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A Case Series

Pulsed Radiofrequency of Lumbar Nerve Roots for Treatment of Chronic Inguinal Herniorraphy Pain

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Background: Inguinal hernia repairs are commonly performed and although not seen in a majority of patients, chronic inguinal pain can be a debilitating state resulting after inguinal hernia repairs. Treatment options exist, including pharmacological and surgical management, but with associated risks and side effects.

Methods: In this case series report, five patients with chronic inguinal pain were selected. After initial positive response to T12, L1 and L2 nerve root blocks, pulse radiofrequency (PRF) was performed.

Results: All patients reported 75% to 100% pain relief lasting from six to nine months.

Discussion: Several hypotheses have been proposed, including selective delta and c-nerve fiber destruction, upregulation of intermediate early gene expression (IEG) and increase in c-fos protein that modulated pain transmission.

Conclusion: The mechanism of action of pulsed radiofrequency remains unclear. This case study demonstrates the effectiveness of minimally invasive neurodestruction of T12, L1 and L2 nerve roots utilizing Pulse Radiofrequency fields.

Key Words: Chronic groin pain, ilioinguinal neuralgia, radiofrequency, pulsed radiofrequency

Approximately 700,000 inguinal hernia repairs are performed annually in the United States alone (1). Although relatively safe and routinely performed worldwide, chronic postoperative inguinal pain can be an unfortunate result, characterized by paresthesias and/or pain in the inguinal region. Innervation is supplied from T11-L2 roots that form the peripheral nerve branches that may be damaged or entrapped by staples or mesh during surgical repair (2, 3). Although the exact incidence of chronic postoperative pain is unknown, a recent review of reported cases revealed an incidence of 0 to 53% of herniorrhaphies (4). Nevertheless, morbidity from chronic pain can be severely debilitating and difficult to treat.

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 (L1-2) 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 temporizing measures. Surgical intervention includes re-exploration, mesh excision, and neurectomy. Although favorable results have been reported, patients are subjugated to the risks of additional surgery and anesthesia. Furthermore, mesh extraction can be tediously difficult and neuritis-like reactions have been reported post-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 malignant pain in which a constant high frequency (500 kHz), high temperature (80-82°C) electrical current is applied to target tissue via electrode. The high temperatures achieved with RF are neurodestructive, thus preventing the propagation of pain signals. RF is characterized by a four to six week period of discomfort occasionally marked by hypnoanesthesia and neuritis-like reaction followed by return of normal sensation and improved 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

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do not occur. Tissue temperatures do not exceed 38-42°C, remaining below the 45°C temperature documented for cellular damage (5). A 500 kHz current is applied with 2 bursts/second with each pulse lasting 20msec over a 120 second interval. Favorable outcomes have demonstrated improved results with PRF compared to RF for the dorsal root ganglion; the mechanism of which remains unclear (7). Current studies are examining the role of cellular protein expression induced with PRF compared to RF (8). Other theories 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, hip, and neuropathic pain.

This report specifically addresses postoperative ilioinguinal neuralgia occurring from damage to the ilioinguinal nerve and its treatment with minimally invasive pulsed radiofrequency.

Methods

The following five patients were diagnosed with chronic ilioinguinal neuralgia secondary to inguinal hernia repair at our institution. All these patients were referred to our service for treatment of chronic pain in the ilioinguinal region. All the patients reported onset of sharp pain in the postoperative period that gradually became aching and nagging in nature in the above areas. Pain that was described was in T12, L1 and L2 dermatomes. All patients had post-herniorraphy pain for at least one year.

Appropriate consent was obtained from all patients. Precautions were taken to protect patient identity.

Initial diagnostic selective nerve root blocks were performed under fluoroscopic guidance, at T12, L1 and L2 using 0.25% bupivacaine. Pain relief of 50% or more was accepted as a positive response to the nerve root blocks, lasting at least two hours.

The patients were then scheduled for PRF of the roots at T12, L1, and L2 vertebral levels. For each patient, informed consent was obtained. The patient was placed in a prone position on the procedure table and the lumbosacral area prepped with Betadine (iodophor solution) and draped with sterile towels. With fluoroscopic guidance the T12 vertebral level was identified under direct anteroposterior view and the T12-L1 disc space squared and end plates aligned. Then the fluoroscope was turned obliquely to optimize the view on the symptomatic side (approximately 45 degrees), such that the facet joints of the respective levels were clearly defined and revealed the typical "Scotty dog" appearance. Skin was anesthetized with 1.5% lidocaine using a 25-gauge 1 1/2 inch needle over the "6 o'clock position", the pedicle being the clock face in an oblique view. A 20-gauge blunt curved cannula with 10 mm active tip was inserted through the anesthetized skin and advanced under fluoroscopic guidance to just inferior to the 6 o' clock position.

Lateral views were then obtained to confirm proper placement and to access adequate depth of the tip of the electrode, keeping it dorsal to the epidural space. The same process was performed for L1 and L2 roots. Sensory stimulation was then performed at 50 Hz to ascertain paresthesias in the dermatome only and not in the lower extremity. Motor stimulation was then tested at 2 Hz to elicit contraction in the paraspinal muscles for T12 and inguinal and upper thigh only for L1, L2 nerve roots and no lower extremity fasciculation was noticed at up to 2 V stimulation.

One mL of 0.25 % bupivacaine was injected and after a one minute delay pulsed radiofrequency lesioning of T12, L1 and L2 nerve roots was performed at 45 degrees for two minutes. All patients tolerated the procedure well and no significant complications occurred.

Case Descriptions

Case #1

A 56-year-old male with a history of left-sided ilioinguinal neuralgia for the past two years after a left-sided inguinal hernia repair successfully underwent a left-sided T12, L1 and L2 root PRF. He reported 80% to 90% pain relief on visual analog scale (VAS) and a decrease from 10 to 2 on a 0-10 intensity scale, lasting for approximately six months.

Case #2

A 47-year-old female with chronic ilioinguinal neuralgia for the past three years after left inguinal hernia repair underwent a left-sided T12, L1 and L2 root PRF. She reported approximately 95% pain relief on VAS and a decrease from 9 to 1 on 0-10 intensity scale, which lasted for a six-month period of time.

Case #3

A 39-year-old male status post right inguinal hernia repair and right-sided groin pain for approximately the past year underwent a successful right-sided T12, L1, L2 PRF of the roots with an eight-month period relief of pain and decrease in intensity from 10 to 2 on intensity scale and more than 80% relief on VAS.

Case #4

A 58-year-old male status post left-sided inguinal hernia repair with a three and a half year history of left ilioinguinal neuralgia successfully underwent a left-sided T12, L1, and L2 PRF with a nine-month period of 100% pain relief.

Case #5

A 42-year-old female status post right inguinal hernia repair presented with a three-year history of right ilioinguinal neuralgia and underwent a right-sided T12, L1, and L2 PRF with 75% pain relief on VAS and a decrease in intensity from 7 to 2 on intensity scale for seven months.

Discussion

We provide a report of five cases with intractable groin pain following inguinal hernia repair. All the patients were treated initially with T12, L1, and L2 nerve root blocks, followed by pulsed radiofrequency. All the patients improved significantly with pain relief of 75% to 100% lasting from six to nine months. This report is important for interventional pain physicians as chronic groin pain is not only debilitating, but

also extremely difficult to manage.

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 mesh or laproscopic versus open procedures predisposes 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 sizes (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 or not PRF preferentially alters neurotransmission in unmyelinated C fibers. Although this theory has been suggested, no definitive evidence exits.

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 in 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 show 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 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 understood. Other studies, however, have demonstrated conflicting findings. In a recent study conducted by Van Zundert et al (12), 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 eight 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. 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 the majority of our patients with pulsed radiofrequency with successful results and without the potential neurodestructive side effects or complications 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.

Conclusion

Pulsed Radiofrequency is a potential treatment option with good outcomes, for patients suffering from chronic debilitating ilioinguinal region pain after inguinal hernia repairs. This minimally invasive technique utilized application of pulsed radiofrequency fields to T12, L1 and L2 nerve roots provide pain relief as demonstrated by decrease in VAS scales.

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