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Neuraxial Consideration with a Spinal Dorsal Arachnoid Web: A Case Report of a Rare Spinal Pathology

Eldhose Abrahams, MD and Aimee Pak, MD

Background: Dorsal arachnoid webs (DAW) are thickened spinal arachnoid tissue bands that impinge onto the subarachnoid space and may progressively cause localized cord compression with an associated syringomyelia.

Case Reports: A 68-year-old woman with metastatic cancer had thoracic back pain a month after spinal fusion for bony spread. Though initially managed symptomatically, the pain progressively worsened without other neurological symptoms. Two years later, we discovered a thoracic DAW without associated syringomyelia during evaluation. Due to higher risk for spinal cord injury, we avoided epidural injection.

Conclusions: Iatrogenic spinal cord compression is a concern when performing neuraxial intervention with a present DAW. The safety or efficacy of epidural or spinal anesthetic techniques in DAW is unknown. Given the rarity of DAW, variable presentation, and difficult radiographic identification, unwitting neuraxial performance in an undiagnosed DAW may occur. Awareness and careful evaluation are important for pain physicians and anesthesiologists performing neuraxial interventions.

Key words: Dorsal arachnoid web, epidural anesthesia, epidural steroid injection, spinal arachnoid web

BACKGROUND

Recent neurosurgical, neurologic, and spine publications have brought attention to a rare, insidious spinal pathology that has not yet been addressed in the anesthesia literature despite its broad relevance to anesthesiologists, particularly those who practice neuraxial techniques such as regional, obstetrical, pediatric anesthesiologists and interventional pain physicians. The authors present a patient diagnosed with a spinal dorsal arachnoid web (DAW) during the workup of progressive back and truncal pain at our interventional pain clinic. DAW are thickened bands of spinal arachnoid tissue that extend into the subarachnoid space and exert focal compression on the dorsal spinal cord. An associated syrinx has been observed in some cases, the formation of which is proposed to be from obstruction or disturbances in cerebrospinal fluid (CSF) flow (1,2). It has a variable clinical presentation, which may range in severity and progression, and diagnosis is often delayed for months to years from symptom onset (1). Symptoms may include pain, motor or sensory deficits in the extremities or trunk, as well as upper motor neuron signs or incontinence (1,2).

The earliest reference to spinal DAW was in 1997 by Mallucci et al (3) and since then has only been described in case reports and case series. Given the nonspecific and variable presentation, scarcity of information and clinical guidance, and potential for devastating iatrogenic injury to the spinal cord, clinical anesthesiologists and pain interventionalists should have awareness of spinal DAW presentation and the potentially higher risk for

From: Department of Anesthesiology, Oklahoma University Health Sciences Center, Oklahoma City, OK

Corresponding Author: Aimee Pak, MD, E-mail: aimee-pak@ouhsc.edu
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complications from neuraxial procedures. To the authors' knowledge, this is the first case reported of spinal DAW in the context of epidural pain management.

CASE

The patient has given her written informed consent to present her case. A 68-year-old woman with metastatic lung adenocarcinoma, pleural metastases, and thoracic intraspinal spread presented to us for progressive thoracic back pain. She had undergone a total laminectomy and posterior fusion from T3 to T7 due to extradural involvement at the T4 to T6 levels with T5 bony invasion. After an uneventful postoperative recovery, she started monoclonal antibody therapy and radiation treatments for her primary cancer. One month after surgery, she developed back pain at the interscapular region down to the T8 level which was initially controlled with muscle relaxants and chronic opioid therapy. However, after 7 months, the pain had extended into her lateral chest wall and became refractory to medications. She denied other associated symptoms. There was no evidence of hardware failure, worsening tumor burden, or new osseous lesions on several postsurgical surveillance computed tomography (CT) imaging. She was referred to us for interventional options for pain control 2 years after her spine surgery.

On physical examination, she had bilateral tenderness over her erector spinae muscles at the T3 to T7 levels. She indicated worse pain on the right side. Palpation of the right thoracic paraspinals in the T4 to T7 region elicited a radiating pain into the ipsilateral anterolateral chest wall. No sensory changes were noted over the posterior thoracic area. There was neither hypoalgesia to pinprick nor allodynia over the incisional site. There were no observed motor deficits or upper motor neuron symptoms.

As surgical hardware interference would affect magnetic resonance imaging (MRI), a CT myelogram of the thoracic spine was instead obtained. A stable T5 compression deformity and posterior fusion from T3 to T7 without fracture or loosening of surgical hardware is seen. Focal flattening of the dorsal spinal cord at T7 to T8 (sagittal view) (Fig. 1) with widening of the dorsal thecal sac (coronal view) is suggestive of an arachnoid web. The remainder of the spinal cord showed normal caliber and without any syrinx. Thus, a T7 to T8 spinal DAW was diagnosed.

While a thoracic epidural steroid injection would have been otherwise indicated, several concerns precluded this option in our patient. First, there was concern regarding iatrogenic spinal cord injury (i.e., cord contusion from direct needle injury, cord compression from epidural injection, or inflammatory response) from epidural injection at the level of the DAW. Second, the postoperative scarring and surgical hardware insertion may have limited adequate injectate spread to the right T4 to T7 nerve roots. Third, the surgical hardware would interfere with fluoroscopic visualization. As an alternative intervention, right-sided T4 to T7 intercostal nerve blocks under fluoroscopic and ultrasound guidance were pursued to alleviate her radiating chest wall pain.

After an informed consent discussion, the patient was brought to the procedural room, connected to standard monitors recommended by the American Society of Anesthesiologists, and placed in a neutral prone position. The right thoracic area was exposed and cleansed with a 2% chlorhexidine gluconate/70% isopropyl alcohol antiseptic skin prep solution. The intercostal spaces associated with the T4 to T7 levels were initially identified under fluoroscopy and then visualized using ultrasound. The points of entry on the skin were anesthetized with one mL of 1% lidocaine. Under ultrasound guidance (Sonosite HFL50XP, Fujifilm, Bothell, WA), a 2-inch insulated 22-gauge block needle (Stimuplex® A, B. Braun, Melsungen, Germany) was advanced into the fascial plane at the inferior border of the ribs 1 cm lateral to its articulation with its associated thoracic transverse process. The needle was visualized in-plane with a 15-6 MHz linear probe, and the tip was maintained superficial to the pleura. A 20-mL total mixture of 17 mL of 0.5% bupivacaine, 2 mL of 80 mg methylprednisolone, and one mL of iohexol radiopaque contrast medium was injected in 5-mL aliquots at each intercostal site. The patient tolerated the procedure well and without complications. Fluoroscopic imaging confirmed adequate injectate spread along the target intercostal nerves. Analgesia was expected in the posterolateral chest wall.

In the recovery room, the patient reported greater than 80% relief of her thoracic back and right chest wall pain. The relief was sustained for the following 2 months until she returned for a follow-up visit, at which time her thoracic spine pain had recurred. She was also undergoing physical therapy to help with pain management and muscle strengthening. No neurosurgical intervention is being pursued for the DAW due to her overall prognosis; however, radiofrequency ablation of her right T4 to T7 intercostal nerves is under consideration for longer-term analgesia.

DISCUSSION

Spinal DAW are transverse or longitudinal bands of thickened meningeal tissue that extend ventrally onto the dorsal spinal cord (4-6). They arise from the arachnoid membrane based on histopathological analysis (4). They may compress the dorsal spinal cord or cause a secondary syringomyelia from CSF obstruction and fluid dynamic disruptions. The exact incidence of DAW is unknown; however, the largest case series to date in 2022 only identified 38 DAW patients over 8 years across multiple hospitals (2), and prior to that a systematic review in 2019 only found 41 documented DAW cases (1). Spinal DAW occur almost exclusively in the thoracic levels (1,2,4), with only one reported case at the brainstem in a Dandy-Walker patient (7) and one at the cervical level (8). The mean age at diagnosis is 52 to 55 years of age with an adult age range from 20s to 70s (1,2,4), though one pediatric DAW case has been reported in a 10-year-old (7).

Prior spinal trauma, surgery, infection, or neuraxial drug instillation has been suspected in DAW formation (3). However, a systematic review of 43 patients found that DAW formation after previous trauma or spine surgery only accounted for 16% for each factor (1). Similarly, in a large case series of 38 patients, 39% of cases had a history of spinal surgery, 8% had trauma to the central nervous system, and none had prior meningitis (2). Chang et al (9) reported histopathological evidence of inflammatory cells in one case of spinal DAW and the possibility of epidural inflammation extending into the subarachnoid space, which may be the mechanism for DAW formation in a patient who had a prior epidural abscess (10). While there might be postoperative, traumatic, infectious, or inflammatory etiologies, idiopathic development appears to occur in many confirmed DAW cases (1,4,11). Also, given its rarity, DAW formation does not seem to occur in most patients with such risk factors.

The clinical presentation is highly variable and may be progressive depending on the affected levels by the impinging DAW or enlarging syrinx. Myelopathic symptoms involving gait, coordination, and balance (68%) as well as thoracic back pain (68%) are the most common symptoms, followed by lower extremity numbness and sensory changes (58%), imbalance (58%), hyperreflexia (50%), lower extremity weakness (45%), and lower extremity radicular pain (42%) (2). This is consistent with an earlier systematic review's findings of weakness (67%) and sensory loss (65%) mostly in the lower extremities (81%) followed by the back or trunk (42%) as the most common presentation (1). Incontinence may occur in nearly a quarter of cases (1,2). Symptom progression occurs in 35% of cases, though that increased to 55% if symptoms lasted beyond a year (1). Syringomyelia is reported in one- to two-thirds of DAW cases (1,2), and may occur at, above, or below the DAW location (4,6).

Fig. 1. Computed tomography myelogram of the thoracic spine.
The thecal sac is opacified with contrast medium (blue asterisk). At the T7-T8 level (white label), the dorsal aspect of the thecal sac is flattened with anterior displacement from the DAW (yellow arrow). The thecal sac returns to normal caliber below T8.

Radiologic diagnosis is difficult since the DAW tissue is very thin. However, the presence of a "scalpel sign," a

discrete anterior indentation of the thoracic spinal cord with widening of the dorsal subarachnoid space which resembles a posteriorly-facing scalpel, is an indirect sign that is pathognomonic for DAW if seen on MRI spine or CT myelography (5). Advanced MRI techniques have been employed, such as high-resolution 3D T2 myelographic sequences (12) or T2-weighted constructive interference in steady state sequence (13) to better visualize DAW bands and cardiac-gated phase-contrast cine-mode MRI to look at disturbances in CSF flow dynamics (12).

Laxpati et al (2) reported that patients managed nonoperatively described a stable or worsening symptomology, while surgically managed patients had stable or improved symptoms. Likewise, Both Nisson et al (1) and Voglis et al (4) reported that 91% of surgically treated patients had improvement in their neurological symptoms. Laminectomy and DAW excision is the most common surgical treatment, with generally positive postoperative outcomes (1,2,4). However, surgical intervention may not improve thoracic pain and may be associated with increased upper extremity and thoracic numbness or paresthesia (2). Other surgical techniques included laminectomy with shunt or stent placement to bypass the obstruction to CSF flow (1), subarachnoid-subarachnoid bypass (14), or percutaneous fenestration via intrathecal catheter (15).

There is an average diagnostic delay of 3.3 to 4.6 years (1,2). It is conceivable that mild or vague symptoms may not trigger a diagnostic workup for DAW or that traditional imaging studies may not visualize DAW tissue. Some patients may only present with trunk, back, or lower extremity pain, which may just be treated symptomatically (16) or attributed to confounding medical issues (e.g., pregnancy). This should be of concern for anesthesiologists who may unknowingly encounter such patients for neuraxial anesthetic or analgesic procedures.

Iatrogenic injury to the spinal cord is a potential complication of neuraxial procedures. A concern with thoracic epidural placement or lumbar epidural with caudal catheter placement into the thoracic level in the presence of an unknown DAW may risk potential spinal cord compression with injectate administration. Patients with spinal stenosis with or without cord compression may be an analogous population to DAW patients given the fixed, compressive spinal pathology. Patients with spinal stenosis are at higher risk for neurological complications with neuraxial blockade with compressive neural ischemia from the injectate or infusate as a proposed mechanism (17), and even mild, preexisting spinal cord compression risks potential complications such as paraplegia (18). In addition, accidental dural puncture and subsequent CSF leak may worsen neurological symptoms, possibly from downward spinal coning from an acute decrease in CSF pressure below the level of the DAW, similarly seen with lumbar punctures in subarachnoid blockage from spinal tumors (19).

A coexisting syrinx and its effects on CSF pressure dynamics add to these considerations. Epidural injection may potentially compress the subarachnoid space to increase pressure within the syrinx (20). A systematic review of parturients with syringomyelia suggests that both epidural and spinal anesthetic techniques may be performed without neurological consequences, though it should be noted that the majority of deliveries were operative and under general anesthesia, which reflected concerns of syrinx aggravation (21).

CONCLUSION

While there are many unanswered questions regarding DAW and neuraxial safety, awareness of DAW is an imperative first step. Given its rarity, variable and progressive clinical presentation, and difficulty in imaging diagnosis, even mild neurological symptoms should be evaluated prior to performing neuraxial intervention.

Authors' Contributions

Eldhose Abrahams: This author helped with the information collection, figure illustration, editing and revision of the manuscript.

Aimee Pak: This author helped with the conception, literature search, writing and revision of the manuscript, and manuscript guarantor.

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