Pulsed Radiofrequency for the Treatment of Ilioinguinal Neuralgia after Inguinal Herniorrhaphy

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Abstract

Background and Purpose: Ilioinguinal neuralgia secondary to inguinal hernia repair is frequently a chronic, debilitating pain. It is most often due to destruction or entrapment of nerve tissue from staples, sutures, or direct surgical trauma. Treatment modalities, including oral analgesics, nerve blocks, mesh excision, and surgical neurectomy, have varied success rates. Pulsed radiofrequency (PRF) has recently been described as a successful method of treating chronic groin pain. Unlike conventional radiofrequency, PRF is non-neurodestructive and therefore less painful and without the potential complications of neuritis-like reactions and neuroma formation. Although the mechanism is unknown, it appears that the interaction of an electromagnetic field and c-fos proteins may alter normal transmission of painful impulses. Our study examines five patients treated with PRF for ilioinguinal neuralgia secondary to inguinal herniorrhaphy.

Method: Five patients were diagnosed with chronic ilioinguinal neuralgia secondary to inguinal hernia repair at our institution. Each patient was treated at vertebral T12, L1, and L2 with root PRF at 42°C for 120 seconds per level.

Results: Four out of five patients reported pain relief lasting from four to nine months on follow-up visits. Only one patient reported no pain relief whatsoever.

Conclusion: Ilioinguinal neuralgia is challenging to treat. We have demonstrated the successful use of PRF for four out of five patients seen in our office.

Key Words: Pulsed radiofrequency, groin pain, ilioinguinal neuralgia.

Introduction

APPROXIMATELY 700,000 inguinal hernia repairs are performed annually in the United States alone (1). Although the operation is relatively safe and is routinely performed worldwide, chronic postoperative inguinal pain can be an unfortunate sequela. In the inguinal region, innervation is supplied from T11–L2 nerve branches, which may be damaged or entrapped by staples or mesh during surgical repair, causing paresthesias (2, 3). Although the exact incidence of chronic postoperative pain is unknown, a recent review of reported cases revealed an incidence complicating 0–53% of herniorrhaphies (4). Morbidity from chronic pain can be severely debilitating and difficult to treat, thereby posing a serious problem to patients and health care workers alike. Our report specifically addresses postoperative ilioinguinal neuralgia occurring from damage to the ilioinguinal nerve, and its treatment with minimally invasive pulsed radiofrequency.

Ilioinguinal neuralgia (T12–L1) is characterized by burning pain through the lower abdomen radiating to the superior medial thigh and to the scrotum or labia majora. A positive Tinel's sign may be present, in which the pain may be reproduced by tapping the affected area or extending the hip and thigh. Similarly, genitofemoral neuralgia (L1–l2) presents with pain in the inguinal region radiating to the superior medial thigh and genitals. Unlike ilioinguinal neuralgia, a Tinel's sign cannot be induced. Differentiation of the two may prove difficult, as anatomic variability sometimes allows for communication between the two nerves. Nerve blocks may be performed on either nerve to see if pain relief results, thus indicating which nerve is involved (2).

Treatment modalities are wide and varied. Pharmaceutical options range from oral analgesics to transdermal patches that often yield inconsistent results. Nerve blocks may be utilized to relieve pain and elucidate the origin of pain, yet they are only temporary measures. Surgical intervention in-

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cludes re-exploration, mesh excision, and neurectomy. Although favorable results have been reported, patients are subjected to the risks of additional surgery and anesthesia. Furthermore, mesh extraction can be tediously difficult and neuritis-like reactions have been reported following neurectomy (3). Other complications reported include areas of hypoanesthesia and loss of cremasteric reflexes following reoperation secondary to groin pain (2). Radiofrequency (RF) has long been used as a neurodestructive treatment for severe pain; in this procedure a constant high frequency (500kHz), high temperature (80–82°C) electrical current is applied to target tissue via electrode. The high temperature achieved with RF is neurodestructive, thus preventing the propagation of pain signals. RF is characterized by a four-to-six-week period of discomfort occasionally marked by hypoanesthesia and neuritis-like reaction, followed by return of normal sensation and reduced pain (5). Furthermore, pain may potentially worsen, as nerve regeneration may lead to neuroma formation. Neuromas can increase sympathetic discharge and exaggerate the normal response to stimuli, leading to hyperalgesia, allodynia, and dysesthesias (6).

Pulsed radiofrequency (PRF) has gained popularity in recent years as an alternative to conventional RF. Unlike RF, which delivers a continuous current of electricity, PRF delivers high intensity currents in pulses, allowing heat to dissipate during the latent period so that neurodestructive temperatures are not reached and neuritis-like reactions do not occur. Tissue temperatures do not exceed 38–42°C, below the 45°C temperature documented for cellular damage (5). A 500 kHz current is applied with 2 bursts/second, with each pulse lasting 20 msec over a 120 second interval. Favorable outcomes have demonstrated improved results with PRF compared to RF; the exact mechanism of PRF remains unclear (7). Current studies are examining the role of cellular protein expression induced with PRF as compared to RF (8). Other studies suggest that an electromagnetic field (EMF) is created during the active phase of PRF and that the EMF causes a cellular change that favorably alters the transmission of painful impulses. PRF is relatively painless in comparison to conventional RF and has been reported to successfully treat chronic joint pains in the back, neck and hip, as well as neuropathic pain.

Methods

The five patients discussed below were diagnosed with chronic ilioinguinal neuralgia secondary to open inguinal hernia repair at our institution. Each patient was treated at vertebral levels T12, L1, and L2 with root PRF at 42°C for 120 seconds per level.

Case Reports

A 56-year-old male with a history of left-sided ilioinguinal neuralgia for the two years following a left-sided open inguinal hernia repair successfully underwent a left-sided T12, L1–L2 root PRF. He reported 80–90% pain relief lasting for approximately four to six months.

A 47-year-old female with chronic ilioinguinal neuralgia for the 3 years following left open inguinal hernia repair underwent a left-sided T12, L1 pulse root radiofrequency. She reported approximately 95% pain relief, which lasted for six months.

A 39-year-old male, approximately one year after right open inguinal hernia repair and subsequent right-sided groin pain, underwent a successful right-sided T12, L1–L2 pulse radiofrequency of the roots with an eight-month period of pain relief.

A 58-year-old male, approximately three and a half years after left-sided open inguinal hernia repair with subsequent left ilioinguinal neuralgia, successfully underwent a left-sided T12, L1–L2 pulse radiofrequency with a nine-month period of pain relief.

A 42-year-old female, three years after right open inguinal hernia repair, with a subsequent right ilioinguinal neuralgia, underwent a right-sided T12, L1–L2 pulse radiofrequency with no pain relief whatsoever.

All patients were evaluated in our offices following treatment with PRF. Patients whose pain symptoms were initially alleviated by PRF were noted to have less severe pain following the return of their symptoms, and they have been satisfactorily treated by oral medications to date. The one patient who received no relief with PRF terminated further follow-up after determining that the treatment had been unsuccessful.

Discussion

Chronic, debilitating groin pain may result from a myriad of etiologies, including blunt trauma to the lower abdomen, surgical trauma or nerve destruction, nerve entrapment by mesh, suture, or adhesion, tissue tension and ischemia from the repair itself, and neuroma formation after regeneration of a cut nerve (6, 9). There have been conflicting reports as to whether the use of minimally invasive surgery is more or less likely than

open procedures to predispose a patient to chronic postoperative pain (4). Factors that appear to increase the risk of postoperative chronic pain include reoperation for a recurrent hernia, ambulatory surgery, preoperative groin pain, visible bulge and numbness in the surgical field postoperatively, and prolonged recovery time (4). Early identification of high-risk patients may facilitate prompt treatment, avoid unnecessary suffering, promote the return to an active, productive lifestyle, and prevent any negative psychological effects from chronic pain.

Although we have experienced excellent resolution of ilioinguinal neuralgia with PRF, the mechanism of action is still unclear. Selective nerve fiber destruction with the use of RF and PRF remains an area of controversy. Experiments on cat saphenous nerves originally indicated that small delta and unmyelinated C fibers were preferentially destroyed by RF (10). Later experiments, however, showed that RF lesions do not differentiate between nerve fiber size (11). Despite conflicting study results, the theory of fiber selectivity remains popular, as it is still unknown why pain transmission is blocked but motor transmission is unimpeded. Likewise, it is unknown whether PRF preferentially alters neurotransmission in unmyelinated C fibers. Although this theory has been suggested, no definitive evidence exists.

Recent studies have examined the effect of electrical fields on upregulation of intermediate early gene (IEG) expression. A current theory is that c-fos proteins, products of IEG expression, are responsible for inducing neuronal changes that modulate pain transmission. A study by Higuchi et al. on dorsal root ganglia (DRG) of rats exposed to PRF at 38°C and RF at 38°C shows that the DRG exposed to PRF had markedly increased c-fos expression in dorsal horn laminae I and II compared to DRG exposed to RF or sham (8). These results imply that c-fos expression is not temperature dependent, but rather is induced by pulsed electrical fields. Whether the increase in c-fos protein is a direct result of electrical stimulation or a secondary post-synaptic effect from activation of DRG has yet to be determined. Other studies, however, have demonstrated conflicting findings. In a recent study conducted by Van Zundert et al., c-fos proteins were measured after rat DRG exposure to sham, RF at 67°C, PRF at 42°C for 120 seconds, and PRF at 42°C for 8 minutes. All treatment groups except for sham showed a significant increase in c-fos proteins in dorsal horn laminae I and II; however, no significant difference was found between RF treated groups and the two PRF groups (12). These results are seemingly consistent with prior evidence that c-fos expression is temperature independent, but do not concur with findings that c-fos is induced by pulsed rather than continuous electrical fields. Although it appears that IEG and c-fos proteins somehow play a role in altering neuronal transmission, further studies are needed.

Ilioinguinal neuralgia can be an unfortunate result of inguinal hernia repair. It can be debilitating for the patient and difficult to treat for the physician. Through early identification of high-risk patients, we were able to treat a majority of our patients with pulsed radiofrequency, with successful results and without the neurodestructive side effects observed with conventional RF. Additional studies both in the clinic and in the lab need to be undertaken in order to elucidate the nature of PRF, so we may better apply this treatment modality in patient care.

References

1. Rutkow IM, Robbins AW. Demographic, classificatory, and socioeconomic aspects of hernia repair in the United States. Surg Clin North Am 1993; 73(3):413–426.
2. Starling JR, Harms BA. Diagnosis and treatment of genitofemoral and ilioinguinal neuralgia. World J Surg 1989; 13(5):586–591.
3. Heise CP, Starling JR. Mesh inguinodynia: a new clinical syndrome after inguinal herniorrhaphy? J Am Coll Surg 1998; 187(5):514–518.
4. Poobalan AS, Bruce J, King PM, et al. Chronic pain and quality of life following open inguinal hernia repair. Br J Surg 2001; 88(8):1122–1126.
5. Sluijter ME. The role of radiofrequency in failed back surgery patients. Curr Rev Pain 2000; 4(1):49–53.
6. Cohen SP, Foster A. Pulsed radiofrequency as a treatment for groin pain and orchialgia. Urology 2003; 61(3): 645xxi–645xxiii.
7. Sluijter ME, Cosman ER, Rittman WB, Van Kleef M. The effects of pulsed radiofrequency fields applied to the dorsal root ganglion—a preliminary report. Pain Clinic 1998; 11(2):109–117.
8. Higuchi Y, Nashold BS, Sluijter M, et al. Exposure of the dorsal root ganglion in rats to pulsed radiofrequency currents activates dorsal horn lamina I and II neurons. Neurosurgery 2002; 50(4):850–855.
9. Fanelli RD, DiSiena MR, Lui FY, Gersin KS. Cryoanalgesic ablation for the treatment of chronic postherniorrhaphy neuropathic pain. Surg Endosc 2003; 17(2):196–200.
10. Letcher FS, Goldring S. The effect of radiofrequency current and heat on peripheral nerve action potential in the cat. J Neurosurg 1968; 29(1):42–47.
11. Smith HP, McWhorter JM, Challa VR. Radiofrequency neurolysis in a clinical model. Neuropathological correlation. J Neurosurg 1981; 55(2):246–253.
12. Van Zundert J, de Louw AJ, Joosten EJ, et al. Pulsed and continuous radiofrequency current adjacent to the cervical dorsal root ganglion of the rat induces late cellular activity in the dorsal horn. Anesthesiology 2005; 102(1):125–131.