Immediate pain resolution in Baxter neuropathy: A novel ultrasound-guided d5w hydrodissection approach in flat foot

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Immediate pain resolution in Baxter neuropathy: A novel ultrasound-guided d5w hydrodissection approach in flat foot

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ABSTRACT

Background. Flat foot is a prevalent foot deformity among Asians and is often associated with nerve entrapment. Baxter neuropathy is among the many causes of chronic heel pain and typically responds well to conservative measures. However, in some intractable cases, more aggressive treatment, such as interventional pain management, is required. Ultrasound-guided nerve hydrodissection with dextrose 5% (D5W) is a novel technique for releasing the Baxter nerve from surrounding fascial planes, offering a promising therapeutic option for such cases.

Case report. A 33-year-old Asian male with a radiologically established flat foot presented with chronic heel pain, with a numeric rating score of 8 out of 10 during activity. The pain was aggravated by activities such as long-distance walking and had begun to interfere with his professional career. The PainDETECT Questionnaire score was 17 out of 35, indicating possible neuropathic pain. The patient reported complete resolution of his chronic and severe heel pain shortly after undergoing ultrasound-guided hydrodissection with D5W, with relief sustained through the fourth month post-procedure.

Conclusions. Ultrasound-guided nerve hydrodissection using D5W is a safe procedure that offers immediate and long-lasting pain relief for Baxter neuropathy associated with flat foot.

Keywords: flat foot, baxter neuropathy, nerve hydrodissection, D5W, ultrasound-guided procedures

Abbreviations:

D5W	Dextrose 5%
NRS	Numbering Rating Score
TRPV1	Transient Receptor Potential Vanilloid-Type 1

INTRODUCTION

Flat foot, or pes planus, is a condition where the longitudinal arch of the foot's medial side is very low or absent, resulting in the entire foot base being visible in footprints. It is one of the most prevalent foot deformities among Asian populations, with a reported prevalence of 2.9% in young Korean males [1]. Nerve entrapment related to flat foot is a commonly encountered problem but often underdiagnosed. Baxter neuropathy is among the many causes of heel pain and has been implicated in up to 20% of chronic heel pain cases [2–4].

Most patients with Baxter neuropathy respond well to conservative treatment. However, in some intractable cases, surgical intervention is often considered as the last resort to release the entrapped nerve [2]. Emerging interventional pain management, such as ultrasound-guided nerve hydrodissection, have shown promising therapeutic result in such intractable cases. Beneficial effects of hydrodissection have been demonstrated in carpal tunnel syndrome, a common upper extremity entrapment neuropathy [5].

We reported a patient with severe chronic heel pain unresponsive to conservative treatment, who underwent ultrasound-guided hydrodissection of Baxter nerve using dextrose 5% (D5W). The procedure resulted in immediate and long-lasting pain relief. To our knowledge, this is the first reported case regarding ultrasound-guided hydrodissection using D5W to release the Baxter nerve as the cause of chronic heel pain.

CASE REPORT

A 33-year-old Asian male presented with a six-month history of left heel pain. He worked in a private sector role that required frequent international business, often involving long-distance walking. The pain was described as occasionally sharp and sometimes resembling a burning sensation extending along the inner side of the heel, accompanied by a tingling sensation radiating to the outer side of the left foot. The numeric rating scale (NRS) was 8 out of 10 (0 being no pain and 10 being the worst imaginable pain), exacerbated by weight-bearing activities such as

prolonged walking or standing and alleviated by rest, typically easing by evening. The PainDETECT Questionnaire score was 17 out of 35, suggesting the possibility of neuropathic pain.

The patient reported no smoking history but acknowledged occasional alcohol consumption, particularly during business trips. He provided a non-contributory medical history, specifically denying diabetes, significant prior trauma, previous foot surgery, inflammatory arthropathies, or systemic illnesses. His family medical history was similarly unremarkable. Despite multiple medical consultations over the preceding six months and treatment with 150 mg pregabaline and 60 mg duloxetine at night, his symptoms persisted.

On physical examination, tenderness was observed along the medial side of the patient's left foot, specifically near the calcaneal bone. A positive Tinel's sign was elicited on the left foot, reproducing pain radiating to the lateral aspect of the foot. Additionally, the patient presented with bilateral flat feet, a likely contributor to his chronic left heel pain, particularly when engaging in extended walking activities.

Weight-bearing lateral view radiographs were obtained to confirm the pes planus diagnosis objectively. Radiographic findings revealed a Meary angle of 1.8° (right foot) and 5.4° (left foot), a Calcaneal Inclination Angle of 14.2° (right foot) and 14.7° (left foot), and a Lateral Talocalcaneal Angle of 40.1° (right foot) and 42.0° (left foot), confirming the diagnosis of bilateral pes planus. (Figure 1)

Figure 1. Weight-bearing lateral view radiograph of patient's feet, objectively demonstrating bilateral flat foot

Given the lack of clinical improvement with conservative medical treatment, ultrasound-guided hydrodissection with D5W was proposed to release the first branch of the lateral plantar nerve. A linear high-frequency probe (Wisonic Navi) was used and a 24G 1 inch needle was inserted from distal to proximal with in-plane approach, targeting the Baxter nerve located in between the fascia of abductor hallucis muscle and quadratus plantae muscle. The nerve was then hydrodissected using 5ml of D5W. The procedure resulted in a dramatic and sustained improvement, with the patient reporting a complete resolution of heel pain and significant enhancement in walking comfort sustained through the fourth month post-procedure.

DISCUSSION

The foot's plantar surface receives sensory innervation from multiple nerves. The sural nerve supplies a small sole region, while the saphenous nerve contributes to a limited region. The primary sensory innervation of the sole is provided by the posterior tibial nerve and its branches: the medial plantar nerve, lateral plantar nerve, and medial calcaneal nerve. The first branch of the lateral plantar nerve referred to as the Baxter nerve, plays a crucial role in sensory innervation. (Figure 2)

Figure 2. The foot's plantar surface sensory innervation

In typical foot anatomy, the Baxter nerve has two potential sites susceptible to entrapment. (Figure 3) Flat foot deformities disrupt normal foot biomechanics, increasing the risk of nerve compression between the fascia of abductor hallucis muscles and the quadratus plantae muscles [6].

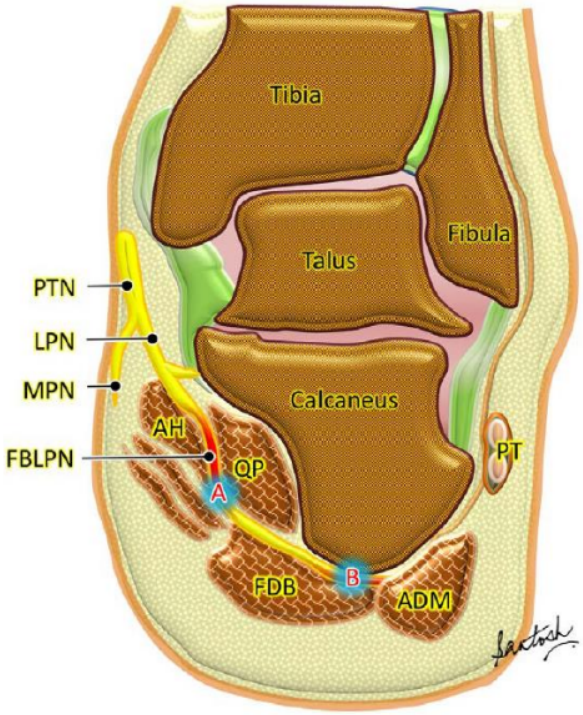

Figure 3. Cross-sectional coronal view of the anterior calcaneus highlighting two potential entrapment sites of Baxter's nerve. Proximal entrapment occurs between the fascia of the abductor hallucis muscle and quadratus plantae muscle (A), while the distal entrapment is located between the quadratus plantae muscle and flexor digitorum brevis muscle (B) [2].

Baxter neuropathy is typically addressed through conservative treatment [2]. Surgical intervention is considered a final option, reserved only for selected cases where initial conservative management strategies fail. For patients who do not achieve adequate pain relief with conventional treatments but do not meet the surgical threshold, interventional pain management techniques offer a minimally invasive alternative to resolve the symptoms. Ultrasound-guided nerve hydrodissection is one such technique, offering a potential substitute for surgery whilst avoiding its associated complications [7].

Sahoo et al [2] reported complete symptom resolution in chronic Baxter neuropathy following a newer technique called ultrasound-guided nerve hydrodissection. This technique utilizes injection of fluid medium between two structures or in the fascial planes under continuous ultrasound visualization to release the nerve [8].

The rationale behind nerve hydrodissection is to relieve the pressure on neurovascular structures, such as nervi nervorum and vasa nervorum, within the epineurium. Adhesion or compression of a peripheral nerve can lead to venous congestion and impaired lymphatic drainage, thus compromising the homeostatic regulation of the endoneural microenvironment [2,9].

Hydrodissection potentially alleviates the congestion and frees the nervi nervorum from the surrounding soft tissue [9].

Traditional injectate for nerve hydrodissection typically consists of a mixture of a local anesthetic with or without a steroid. Some experts recommend radiofrequency nerve ablation of the lateral plantar and medial calcaneal nerves for chronic heel pain to avoid steroid injection [10].

A newer injectate using D5W has emerged as an alternative to substitute the usage of steroids and is preferred for peripheral nerve entrapment neuropathies [9,11], Studies have demonstrated the beneficial effects of nerve hydrodissection using D5W in carpal tunnel syndrome, a common entrapment neuropathy of the upper extremity [5].

The proposed mechanism of D5W involves a sensorineural mechanism by downregulating the transient receptor potential vanilloid-type 1 (TRPV1), which is often upregulated in chronic neuropathic pain. Additionally, D5W may reduce neurogenic inflammation and reverse the hypoglycemic status, thereby decreasing C-fiber activation [7].

A recent cadaveric study has thoroughly documented the sonoanatomical characteristics of the Baxter nerve, confirming the ability of ultrasound to visualize the nerve [12]. This facilitates precise hydrodissection between fascial planes, offering a clinically effective intervention for Baxter neuropathy.

To our knowledge, this is the first reported case with positive clinical outcomes regarding ultrasound-guided nerve hydrodissection using D5W to release Baxter nerve in a patient with pes planus. Further studies with larger sample sizes and extended follow-up intervals are needed to validate the beneficial effect of this approach for Baxter neuropathy.

CONCLUSION

Ultrasound-guided nerve hydrodissection using D5W is a safe procedure that offers immediate and long-lasting pain relief for Baxter neuropathy associated with flat foot.

Patient consent: The patient gave written informed consent for the publication of the clinical details and/or clinical images.

Conflict of interest: None

Authors' contributions: Conceptualization, HW; Formal analysis, investigation, resources, HW and YMTS; Writing – original draft preparation, HW; Writing – review and editing, HW and YMTS; Supervision, YMTS. All authors have read and agreed to the published version of the manuscript.

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