management with reduced opioid use. Both cases highlight the effectiveness of ultrasound in accurately locating metastatic lesions and determining the appropriate spinal level for thoracic paravertebral block, resulting in significant pain relief and improved quality of life. These findings underscore the importance of precise anatomical localization and the potential of ultrasound-guided thoracic paravertebral block as a valuable tool for managing pain associated with pleural metastases.

Keywords: Ultrasonography; thoracic paravertebral block; pleural neoplasms; intractable pain

1. Introduction

Pain caused by pleural metastasis poses a significant challenge in advanced malignancies, leading to considerable morbidity and reduced quality of life. Effective pain management is crucial for alleviating suffering and improving overall functionality (1). Thoracic paravertebral block (TPVB) is a valuable regional technique for thoracic pain, reducing pain, opioid use, and systemic side effects (2).

Traditionally, TPVB is performed using anatomical landmarks and loss-of-resistance techniques, which increases the risk of inaccurate needle placement. Ultrasound guidance has revolutionized regional anesthesia via precise localization of the paravertebral space, improving needle placement accuracy and reducing complications such as pneumothorax and pleural puncture (3). Ultrasonography is crucial for identifying lesions and guiding the TPVB to the appropriate spinal level in pleural metastases with localized pain. Correctly targeting the spinal nerves ensures optimal clinical outcomes and safety. Despite these advantages, few studies have explored the role of ultrasound-guided TPVB in pleural metastasis. This report highlights two cases where ultrasound was used for metastatic lesions to determine the appropriate spinal level for TPVB in patients with painful pleural metastases.

2. Case Presentation

2.1. Case 1

A 76-year-old woman with non-small cell lung cancer presented with intractable left upper back pain for two months. The pain, described as sharp and electric shock-like, worsened in the supine position and disrupted her sleep. Her pain score fluctuated between 2 and 8 on the numeric rating scale (NRS). Physical examination revealed T5 dermatome tenderness and allodynia, suggesting intercostal nerve irritation from pleural metastasis as the primary pain source. To confirm the presence of pleural metastasis and accurately determine the spinal level for TPVB, ultrasound imaging (LOGIQTM E10, GE Healthcare, USA) was utilized. Ultrasonography confirmed a metastatic lesion adjacent to the T5 vertebra (Fig. 1), corroborating prior computed tomography (CT) findings (Fig. 2). Consequently, TPVB was performed at the T5 level corresponding to the identified lesion. Ultrasound-guided TPVB was conducted with the patient in the prone position using a transverse in-plane approach to visualize the needle as

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it entered the left-sided paravertebral space at T5. Ten milliliters of 0.2% ropivacaine combined with 5 mg dexamethasone was injected into the paravertebral space. Approximately 20 min after the procedure, the patient reported a significant reduction in pain from 5/10 to 0/10 on the NRS. Numbness was observed in the sensory distribution of the left T5 dermatome. On the day of the procedure, the patient experienced a marked reduction in pain intensity, ranging from 1 to 5 out of 10 on the NRS. The patient was able to lie in the supine position without discomfort, with significantly improved sleep quality. Additional TPVBs were performed over the following month without further pain reduction. However, the patient continued to report sustained improvements in pain levels and sleep quality following subsequent cancer treatment.

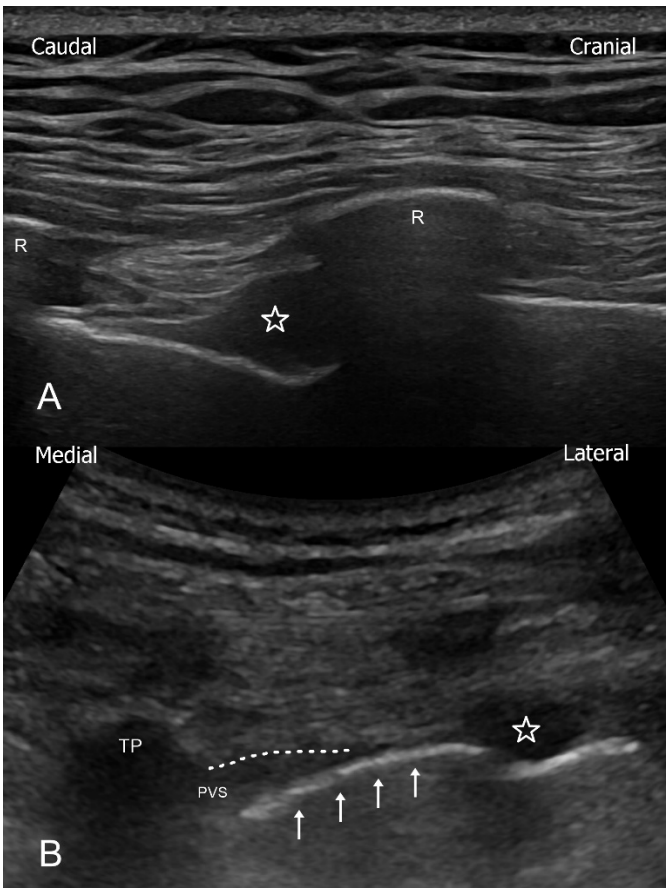

Fig. 1. Ultrasound imaging for localization of pleural metastasis adjacent to the T5 vertebra (Case 1). (A) Parasagittal ultrasound image showing rib shadows (R) and the hypoechoic metastatic lesion (☆) near the T5 vertebral level. (B) Transverse ultrasound view demonstrating the metastatic lesion (☆) in the paravertebral space (PVS), deep to the transverse process (TP). The dotted line indicates the parietal pleura, and the white arrows mark the trajectory of the intended needle path for TPVB

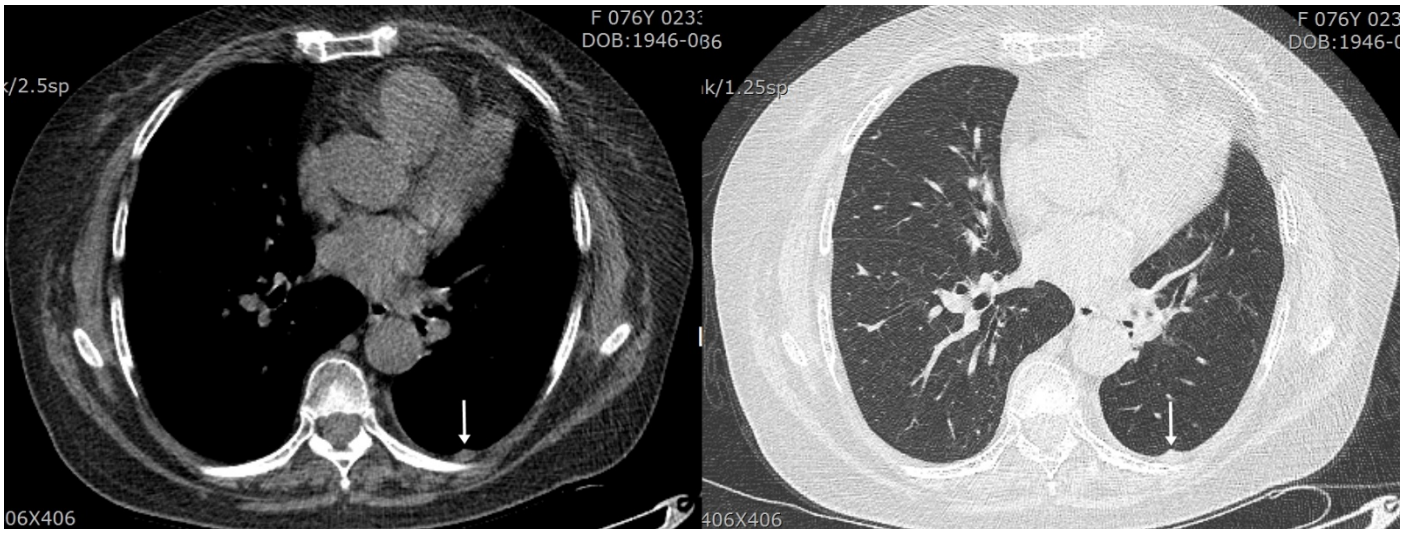

Fig. 2. Axial CT images revealing pleural metastasis (Case 1). (Left) Axial non-contrast-enhanced chest CT image showing a pleural-based soft tissue mass (white arrow) adjacent to the T5 vertebra on the left hemithorax. (Right) Lung window setting of the same axial level, highlighting the pleural lesion (white arrow) with adjacent parenchymal distortion

2.2. Case 2

A 72-year-old man with non-small cell lung cancer and pleural metastasis experienced severe left upper back pain for four months, described as burning and electric shock-like, with sleep-disrupting tingling sensations. Despite opioid use, the patient reported persistent severe pain, rated 8/10 on the NRS, with recent opioid resistance. Ultrasonography confirmed a metastatic lesion adjacent to the T6 vertebra, aligning with the prior CT results. Imaging revealed a distinct metastatic lesion in the pleura adjacent to the T6 vertebra (Fig. 3). Ultrasound-guided TPVB at T6 was performed, leading to immediate pain relief and numbness in the left T6 dermatome. Over the following months, the breakthrough pain intensity and frequency decreased by 50%, allowing effective pain management with oral analgesics and continued cancer treatment without additional blocks.

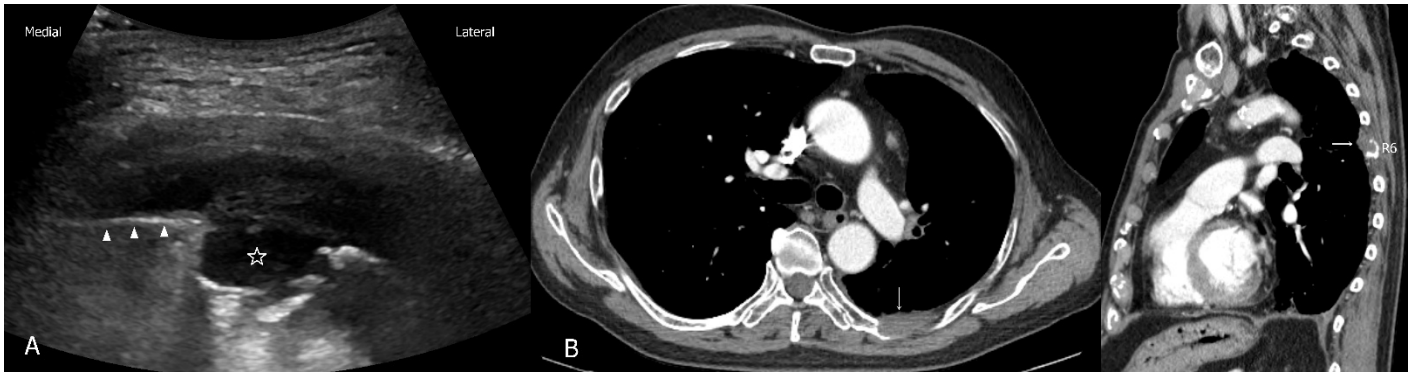

Fig. 3. Imaging findings (Case 2). (A) Ultrasound image showing a hypoechoic metastatic lesion (☆) adjacent to the transverse process at the T6 level; white arrows mark the trajectory of the intended needle path for TPVB. (B) Axial and sagittal computed tomography (CT) images show a pleural-based metastatic lesion adjacent to the left T6 vertebra (white arrows)

3. Discussion

This case report highlights the significance of ultrasound guidance in managing pain associated with pleural metastasis in patients with TPVB. Unlike traditional imaging techniques, ultrasound provides real-time visualization of the paravertebral space, enabling precise identification of metastatic lesions and accurate determination of spinal levels for needle placement. These features improve the safety profile of the procedure and enhance pain relief. Moreover, the immediate and significant pain reduction observed in both cases highlights the importance of meticulous anatomical localization and targeted intervention.

Cancer pain involves mixed mechanisms involving inflammatory, neuropathic, and ischemic processes, rendering treatment challenging (4). In pleural metastasis, localized pain on the affected side often results from direct tumor invasion of the pleural surface, causing inflammation and irritation of the parietal pleura (5). The parietal pleura is innervated by the somatic intercostal nerves. Any trauma or inflammation in this region leads to pain localized to the corresponding cutaneous nerve (6). This irritation commonly manifests as sharp, stabbing, or electric shock-like pain, often worsened by deep breathing or positional changes (5). TPVB provides ipsilateral, segmental, somatic, and sympathetic nerve blockade across contiguous thoracic dermatomes by delivering local anesthetics and anti-inflammatory agents into the paravertebral space and interrupting sensory, motor, and autonomic signal transmission, thereby inhibiting pain perception (7).

Ultrasound-guided TPVB is a well-established technique in regional anesthesia; however, it is traditionally performed based on anatomical landmarks. Reliance on these landmarks, however, does not always ensure alignment with actual pathological spinal segments (8), especially in patients with metastatic lesions. This misalignment can lead to suboptimal analgesia and an increased risk of complications. In this context, our report highlights the significant utility of high-resolution ultrasound in identifying and precisely localizing metastatic lesions in the thoracic region. Ultrasound enhances the precision of needle placement and facilitates targeted drug delivery by directly visualizing the pathological segments. Compared with existing studies, such as Malik's 2014 report (9) on ultrasound-guided paravertebral neurolytic blocks for lung cancer with pleural invasion, our case report emphasizes how ultrasound can overcome the limitations of landmark-based techniques by providing real-time imaging of both normal and pathological anatomies.

While ultrasound can determine the target level in cases of chest wall pathologies, such as rib fractures and pleurisy (10), its utility in complex anatomical scenarios may be limited. However, in the aforementioned cases, ultrasound was essential for confirming thoracic metastatic lesions and facilitating targeted drug delivery, highlighting its potential for addressing the challenges posed by conventional methods. Despite the acoustic challenges posed by skeletal structures, ultrasound has demonstrated its invaluable role in complex anatomical settings by providing precise and reliable visualization to guide interventions. This underscores the diagnostic and therapeutic value of TPVB in improving its accuracy and safety in cases of pleural metastasis.

A key limitation of this study is the absence of a long-term pain control assessment, which is needed to determine the lasting effectiveness of analgesia. While high-resolution

ultrasound proved valuable in detecting tumor invasion of the pleura and chest wall (11), reliance on ultrasound alone without corroborative imaging may affect accuracy, especially in complex cases. Further research is needed to evaluate the broader application, long-term efficacy, and standardized protocols of ultrasound-guided TPVB for pleural metastases.

In conclusion, ultrasonography is crucial for accurately identifying metastatic lesions and guiding TPVB in pleural metastases, thus enabling precise targeting for effective analgesia. Ultrasound-guided TPVB is safe and effective for managing oncological pain in patients with pleural involvement.

Ethical Statement

This study was approved by the institutional review boards of the Inje University Haeundae Paik Hospital, Republic of Korea; a waiver of consent was obtained (Number: HP IRB 2024-05-040 Date: 2024.5.31).

Conflict of interest

The authors declare no conflict of interest.

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None to declare.

Authors' contributions

Concept: J.H.K., D.O., Design: J.H.K., D.O., Data Collection or Processing: J.K., B.L., Analysis or Interpretation: S.H.M., M.J.K., Literature Search: Y.H.P., Writing: J.H.K., D.O.

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