Thoracic Disc Herniation Manifesting as Abdominal Pain Alone Associated with Thoracic Radiculopathy

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Introduction
Symptomatic thoracic disc herniation (TDH) is estimated to occur with a frequency of 1 per million each year.¹,² The commonest location of TDH is central or centrolateral to the spinal canal below the T7 level. When TDH occurs in these positions, it is extremely rare that radicular pain is the only symptom.³ A patient who only complains of radiculopathy, such as abdominal pain, might be mistakenly diagnosed with psychogenic pain, intercostal nerve entrapment caused by muscle stiffness and truncal position or visceral disease without history of trauma, prior surgery or skin infection, thereby resulting in the risk of downgrading the severity of the disease or undergoing unnecessary invasive procedures.³ We report here a rare case of a 52-year-old male, who presented with unilateral severe flank pain with a previous diagnosis of intercostal neuralgia after visiting different hospitals. We evaluated that his pain derived from thoracic radiculopathy caused by TDH and successfully treated him surgically. In the discussion section, we also review the literature of TDH presenting with thoracic radiculopathy to discuss how to make a correct diagnosis and provide adequate treatment.

Case Report
A 52-year-old male was referred to us with medically refractory severe right flank pain lasting for 1 year. The pain radiated from the back to the umbilics on the right side in the T9 dermatomal distribution, which was relieved by truncal extension and deteriorated by truncal flexion. He was working as a security guard and had to put a lumbar brace on to maintain the truncal extension posture and avoid daily exacerbating pain. He had visited multiple medical institutions and was unsuccessfully prescribed with various type of painkillers. He also underwent several intercostal nerve block procedures performed by anesthetists with little effect. Otherwise, he was neurologically intact, without weakness and sensory disturbance in the four limbs. His past medical history was unremarkable, and there was no history of trauma, prior surgery or skin infection. Thoracic spine magnetic resonance imaging (MRI) showed a centrolateral to foraminal TDH at the T9-10 level (Fig. 1). Thoracic spine computed tomography (CT) showed intraforaminal calcification, indicating the presence of calcified disc herniation (Fig. 2). We evaluated that his symptoms were compatible with T9 thoracic radiculopathy caused by TDH, based on his pain distribution, characteristic pain intensity changes in accordance with his truncal position, and the corresponding radiological imaging findings. We also judged that the prior intercostal nerve block procedures had been ineffective, since the pathology was located far proximal to the injection site for the nerve block. The patient declined to undergo additional nerve root block, such as T9 nerve root block, so we proceeded to perform a thoracic hemilaminectomy and microdiscectomy at T9-10 level via a posterior approach, following the patient’s wish. We used an O-arm-based navigation system to control the scope of facet joint resection up to 50%. The herniated disc was successfully removed, taking the pressure off from the affected T9 nerve root (Figs. 3D and 3E). The surgery was successful, without any neurological complications and his pain disappeared immediately after surgery. Postoperative CT showed that more than half of the facet joint was preserved (Figs. 3A–3C). At his postoperative 1-year follow-up, he is completely free from the pain.

Discussion
There is a wide variety of signs and symptoms caused by TDH. Quint et al.⁴ reported that 92% of TDH patients complained of pain, and more than half of them complained of radicular pain. In their review of literature, Elhadi et al.⁵ reported that 39.5% of the 488 TDH patients showed

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radiculopathy. Radicular pain itself is not uncommon for TDH. However, it is extremely rare that radiculopathy is the only symptom. To the best of our knowledge, there are only 11 cases in the literature reporting a TDH with radiculopathy alone, such as chest, abdominal pain, and abdominal muscle weakness (Table 1). Radiculopathy of TDH could result in abdominal muscle weakness and pain along with the thoracic spinal dermatomal distribution, occasionally accompanied by nausea and vomiting, which may easily be misdiagnosed with intra-abdominal or pelvic pathology. Some of the reported cases underwent unnecessary invasive procedures, such as laparoscopy, before the correct diagnosis of TDH was made. While a thorough visceral test should be required in these cases, when a diagnosis of visceral disease...
is ruled out, we need to differentiate abdominal wall pain. Abdominal wall pain includes intercostal neuralgia, myofascial pain, and visceral disease in which inflammation spreads to the peritoneum other than thoracic radiculopathy. Srinivasan et al.\textsuperscript{17} reported the usefulness of Carnett’s test (judged as positive if the tenderness exacerbates when the abdominal wall is tensed) in differentiating abdominal wall pain from visceral diseases. They described that chronic abdominal wall pain can be diagnosed with 85% sensitivity and 97% specificity if any of the following criteria are satisfied with pain lasting more than 1 month: (1) very localized pain that can be covered with a fingertip and (2) fulfillment of any of the following criteria: fixed location of tenderness with superficial tenderness; point tenderness less than 2.5 cm; or positive Carnett’s test. Routine needle EMG is also helpful for the assessment of nerve root impairment, disclosing positive sharp waves or fibrillation potentials in muscles on the radiculopathy level.\textsuperscript{19} Carnett’s test was positive in the present case, while invasive tests such as EMG was not performed since the diagnosis could be made based on radiological findings and clinical symptoms. Intercostal neuralgia is the most common in the abdominal wall pain, which is usually caused by herpes zoster, direct injury to the nerve or nerve entrapment associated with iatrogenic neuroma or prior surgery and deteriorates on coughing, sneezing, and deep inspiration.\textsuperscript{18} It is sometimes difficult to identify the thoracic radiculopathy as a cause of intercostal neuralgia. In the present case, the intercostal nerve block had almost no effect on the pain, indicating far more proximal lesion to the site of nerve block. Furthermore, the pain distribution corresponded to a dermatomal distribution at the index level and the intensity of pain varied in accordance with spinal movements. Several reports described that the radiculopathy caused by TDH is aggravated with lateral bending, rotation, flexion of the trunk,\textsuperscript{19} and supine or side-lying position.\textsuperscript{14,20} The patient in this report exhibited pain relief only when the trunk was extended when standing with a rigid lumbar brace. We think that reduction of intervertebral disc pressure by extension and/or stabilization of functional motion unit of T9-10 by rigid lumbar brace led to temporary pain relief. We observed a clearly calcified TDH squeezing the T9 nerve root on MRI, which was consistent with his pain distribution. These findings prompted us to consider that his pain originated from the thoracic spine.

The surgical indications and surgery of choice for treating TDH should be determined on a case-by-case basis. Surgical treatment is indicated in the case of medically refractory pain or progressive myelopathy.\textsuperscript{21,22} Several surgical approaches

\textbf{Fig. 3} Postoperative CT images showing the location of laminectomy (arrow) and decompressed intervertebral foramen (A). Axial CT images show that more than half of the facet joint was preserved (B, C). D showed T9 disc herniation. T9 nerve root (arrow) was severely compressed by the disc TDH (arrowhead) and displaced rostrally, looking congested (E). The pressure was successfully taken off from the T9 root (arrow) and TDH was nicely removed (arrowhead). C: caudal side, CT: computed tomography, M: medial side, L: lateral side, R: rostral side, TDH: thoracic disc herniation.
have been suggested for the removal of TDH without manipulating the spinal cord. These procedures are classified into posterolateral, posterior, lateral transthoracic approach, and less invasive techniques using image-guided thoracoscopy, endoscope, and novel retractor system.23–26) Because the herniated disc was not centrally located in our case, we could successfully remove TDH without spinal cord manipulation via the posterior approach without spinal fusion. Fusion may be avoided if the lateral portion of the facet joint is preserved.21,22) As reported by Kim et al.27) and Schlenzka et al.,28) an O-arm-based navigation system helped to firmly identify the spinal anatomy. We could determine the extent of the bone resection and muscles dissection with the image guidance technique resulting in preservation of more than half of the facet joint. O-arm-based navigation system allows us to minimize muscle invasion and damage to medial branch of posterior ramus of the spinal nerves. Furthermore, we could easily identify the index level with this system even for hard-to-localize middle to upper thoracic levels. We could eventually preserve more than half of the facet joint with the image guidance technique. Postoperative CT showed that the bone resection had been performed as planned, resulting in no indication of spinal instability.

**Conclusion**

We report here a patient manifesting abdominal pain due to radiculopathy caused by TDH at the T9-10 level. If abdominal pain alone is observed, it is necessary to investigate the characteristics of pain and considering the possible presence of TDH. TDH with only thoracic radiculopathy can be treated with less invasive surgical procedure, without spinal fusion.

**Conflicts of Interest Disclosure**

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper. The authors have no personal, financial, or institutional interest in any of the drugs, materials, or devices described in this manuscript.

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