CASE REPORT

Ultrasound-guided pulsed radiofrequency ablation of the genital branch of the genitofemoral nerve for treatment of intractable orchalgia

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ABSTRACT

Chronic orchalgia is a frustrating clinical problem for both the patient and the physician. We present a 17-year-old boy with a bilateral idiopathic chronic intractable orchalgia with failed conservative treatment. For 2 years, he suffered from severe attacks of scrotal pain that affected his daily activities and caused frequent absence from school. Ultrasound-guided pulsed radiofrequency ablation (PRF) of the genital branches of the genitofemoral nerve performed after local anesthetic nerve block confirmed the diagnosis and yielded 6 weeks of symptom relief. Seven-month follow-up revealed complete satisfactory analgesia. The use of PRF is an effective and non-invasive approach to treat intractable chronic orchalgia.

Key words: *Chronic orchalgia, genital branch of genitofemoral nerve, pulsed radiofrequency, ultrasound*

INTRODUCTION

Chronic orchalgia refers to testicular pain that is either intermittent or constant, lasts for more than 3 months and interferes with daily activities. There is a paucity of literature concerning the management of pediatric chronic orchalgia as compared with adults.[1]

Ultrasound has become a commonly used modality in the performance of chronic pain interventions. It allows direct visualization of tissue structure while allowing real-time guidance of needle placement and medication administration.[2] While an ultrasound-guided spermatic cord block was reported for scrotal surgery,[3] selective ultrasound-guided block of the genital branch of the genitofemoral nerve has, to the best of our knowledge, not been reported.[4]

We present a case of an adolescent patient who was diagnosed with intractable idiopathic chronic orchalgia and treated successfully with ultrasound-guided pulsed radiofrequency ablation.

Access this article online	
Quick Response Code:	Website: www.saudija.org
	DOI: 10.4103/1658-354X.130755

CASE REPORT

A 17-year-old boy, ASA physical status class I, was referred by the urologist to our pain clinic in Prince Sultan Military Medical City (PSMMC) with a diagnosis of intractable idiopathic chronic orchalgia, which had failed all pharmacological conservative treatments (NSAID, Pregabalin and Tramadol). He suffered sudden attacks of severe (10/10) scrotal pain that lasted for hours and happened on average once per month. These affected his daily activities, caused frequent absence from school and were associated occasionally with syncopal attacks. The orchalgia had started almost 6 years ago but had become more severe over the last 2 years. There were no specific triggers apart from cold weather. Attacks were associated with frequency and dripping of urine. There was no associated scrotal numbness or impotence, although he could not maintain an erection because of the severe associated testicular pain. No remarkable history of trauma, infections or other medical diseases was elicited. All workups were unremarkable.

Procedure description

With the patient supine and using an aseptic technique, a high-frequency probe (3-12 MHz), (CX50 Philips, Bothell,

WA, USA) was used to perform a selective block of the genital branch of the genitofemoral nerve.

- The inferior epigastric vessels [Figure 1, R – 1 and L – 1] were localized under the rectus sheath and the probe was then moved caudally to the point where the inferior epigastric artery connects with the external iliac artery. At this level, the probe was moved medially to locate the spermatic cord. (Another approach would be to follow the femoral artery cranially until it enters the external iliac artery and then move the probe medially at this level to locate the spermatic cord.)
- After localizing the spermatic cord above the inguinal ligament just lateral to the symphisis pubis, genital retraction of the testis resulted in movement of the spermatic cord. Color Doppler was used to locate the testicular and vas deferens vessels [Figure 1, R – 2 and L – 2]
- The area containing the spermatic cord was zoomed for better visualization of the genital branch of the genitofemoral nerve, which in our case was located lateral to the deferens duct. Gentle compression by the probe caused obliteration of the vessels but not the duct, and the duct appeared as a hypoechoic non-compressible structure [Figure 1, R – 3 and L – 3].

A confirmatory and diagnostic local anesthetic injection was performed between the internal and the cremaster fasciae using a 22-gauge insulated needle (in-plane technique), using 20 mg of methyl prednisolone and 5 mL of 2.5% bupivacaine bilaterally. The patient reported immediate pain relief that lasted for 6 weeks.

The patient was then counseled on the risks and benefits of thermal ablation using the same ultrasound-guided technique, and opted for treatment. For the radiofrequency ablation, a 50 mm, 22 Gauge SMK needle and a 50 mm neuropole connected to the radiofrequency generator (NeuroTherm NT 1100, Wilmington, MA, USA) were used. After sensory and motor stimulation (the latter by watching for cremaster muscle contraction), PRF of 42°C was applied for 120 s.

Patient follow-up

After a 7-month follow-up period, the patient reported satisfactory analgesia with a VAS of 0/10 at rest when playing football and masturbating (which he was unable to perform before). He was not using any analgesic medications. There were no complications, specifically no testicular atrophy or sexual problems, and the cremaster reflex was present bilaterally.

DISCUSSION

Idiopathic chronic orchalgia is a frustrating clinical problem for both the patient and the physician, which represents approximately 25% of the chronic orchalgia cases.[5] The non-idiopathic forms are usually secondary to infection, tumor, varicoceles and spermatoceles, or as a complication of vasectomy or inguinal hernia repair.[6]

The testis receives its main innervation from the superior spermatic plexus via nerve fibers complementary with the internal spermatic vessels. The parietal and visceral layers of the tunica vaginalis and cremaster muscle receive afferent innervation by the genital branch of the genitofemoral nerve.[5] The genitofemoral nerve originates from the upper part of the lumbar plexus (L1 and L2). It emerges on the anterior surface of the psoas muscle, then runs downward in front of the muscle and divides into the femoral and genital branches. The genital branch of the genitofemoral nerve is a mixed sensory-motor nerve that descends within the spermatic cord to the scrotum and supplies the cremaster and dartos muscle, and gives a few filaments to the skin of the scrotum.[7] However, the femoral branch is a pure sensory nerve. The spermatic cord is a collection of structures that passes through the internal inguinal ring and forms the testis. It is covered by three fasciae that are derived from the layers of the anterior abdominal wall; the external spermatic fascia, the cremasteric fascia and the internal spermatic fascia. It contains the vas deferens and its artery, the testicular artery and veins (the "pampiniform plexus"), lymphatic vessels, autonomic nerves and remains of processus vaginalis (enclosed by the internal spermatic fascia), the genital branch of the genitofemoral nerve, the cremaster muscle and its vessels (enclosed by the cremasteric fascia), while the external spermatic fascia encloses all the previous structures.[7] The genitofemoral nerve entered the internal inguinal ring and continued within the spermatic cord between the fibers of the cremaster and the internal spermatic fascia. In 59% of patients, the nerve is related to the inferior fibers of the cremaster muscle and in 38% of patients the nerve is related to its lateral or medial fibers. In only 3% of patients does the genital branch run the spermatic cord. In our case, we found it in relation to the lateral fibers of the cremaster muscle.[8]

Treatment options for chronic orchalgia include non-surgical (e.g., NSAID, alfa-adrenergic antagonists, tricylic antidepressants, transcutaneous electrical nerve stimulation [TENS] and pulsed radiofrequency) and surgical (e.g., pelvic plexus blockade under trans-rectal ultrasound [TRUS] guidance, laparoscopic denervation of spermatic cord, microsurgical denervation of the spermatic cord, microsurgical testicular denervation, epididymectomy and orchiectomy) procedures.[5,6,9] Microsurgical denervation of the spermatic cord for treatment of chronic orchalgia is one of the minimally invasive approaches,[10,11] with a reported success rate between 70% complete remission and 20%

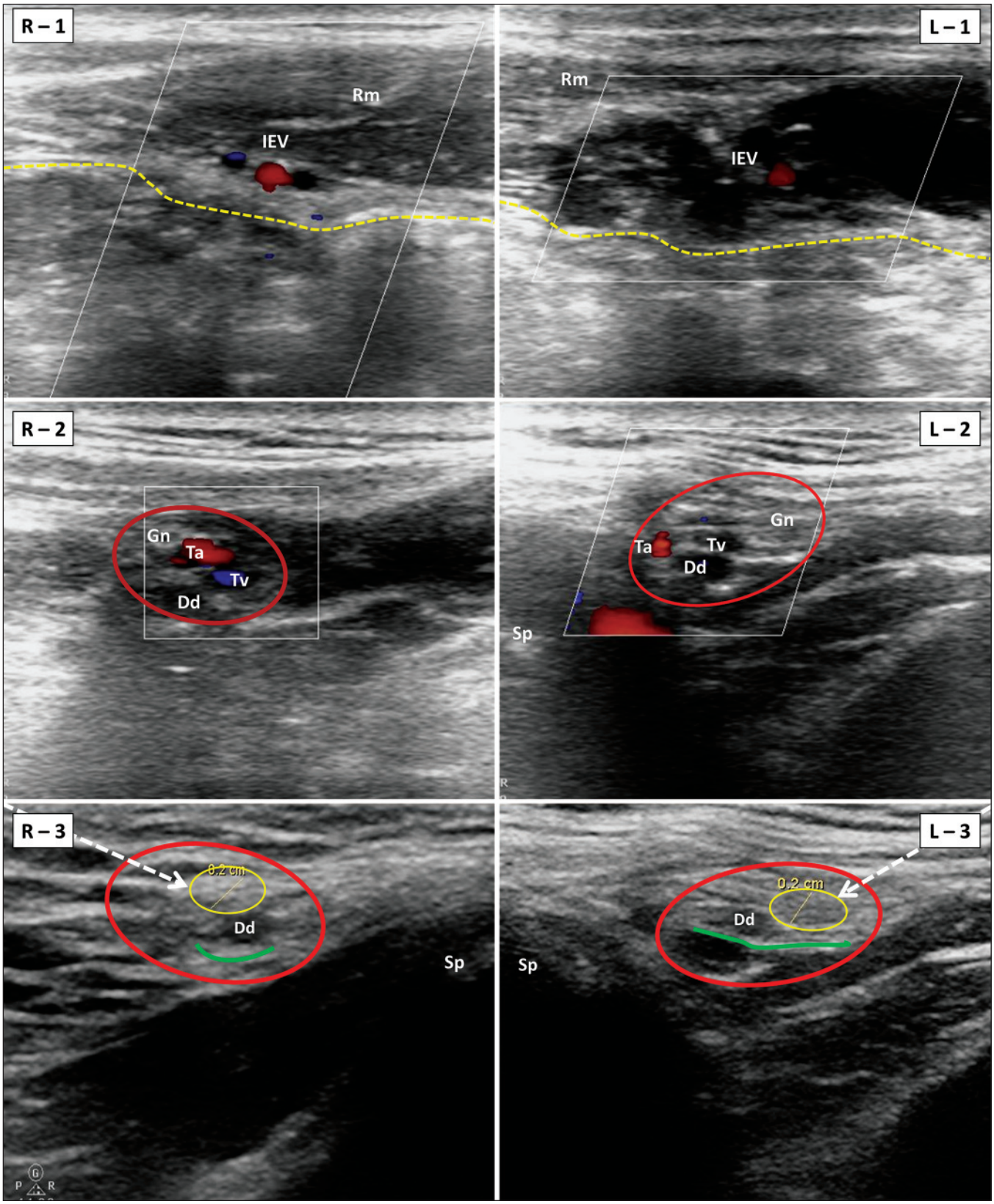

Figure 1: Three steps for localizing the (right [R] and left [L]) genital branch of the genitofemoral nerve. Rm: Rectus muscle; IEV: Inferior Epigastric vessels; Gn: Genital nerve; Ta: Testicular artery; Tv: Testicular vein; Dd: Vas Deference duct; Sp: Symphysis pubis; Dashed yellow line: Peritoneum; Red circle: Spermatic cord (external spermatic fascia); Yellow circle: genital nerve; Green line: Inferior border of internal spermatic fascia; White arrow: Needle track. Notice that the vessels disappear with compression while the Dd is not comprisable (R — 3 and L — 3)

partial relief from pain.[11] However, it may cause possible distortion of anatomy and requires hospital admission.

Table 1 summarizes the reported non-surgical approaches that have been used for the treatment of intractable chronic orchalgia, mainly in adults. Despite the successful use of both peripheral[12] and sacral[13] nerve stimulation for the treatment of adult secondary chronic orchalgia, none of them achieve 100% pain relief and both are more invasive procedures and costly than PRF. On the other hand, it is unclear how long the benefit of PRF will last, and repeat procedures may be required. In our case, the patient was pain free at 7 months of follow-up and there was no need to repeat the procedure.

Both cryoablation and pulsed radiofrequency were reported with successful results in chronic inguinal pain. Cryoablation of the femoral component of the genitofemoral nerve using an ultrasound-guided 14 gauge Lloyd Neurostat cryoprobe has been used for the treatment of chronic inguinal pain.[14] Radiofrequency ablation was used successfully for the treatment of refractory chronic inguinal neuralgia, and it shows superior results when compared with local steroid injection.[15]

Even though the mechanism of action of PRF is poorly understood, PRF antinociceptive effects are independent of temperature, unlike conventional radiofrequency ablation. PRF current reversibly and selectively disrupts impulse transmission in small un-myelinated pain fibers (C fibers) without neuroablation or thermal destruction, while preserving large nerve fibers that are protected by their myelin sheath.[16] Thus, it would result in selective sensory component selection in mixed (sensory-motor) nerves, as in our case. PRF ablation allows for heat dissipation and is usually applied up to 40-42°C by applying "pulses" of radiofrequency energy with intervening pauses.[17,18] Possible mechanisms of actions include structural cellular damage, neuronal activation and alterations in gene expression.[16] PRF has been reported to be successful in the treatment of painful metastatic tumors involving the brachial plexus as well as in spinal facet pain, trigeminal neuralgia, chronic shoulder pain, cervical radicular pain[17] and refractory pudendal neuralgia.[19]

In our case, we chose to use PRF because the genital branch of the genitofemoral nerve is a small (about 2 mm), mixed nerve, and it lies in a well-perfused area away from the bone such that heat transmission is good. Because of the need for a small introducer and needle to accommodate the small space, we used the radiofrequency 22-G needle that fits those requirements. The use of a relatively low temperature (i.e., 42°C) would help avoid the risk of neuroma formation.[9] Finally, the duration of neurolysis is longer (6-12 months) with this approach.[18]

While, traditionally, radiofrequency was applied blindly to the spermatic cord for the treatment of chronic orchalgia,[9] the use of ultrasound guidance in our case helped to selectively target the genital branch of the genitofemoral nerve as this nerve is known for its anatomical variation.[8] Use of ultrasound also avoided inadvertent vascular or vas deferens duct injury.

CONCLUSION

The use of ultrasound-guided pulsed radiofrequency ablation is an effective, relatively inexpensive, and non-

Table 1: Reported non-pharmacological, non-surgical treatment modalities for intractable chronic orchalgia

Method/authors	Clinical presentation	Procedure	Outcome
Peripheral nerve stimulation on the cutaneous branch of the ilioinguinal and genital branches of the genitofemoral nerves, (Rosendal *et al.*) 2013 (12)	30 years, with a 4-year history of chronic testicular pain following scrotal hydrocele surgery	X-ray guided, two percutaneous leads were implanted in his groin with low-frequency stimulation of the cutaneous branch of the ilioinguinal and genital branches of the genitofemoral nerves	At 7-month follow-up, the pain intensity had declined from 9/10 to 2/10
Pulsed radiofrequency (PRF) denervation of spermatic cord for the treatment of chronic orchalgia, (Basal *et al.*) 2012 (9)	Five patients (32, 23, 25, 29 and 37 years), without any preceding factors	Anatomical landmark; needle insertion with further localization based on the patients' identification of the point of maximal stimulation. Pulsed radiofrequency denervation of spermatic cord was done	Mean VAS before and after the procedure were 9 and 1, respectively. Mean follow-up period was 20±2.5 weeks
Sacral nerve stimulation as a treatment modality for intractable neuropathic testicular pain, (McJunkin *et al.*) 2009 (13)	31 years, with sharp localized pain in the anterior aspect of right-sided testicular for years, secondary to recurrent epididymitis	Fluoroscopy-guided; sacral nerve stimulation trial was done via a caudal epidural approach. Then, permanent implant was done surgically	80% decrease in pain at 4 months
Ultrasound-guided radioablation of the genital branch of the genitofemoral nerve (our case)	17 years, with bilateral idiopathic chronic orchalgia for 2 years	Ultrasound-guided, pulsed radiofrequency ablation of the genital branch of the genitofemoral nerve	At 7-month follow-up, the pain intensity had declined from 10/10 to 0/10

invasive treatment modality for intractable chronic orchalgia. In our case, it resulted in effective pain relief while preserving function. It may be considered as a potential approach for the treatment of such cases, but further prospective clinical trials with longer follow-up and comparisons with other treatment modalities are encouraged.

ACKNOWLEDGMENT

The authors are thankful to Dr. Marcel E. Durieux, Department of Anesthesiology, University of Virginia Health System, Charlottesville, VA, USA, for his review of the final manuscript.

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How to cite this article: Terkawi AS, Romdhane K. Ultrasound-guided pulsed radiofrequency ablation of the genital branch of the genitofemoral nerve for treatment of intractable orchalgia. Saudi J Anaesth 2014;8:294-8.
Source of Support: Nil, **Conflict of Interest:** None declared.