Operative Management of Refractory Neuropathic Inguinodynia by a Laparoscopic Retroperitoneal Approach

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IMPORTANCE With the technical success of tension-free inguinal herniorrhaphy, chronic groin pain has far surpassed recurrence as the most common long-term complication.

OBJECTIVE To evaluate laparoscopic triple neurectomy of the ilioinguinal, iliohypogastric, and genitofemoral nerve trunks in the retroperitoneal lumbar plexus for treatment of refractory inguinodynia.

DESIGN Prospective study.

SETTING University hernia center.

PARTICIPANTS Twenty consecutive patients with chronic inguinodynia (14 male; mean age, 46 years; all failing pain management; prior neurectomy in 4 patients) and follow-up to 180 days (minimum, 90 days).

MAIN OUTCOMES AND MEASURES Groin pain (Numeric Rating Scale score), dermatomal mapping, hernia recurrence, histologic confirmation, and complications.

RESULTS There were no intraoperative complications. All patients had histologic confirmation of neurectomy and clinical confirmation with dermatomal mapping. Mean numeric pain scores were significantly decreased (baseline score, 7.8) on postoperative days 1 (score, 2.9; \(P < .001\)), 7 (score, 2.2; \(P < .001\)), 30 (score, 1.7; \(P < .001\)), and 90 (score, 1.9; \(P < .001\)). Narcotic dependence decreased and activity level increased. Five patients reported transient hypersensitivity consistent with deafferentation. All had numbness in the distribution of neurectomy without complaint. Four had residual meshoma pain, with 2 undergoing subsequent reoperation to remove mesh. Orchialgia was not improved.

CONCLUSIONS AND RELEVANCE This represents the largest series of laparoscopic retroperitoneal triple neurectomies for treatment of inguinodynia. The rate of successful intervention was better than reported for standard triple neurectomy and open extended triple neurectomy. The procedure allows access proximal to all potential sites of peripheral neuropathy and overcomes many of the limitations of open triple neurectomy. In the absence of recurrence or meshoma, it is the preferred technique for definitive management of chronic inguinal neuralgia.

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While the use of mesh and tension-free techniques of inguinal hernia repair have significantly improved outcomes and reduced the rates of recurrence, postherniorrhaphy chronic pain has been reported in as many as 63% of cases and is an important measure of clinical outcome.1–3 Clinically significant moderate to severe pain affecting physical activity, social interactions, health care utilization, employment, and productivity occurs in 6% to 8% of patients and represents a tremendous individual and societal burden.2–6

Common sources of pain include hernia recurrence, nociceptive problems (tissue inflammation, foreign material, meshoma), and neuropathic causes (direct nerve injury or perineural scarring).7–12 There is no discrete distinction between neuropathic and nociceptive pain, and the diagnosis is further complicated by psychological, social, genetic, and economic factors.2–5,9 Patients with neuropathic pain classically demonstrate hypoesthesia or hyperesthesia, allodynia, and parasthesias. While most of these patients can be managed with pharmacologic, interventional, and behavioral measures, operative management is sometimes necessary. Triple neurectomy of the ilioinguinal nerve (IIN), the iliohypogastric nerve (IHN), and the genitofemoral nerve (GFN), described by us in 1995 with subsequent technical modifications in more recent years, has been well established and arguably represents the gold standard for operative management of refractory neuropathic inguinodynia, with response rates of 85% to 97%.13–16

Triple neurectomy is usually performed as an open anterior operation with identification and resection of the nerves proximal to the site of injury.14 The open approach is limited by the need to reoperate through the previously scarred field, the difficulty of identifying the 3 inguinal nerves in the reoperative inguinal canal, the challenge of accessing the nerves in altered tissues, the potential to disrupt the prior hernia repair, pain from reoperation in an already hypersensitive location, and the increased risk of injury to the spermatic cord and testicle.

Laparoscopic retroperitoneal triple neurectomy is a minimally invasive 1-stage approach to the main trunks of the IIN, IHN, and GFN in the lumbar plexus, allowing access proximal to all potential sites of peripheral neuropathy in the prior surgical field. This study was undertaken to review our management strategy and experience with this new operative technique for refractory neuropathic inguinodynia.

Methods

This prospective study was open to all patients with refractory chronic inguinodynia presenting to the Lichtenstein-Amid Hernia Clinic at the David Geffen School of Medicine between January 1, 2012, and August 31, 2012. The study was approved by the University of California, Los Angeles Institutional Review Board.

Inclusion criteria required chronic groin pain due to suspected nerve injury present for a minimum of 6 months. Cross-sectional imaging using computed tomography, magnetic resonance, or ultrasonography was performed to evaluate for meshoma, occult recurrence, or concurrent pathology such as prostatitis, epididymitis, osteitis, degenerative disk disease, and musculoskeletal or ligamentous injury. All patients had been evaluated and treated by a pain management specialist and received regional or paravertebral nerve blockade for diagnostic and therapeutic purposes as well as unsuccessful nonoperative pharmacologic, behavioral, and procedural interventions. Patients were excluded if they had comorbidity (American Society of Anesthesiologists classification ≥4), primary orchalgia, nonneuropathic pain, hernia recurrence, pain unrelated to prior surgical intervention, meshoma pain, prior retroperitoneal surgery, pain outside the expected distribution of the inguinal nerves, multifocal pain syndromes, and histologically confirmed prior triple neurectomy.

All operations were performed under general anesthesia with patients in the lateral decubitus position and supported with a bean bag and axillary roll. A urinary catheter was placed for bladder decompression, and cefazolin sodium was administered for prophylaxis. The table was flexed to open the space between the iliac crest and costal margin. A 12-mm transverse incision was made in the midaxillary line 3 to 4 cm above the iliac crest (Figure 1 in Supplement). The external oblique fascia was incised and the oblique muscles were separated until the retroperitoneum was accessed. An oval dissecting balloon was inserted into this potential space and inflated under direct visualization. The dissecting balloon was then exchanged with a 12-mm balloon trocar and carbon dioxide was insufflated to a pressure of 15 mm Hg. Under direct vision, another 5-mm port was inserted 2 cm medially. Using laparoscopic cautery or a 5-mm vessel-sealing device, the retroperitoneal fat pad was dissected medially to expose the quadratus lumbrum and psoas muscles. The lumbar plexus was defined prior to any neurectomy (Figure 2 in Supplement). The subcostal nerve was first identified at the T12 costal margin, followed by the IHN and IIN overlying the quadratus muscle at L1 (Figure 1). Frequently, these will share a common...
Figure 2. Intraoperative Identification of Retroperitoneal Nerve Anatomy (Caudal View)

Genitofemoral nerve (GFN) trunk at the bottom coursing over the psoas muscle, with the ureter crossing over the iliac artery seen medially.

trunk.17,18 The dissection was then directed toward the groin where the GFN trunk can be found directlyoverlaying the psoas muscle (Figure 2). Separate genital and femoral trunks are often noted. The lateral femoral cutaneous nerve was identified coursing lateral to the psoas below the iliac crest. Medial to the psoas, the ureter and iliac vessels were clearly identified and protected (Figure 2). Once all structures were defined, resection of the IHN and IIN was performed over the quadratus muscle after placing a clip proximally and distally to close the neurilemma. The GFN trunk was then clipped and resected over the psoas muscle. All resected nerve specimens were sent for histologic confirmation. Postoperative activity was unrestricted.

A single designated physician (D.C.C.) collected data on days 0, 1, 7, 30, 90, and 180. The Numeric Rating Scale was used to quantify self-reported levels of pain, with 0 representing no pain; 1 to 3, mild pain without interference with daily activities; 4 to 6, moderate pain with significant interference; and 7 to 10, severe disabling pain.19 Medication regimens were assessed, and levels of activity and disability were documented. Dermatomal mapping described by Álvarez et al20 was performed preoperatively, within the first 24 hours of operation and at postoperative day 30. Subjectively reported mean numeric pain scores at each postoperative time with SAS version 9.3 statistical software (SAS Institute, Inc). P < .05 was considered statistically significant.

Results

During the study period, 119 patients were evaluated for inguinodynia after prior groin herniorrhaphy. Of these, 20 patients met inclusion criteria and were selected for laparoscopic retroperitoneal neurectomy, while 99 patients were excluded for the following reasons: inadequate evaluation by interventional pain specialists (38 patients), primary orchialgia (16 patients), nonneuropathic pain (12 patients), hernia recurrence (9 patients), pain unrelated to prior surgical intervention (7 patients), meshoma pain (6 patients), prior retroperitoneal surgery (3 patients), pain outside the expected distribution of the inguinal nerves (2 patients), multifocal pain syndromes (2 patients), American Society of Anesthesiologists classification of 4 or higher (2 patients), and prior histologically confirmed triple neurectomy (2 patients).

Of the 20 patients, the mean age was 46 years (range, 29-76 years) and 14 were male. Prior hernia repairs included laparoscopic preperitoneal in 10 patients (total extraperitoneal in 9 and transabdominal preperitoneal in 1), open preperitoneal bilayer hernia systems in 4, tension-free Lichtenstein in 4, plug in 1, and Bassini in 1.

All patients had been referred for surgical intervention after extensive treatment or returned after receiving unsuccessful pharmacologic and interventional treatment in our pain clinic. The subjectively reported mean numerical pain score was 7.8 (range, 5-10). Pharmacologic pain regimens included continuous narcotics in 12 patients, intermittent narcotics in 5, and nonopioid analgesics in 3. All patients underwent a trial of neuropathic medications, with 16 maintained on the agent at the time of operation. At least 1 prior remedial operation, without resolution or meaningful improvement, had been performed in 9 patients (1 prior operation in 5 patients, 2 operations in 2 patients, and 3 and 4 operations in 1 patient each). Operative procedures included diagnostic groin reexploration in 4 patients, selective ilioinguinal neurectomy in 3, laparoscopic tack removal in 2, neurostimulator placement in 2, and remedial laparoscopic hernioplasty, remedial open anterior repair, unsuccessful triple neurectomy, vas deferens neurolysis, and orchietomy in 1 patient each.

All 20 patients received laparoscopic retroperitoneal triple neurectomy, as described, with 64 nerves identified and removed. Normal anatomy with 3 nerves was present in 8 patients, while variants were found in 12 patients (2 separate trunks of the GFN in 7 patients, a common trunk of the IIN and IHN in 4, and a double IIN in 1). The mean (SD) operating time was 132.6 (27.2) minutes, with the 7 most recent cases performed in under 90 minutes. There were no conversions. The single intraoperative complication was a small laceration of the posteriorinferior diaphragm; the laceration closed immediately using an absorbable laparoscopic tack without sequelae. The mean (SD) estimated blood loss was 12 (0.9) mL, with no transfusions of blood or blood products in any patients.

The mean (SD) hospital stay was 0.8 (0.9) days, with 18 of the 20 patients observed in an outpatient overnight setting or discharged on the day of surgery. There were no perioperative adverse events or complications.

Histopathologic examinations identified normal neural tissue in all 20 patients and confirmed the variants identified at operation in 12 patients. Successful neurectomy was confirmed in all patients by appropriate numbness in the distribution of the IIN, IHN, and GFN and by postoperative dermatomal mapping within 24 hours of operation and at postoperative day 30. Subjectively reported mean numeric pain scores were significantly decreased on postoperative days 1 (score, 2.9; P < .001), 7 (score, 2.2; P < .001), 30 (score, 1.7;
P < .001, and 90 (score, 1;9; P < .001) as compared with the preoperative value (score, 7.8). There was no significant difference in the scores at days 7, 30, and 90.

The mean duration of follow-up was 157 days (range, 110-282 days). Late follow-up at 3 months postoperatively showed that narcotic dependence was decreased in 19 patients. Narcotic or neuropathic pain medications, required preoperatively by all patients, were continued by 7 patients and eliminated completely by 13. Subjectively reported activity level and quality of life improved in all 20 patients. Therewerenoherniarecurrences.

The mean effectiveness of the operation was 90 (score, 7.8). The range was 70-90. The mean duration of follow-up was 157 days (range, 110-282 days). Late follow-up at 3 months postoperatively showed that narcotic dependence was decreased in 19 patients. Narcotic or neuropathic pain medications, required preoperatively by all patients, were continued by 7 patients and eliminated completely by 13. Subjectively reported activity level increased in all 20 patients. There were no hernia recurrences.

While numeric pain scores confirmed improvement of preoperative neuropathic symptoms in all patients, 5 patients reported hypersensitivity in the distribution of the nerve with or without selective neurectomy in all patients. The mean duration of follow-up was 157 days (range, 110-282 days). Late follow-up at 3 months postoperatively showed that narcotic dependence was decreased in 19 patients. Narcotic or neuropathic pain medications, required preoperatively by all patients, were continued by 7 patients and eliminated completely by 13. Subjectively reported activity level increased in all 20 patients. There were no hernia recurrences.

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### Discussion

Inguinal hernia repair remains one of the most common procedures, with approximately 20 million operations worldwide and 800,000 performed by 18,000 surgeons in the United States each year. Postherniorrhaphy inguinodynia is a debilitating complication caused by a combination of nociceptive (tissue injury/inflammation) and neuropathic (direct nerve entrapment/irritation) factors. There is no clear distinction between the two, and delineating the exact cause of pain is further complicated by excitatory coupling between sympathetic and afferent nociceptive nerve fibers, neuroplasticity, deafferentation hyperalgesia, and pain centralization, in addition to social, genetic, and patient-related factors. Development of inguinodynia is independent of the method of hernia repair, but the original technique determines the options for intervention and remedial surgery. Neuroanatomy, classification, and causes of inguinodynia have been described by us and others. Operative neurectomy in conjunction with removal of the peritoneum, when present, provides effective relief in most patients with refractory inguinodynia. Treatment is based on several factors, including the original repair technique and subsequent reoperations, the character of pain, and the presence of recurrence, meshoma, fixation material, or orchialgia, which requires resection of the paravasal nerves.

Selective IIN, IHN, and GFN neurolysis or neurectomy, removal of mesh and fixation material, and revision of the prior herniorrhaphy are common options for treatment. However, the significant anatomical variation and cross-innervation of the inguinal nerves in the retroperitoneum and inguinal canal make selective neurectomy less reliable. Triple neurectomy, pioneered in our institute in 1995, is currently a universally accepted surgical treatment for neuropathic pain refractory to conservative measures and is arguably the most effective option. A review of operative series is presented in the Table.
Previously, we have suggested the benefit of endoscopic triple neurectomy through a transabdominal extraperitoneal approach. The IIN and HN can be identified within the retroperitoneal space over the quadratus lumborum muscle and the GFN over the psoas muscle proximal to the scarred operative field (eFigure 2 in Supplement). Endoscopic retroperitoneal selective neurectomies of the GFN and IIN have been reported.26-28

The present series demonstrates the effectiveness of triple neurectomy using a minimally invasive retroperitoneal approach. All patients had improvement of symptoms and subjectively reported numeric pain scores as well as qualitative improvements in their daily activities and diminished narcotic dependence. The rate of successful intervention was 100% and was superior to standard triple neurectomy (80%) and open extended triple neurectomy including the GFN trunk (87.5%).13-16,21 This retroperitoneal approach addresses many of the causes for failure of open neurectomy with minimal morbidity, nerve identification is 100%, and patients have little to no perioperative disability. The effectiveness of neurectomy is assessed immediately in the recovery room with dermatomal mapping.20 Mapping demonstrated anticipated numbness in the neurectomy distribution that was accepted by all patients without complaint.

From our experience with more than 600 operations for postherniorrhaphy pain, a number of principles are clear:24,21 The recommended timing for surgical treatment of chronic postherniorrhaphy pain not responding to nonsurgical management is 6 months to 1 year after the original inguinal hernia repair. A systematic and thorough preoperative evaluation to identify the potential causes of pain is mandatory. This assessment should include symptoms, review of the prior operative report for technique (specifically type of repair, type of mesh used, position of the mesh, method of fixation, and nerve handling), imaging to assess for meshoma or other anatomical abnormalities, and thorough conservative management with pharmacologic and interventional modalities. All patients require multidisciplinary treatment with a mandatory evaluation by a pain specialist. Pharmacologic intervention including anti-inflammatories, topical anesthetics, neuropathic medications, and opioid analgesics should be assessed. All patients should undergo diagnostic and therapeutic nerve block of the IIN, IHN, and GFN as appropriate.

It is critical to manage patient expectations and clearly explain potential benefits and consequences of this operation. Psychosocial and emotional factors compound the subjective experience of pain, and patients are often most upset by the lack of adequate informed consent with their initial “routine hernia repair.” In addition to the usual operative risks, specific considerations include permanent numbness, the inability to access or identify 3 nerves, abdominal wall laxity from partial denervation of the oblique muscles, testicular atrophy, numbness in the labia in females that can interfere with sexual sensation, and loss of a cremasteric reflex in male patients. Patients are specifically advised of the potential for ongoing pain and disability despite successful neurectomy due to the nociceptive component of pain, neuroplasticity, afferent hypersensitivity, and centralization of pain. Hypersensitivity consistent with deafferentation may occur and typically diminishes over time, but its course is unpredictable. This operation does not address the nociceptive component caused by meshoma or neuropathic testicular pain. These issues require serious consideration and should be discussed with the patient and adequately recorded.

As no universally agreed-upon definition, pathophysiology, or treatment for chronic postherniorrhaphy pain exists, the best measure to address this disabling complication remains prevention by refining the technique of hernia repair. In-depth knowledge of groin neuroanatomy is critical. Meticulous adherence to surgical principles with 3-nerve identification, preservation, or pragmatic neurectomy during open anterior repair decreases the incidence of chronic inguinalgia.22,29 Avoidance of the preperitoneal nerves below the iliopubic tract and limited or no mesh fixation decrease the risk of pain after laparoscopic herniorrhaphy.22

In summary, specific efforts to prevent injury at the time of initial repair through identification and careful handling of the 3 nerves are the best measures to prevent this debilitating problem. Laparoscopic retroperitoneal triple neurectomy is an ideal operative approach to the inguinal nerves outside the field of scarring. This procedure obviates many of the technical limitations, decreases the risks associated with remedial surgery, and, in the absence of recurrence or meshoma, is the preferred technique for definitive management of chronic inguinal neuralgia.

**Conflict of Interest Disclosures:** None reported.

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**REFERENCES**

Management of Refractory Neuropathic Inguinodynia


