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# Ultrasound-Guided Pudendal Nerve Dextrose Hydrodissection for Urinary Incontinence: A Clinical Review and Case Reports

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**Background:** Pudendal nerve (PN) entrapment can result from both mechanical and nonmechanical causes. Mechanically, the nerve may be compressed, transected, or stretched, often during surgical procedures. Nonmechanical causes may include chronic conditions, such as diabetes mellitus.

**Case Reports:** These case series include a 66-year-old man with a 3-year history of benign prostatic hyperplasia, who complained of urinary incontinence after surgery, and a 67-year-old woman with a 10-year history of well-controlled type 2 diabetes and diabetic urogenital autonomic neuropathy, whose urinary incontinence responded to ultrasound-guided dextrose hydrodissection of the PN.

**Conclusions:** Ultrasound-guided PN dextrose hydrodissection can be a straightforward and safe treatment option for urinary incontinence.

**Key words:** Case report, pudendal nerve, benign prostatic hyperplasia, diabetes, ultrasound

## BACKGROUND

Pudendal nerve (PN) entrapment syndrome, a condition that, despite its rarity, holds significant implications for those affected. The true prevalence of this syndrome remains unknown, but it is estimated to impact about 1% of the general population. Interestingly, it accounts for approximately 4% of all patient consultations for pain control, with women being more than twice as likely to be affected as men (1). PN entrapment can stem from both mechanical and nonmechanical causes. Mechanically, the nerve can be compressed, transected, or stretched. Pelvic surgery is a common cause of PN entrapment. Nonmechanical causes are diverse, including viral infections, such as herpes zoster and HIV, chronic conditions like multiple sclerosis and diabetes mellitus, and even radiation therapy. The PN innervates various structures in the pelvic region, including the muscles involved in controlling urination. When the nerve is entrapped or compressed, it can lead to a range of symptoms, including pain, numbness, and dysfunction of the pelvic organs. The hallmark symptom of PN entrapment is perineal pain, which worsens with sitting and is relieved by standing or sitting on a toilet. However, it can also manifest through bladder dysfunction, including urgency and frequency, as well as sphincteric dysfunctions, such as dysuria, urinary hesitancy, and urinary incontinence (1).

Specifically, PN entrapment can affect the external urethral sphincter (EUS), which is crucial for maintaining continence. If the nerve's function is impaired, it can lead to difficulties in controlling the bladder, potentially resulting in urinary incontinence (2). The PN, which innervates the EUS and perineal muscles, travels through the Alcock's canal.

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Compression in this area can contribute to urinary symptoms. Compression of the PN within this canal can lead to dysfunction, including urinary incontinence. Hydrodissection in this region helps release the nerve from surrounding tissues, relieving the compression and restoring normal function (3).

Understanding the diverse presentations and underlying causes of PN entrapment is crucial for effective diagnosis and management. This article aims to explore the etiology, clinical features, and therapeutic approaches to PN entrapment syndrome. We present 2 case reports demonstrating successful outcomes with ultrasound-guided PN dextrose hydrodissection: a woman with diabetic cystopathy and a man with benign prostatic hyperplasia (BPH) who exhibited symptoms of nocturia, poor stream, hesitancy, and prolonged micturition. Both patients underwent ultrasound-guided PN dextrose hydrodissection, and we will discuss the outcomes associated with this intervention.

In both cases, as noted, PN entrapment between the sacrospinous (SS) and sacrotuberous (ST) ligaments, along with narrowing, fibrosis, or abnormal thickening, and nerve swelling or hypoechoic (darker) appearance with hypervascularity around the nerve, was confirmed at the bedside using diagnostic ultrasound. This modality allows for real-time visualization of the nerve as it courses through key anatomical sites, such as between the SS and ST ligaments, as well as other potential entrapment sites like Alcock's canal and the piriformis muscle. High-frequency transducers provide detailed imaging of the nerve's path, enabling clinicians to identify any narrowing, fibrosis, or abnormal thickening in these regions, which may indicate compression. Furthermore, dynamic ultrasound can help assess movement-related compression, offering insights into whether the nerve becomes impinged during specific activities. Color Doppler is also useful in assessing vascular compromise, as ischemia can contribute to the pain experienced in pudendal neuralgia.

Ultrasound-guided PN dextrose hydrodissection for urinary incontinence is a novel technique aimed at controlling bladder dysfunction caused by entrapment neuropathy of the PN. Five percent dextrose in water (D5W) is a nontoxic, biocompatible solution used in hydrodissection to gently create space around the nerve under ultrasound guidance to reduce mechanical pressure, which is particularly important in cases of entrapment neuropathy. It separates the nerve from surrounding tissues without causing irritation or damage, as can occur with repeated use of local anesthetics. Research suggests that buffered glucose, such as D5W, may also help alleviate neuropathic pain by correcting abnormal metabolic homeostasis, contributing to improved nerve function and reduced pain perception. This makes D5W a safe and effective choice for the procedure, minimizing potential risks, while achieving therapeutic benefits without the need for invasive surgery (4). Higher concentrations of dextrose are not recommended, as they may cause irritation or damage to the nerve or surrounding tissues (5). Additionally, hydrodissection is preferred to nerve blocks, which primarily provide temporary analgesia by inhibiting nerve transmission, hydrodissection addresses the underlying structural issues, promoting a more sustainable improvement in nerve function. Additionally, hydrodissection is preferred over nerve blocks, which primarily provide temporary analgesia by inhibiting nerve transmission. By addressing the underlying structural issues, hydrodissection promotes a more sustainable improvement in nerve function, ultimately targeting the root cause of nerve compression and enhancing overall treatment efficacy (1).

As data in this field are still limited, we hope that introducing this treatment will contribute to improved management of this uncomfortable condition.

## CASE REPORT 1

A 67-year-old woman with a 10-year history of well-controlled type 2 diabetes currently treated with empagliflozin 5 mg/metformin 500 mg twice daily combination therapy with tightly controlled glucose levels. Past medical and drug history include hypercholesterolemia managed with rosuvastatin 5 mg once daily, and urinary urge incontinence managed with solifenacin 10 mg once daily.

The patient has no significant family or social history. She is a nonsmoker, has a good education and adherence to diabetic monitoring, with a healthy diet and exercise regimen, and an otherwise healthy lifestyle. To date, there have been no identified diabetic-associated complications.

The patient presented to the clinic with a 4-year history of intermittent worsening dysuria, frequency, and nocturia. She has been treated for urinary tract infections on several occasions over the years with no resolution of symptoms.

On presentation, the patient's symptom severity has worsened, specifically the urinary frequency has

increased with nocturia from an average of 2 to > 10 episodes over the last 3 months. This has resulted in a significant impact on the patient's life and attendance to the clinic. After exclusion of all other potential causes of the patient's urinary symptoms, diabetic urogenital autonomic neuropathy was suspected. After informed consent and upon suspicion of diabetic neuropathy, diagnostic ultrasound confirmed the involvement of the PNs.

Using a 5% dextrose solution, both nerves were released under ultrasound guidance.

Hydrodissection was used to create space around the PN, allowing it to move freely and reducing compression within Alcock's canal. This method minimizes the need for invasive surgery while offering symptom relief. For skin anesthesia, 1 mL of 10% lidocaine was used before needle insertion to ensure patient comfort during the procedure. Subsequently, patients were requested to monitor and log their urinary frequency for further evaluation over around 4 weeks, alongside their regular medications, with their usual fluid intake and diet (Fig. 1). Additionally, patient education about the condition and its treatment was provided to enhance their understanding and engagement in their management plan.

The patient precisely recorded her urinary frequency over a 35-day period, with 2 days (8 and 13) missing due to illness, as shown in Fig. 1. Following the treatment, the patient reported a remarkable improvement in urinary frequency during both daytime and nighttime, accompanied by enhanced sleep quality and daily activity, reflecting the broader impact of effective symptom management on the patient's overall well-being. The patient expressed high satisfaction with the intervention.

Prior to the treatment, the patient reported an average urinary frequency of approximately 7 times during the daytime and around 10 times during the nighttime over the preceding 3 months (recorded as day 0 in Fig. 1). Subsequent to the PN injection intervention, the average urinary frequency dropped to approximately 4 times during the daytime and approximately 2.5 times during the nighttime, reflecting a notable improvement in bladder function. Notably, on day 15, no nocturia was reported, which was unusual for the patient. Ultimately, on day 10, the patient stopped solifenacin 10 mg once daily following consultation with her physician and was otherwise happy with the frequency of her urination. The patient's ability to stop taking solifenacin after treatment highlights the possibility of lowering dependency on pharmacotherapy with effective intervention, hence minimizing negative effects from medication. Improvement in urinary incontinence persisted during the 4 months of observation.

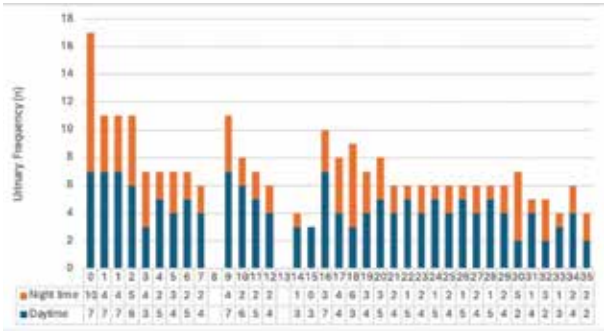


Fig. 2. This chart illustrates a record of the patient's urinary patterns, providing insights into the variation in urinary frequency over daytime and nighttime periods across a 35-day timeframe after bilateral PN dextrose hydrodissection.

## CASE REPORT 2

A 66-year-old man with a 3-year history of BPH presented with symptoms of nocturia, poor stream, hesitancy, and prolonged micturition and failed conservative treatment. The patient then underwent a direct vision urethrotomy operation using the Sachse method and continued with transurethral resection of the prostate (TURP) 3 weeks later. One month after the TURP procedure, the patient was referred to the Physical Medicine and Rehabilitation Department with symptoms of urinary incontinence (urgency and urine leakage following an intense desire to empty the bladder, urinary leakage when coughing or sneezing, and inadequate time to reach the toilet once the urge to urinate was felt). The patient had to use diapers every day because of these urinary incontinence symptoms. He also had nocturia, so his diaper was always full at night. He received treatment from physiotherapy using parasacral transcutaneous electrical stimulation and pelvic floor exercise for a month, but no improvement was found. As conservative treatment for urinary incontinence failed, plans were made to undergo PN dextrose hydrodissection after the patient's informed consent, with the same methodology as in case study 1 being used.

The patient reported a gradual decrease in urine leakage following the procedure. He was able to sense the urge to urinate, allowing him to wake up 3 times during the night to use the toilet. After 3 days of treatment,

there was a significant improvement in urinary incontinence, with no further symptoms of urgency or urine leakage. He no longer required the use of diapers, as he was able to reach the toilet once the urge to urinate was felt. Additionally, nocturia was resolved. The improvement in urinary incontinence persisted over the 5-month follow-up period, with regular assessments at 1, 2, 3, 4, and 5 months.

## METHODS

Ultrasound-guided PN dextrose hydrodissection for both cases involved the following; the patient is positioned in a prone position. The ultrasound probe is placed transversely along the medial third of an imaginary line extending from the caudal canal to the greater tuberosity. Color Doppler is used to locate the pulsation of the internal pudendal artery (PA) near the ischial spine. The SS and ST ligaments are visualized as hyperechoic lines, and the PN is identified between these ligaments and adjacent to the internal PA.

A total of 1 mL of 10% lidocaine is administered for local skin anesthesia. The needle is inserted in-plane, advancing from medial to lateral, with the artery's pulsation serving as a landmark to avoid the sciatic nerve. The needle is advanced to the medial aspect of the PA, passing through the ST ligament (a "click" may be felt). The needle is then guided in-plane, from the edge of the probe toward the fat-filled groove created by the SS ligament ventromedially and the ST ligament dorsomedially, known as the "biligamentary tunnel." Hydrodissection of the PN is performed using 10 cc of D5W as the injection progresses, opening the fascial plane and the space between the 2 ligaments (Fig. 2).

## DISCUSSION

Urogenital autonomic neuropathy, a common complication of poorly controlled or longstanding diabetes mellitus, presents as bladder dysfunction, also known as diabetic cystopathy. This condition is characterized by diminished bladder sensation, impaired contractility, and elevated postvoid residual urine levels, identifiable through urodynamic testing, uroflowmetry, and assessment of postvoid residual urine volume (6-8). Symptoms can vary from urinary retention with hesitancy to urinary incontinence with urgency, often accompanied by sexual dysfunction.

Histopathological evidence suggests a specific mechanism through which diabetes is most likely to contribute to neuropathy. At the molecular level, deposition of various amyloid proteins has been observed in type 2 diabetes. These abnormal protein accumulations cause dysregulation and subsequent damage, which mostly affects the nerves by interfering with regular cellular functions. As a result, this series of molecular events is identified as a common etiological component that causes entrapment neuropathy in diabetic individuals (9). This neuropathic impact extends to the pathophysiology of diabetic cystopathy. In this instance, low-frequency impulses initiate the activation of afferent nerves, which then relay signals to the pontine storage and micturition centers during bladder filling with low volume. This activation subsequently triggers sympathetic outflow

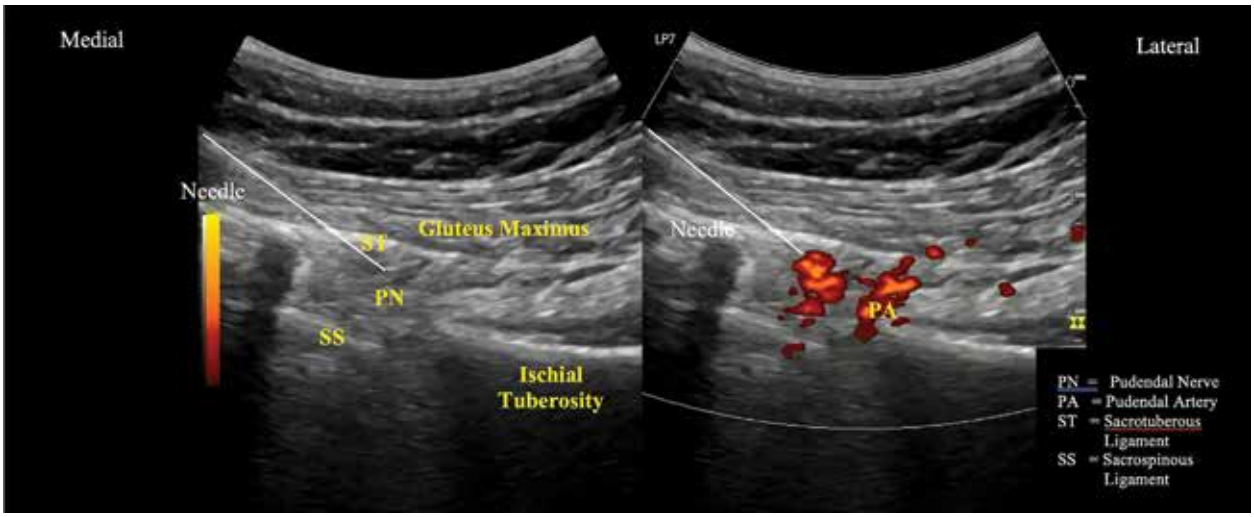


Fig.1. Ultrasound-guided PN dextrose hydrodissection between ST and SS ligaments. PN, pudendal nerve; PA, pudendal artery; ST, sacrotuberous; SS, sacrospinous.

via the hypogastric and PNs (1,10). Consequently, there is diminished bladder sensation, impaired contractility, and elevated postvoid residual urine levels.

Urinary incontinence can be one of the complications of post-BPH. One of the most common operations for BPH is TURP. The incidence of urinary incontinence post-TURP in BPH is 59.3% (11).

Urinary continence in men is maintained by the proper function of the detrusor smooth muscle, the proximal intrinsic sphincter at the bladder neck, the EUS, and the urethral suspensory mechanism (pubourethral ligaments). Continence of urination is maintained primarily by the EUS, which is innervated by the PN (12). During a TURP, the internal urethral sphincter is resected and rendered incompetent (13).

The possible diagnosis of urinary incontinence in BPH patients post-TURP could be caused by stress urinary incontinence and bladder dysfunction. Decreased compliance is associated with an increase in detrusor pressure with the storage of urine, which can result in urinary incontinence. This patient did not undergo urodynamic examination as the gold standard to check detrusor pressure. If urodynamics were used, urinary incontinence symptoms could differentiate whether the patient has stress urinary incontinence, overactive bladder, or mixed incontinence. But in this case, the patient presented with symptoms of urgency and complaints of urinary leakage when coughing or sneezing, so we diagnosed that he had mixed urinary incontinence. There is some possibility that urinary incontinence is caused by a complication of the operation, such as the resection affecting the part of the EUS or injury to a deep branch of the perineal nerve or postoperation inflammation or edema that entraps the deep branch of the perineal nerve or bladder dysfunction that will cause the failure of coordination between the internal sphincter and EUS during the storage and voiding phase (14-19).

The second case showed a delayed effect, taking 3 days postintervention for noticeable improvement, likely due to the time needed for the coordination of urinary sphincter muscles posthydrodissection. This highlights the need for further studies to clarify this mechanism. The study's generalizability is limited by its 2-case design, emphasizing the necessity for larger sample sizes and additional research given the limited existing literature.

## CONCLUSIONS

In conclusion, bilateral PN dextrose hydrodissection presents itself as a promising, safe, effective, and straightforward alternative treatment for urinary incontinence following prostate surgery. Additionally, it holds significant potential as an effective symptomatic therapy for diabetic cystopathy.

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