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Cryoanalgesic ablation for the treatment of chronic postherniorrhaphy neuropathic pain

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Abstract
Background: Chronic postoperative pain has been reported in as many as 62.9% of patients after inguinal herniorrhaphy. Moderate to severe neuropathic pain requiring intervention develops in 2.2% to 11.9% of patients as a result of ileoinguinal and genitofemoral nerve entrapment. Cryoanalgesic ablation has been successful in treating chronic pain from craniofacial neuralgia, facet joint syndrome, and malignant pain syndromes. We report our experience using cryoanalgesic ablation for chronic ileoinguinal and genitofemoral neuralgia after inguinal herniorrhaphy.
Methods: Ten patients with ileoinguinal, genitofemoral, or combined neuralgia underwent 12 cryoanalgesic ablations between April 1996 and June 2001. These patients were referred from a multidisciplinary pain clinic, and focused low-volume nerve blocks were used to map nerve involvement preoperatively. After surgical exposure, nerves and surrounding tissues were cooled to −70°C for 3 min using the Lloyd Neurostat. Patients were seen 2 weeks postoperatively and offered monthly follow-up assessments.
Results: Nine men and one woman, ages 20 to 54 (mean, 42.6 years) were treated during 58 months, with a mean follow-up period of 8.2 months, for ileoinguinal ($n = 4$), genitofemoral ($n = 1$), and combined ($n = 5$) neuralgia. Patients reported one to five prior herniorrhaphies (mean, 1.8), experienced neuropathic pain 0 to 14 years (mean, 6.3 years), and underwent up to 3 (mean, 1.3) ablative pain procedures before referral. After cryotherapy, patients reported overall pain reduction of 0% to 100% (mean, 77.5%; median, 100%); 80% reported decreased analgesic use, and 90% reported increased physical capacity. Two patients underwent additional cryotherapy, one for incomplete relief and one for recurrent pain, both with 100% efficacy. Wound infection ($n = 1$) was the only complication.
Conclusions: Cryoanalgesic ablation successfully eliminates ileoinguinal and genitofemoral neuralgia in most patients, and should be considered early in the treatment of patients with postherniorrhaphy neuropathic pain.

Key words: Cryoanalgesic ablation — Chronic neuropathic pain — Inguinal herniorrhaphy — Postherniorrhaphy pain — Nerve entrapment syndrome

Introduction

Chronic neuropathic pain is a recognized complication after inguinal herniorrhaphy. The reported incidence varies, depending on whether the hernia is primary or recurrent, the type of repair used, the use of prosthetic mesh, and the number of prior repairs for recurrent hernias [5, 16]. The exact incidence of chronic neuropathic pain after inguinal herniorrhaphy is unknown but is reported to occur to some degree in up to 62.9% of patients undergoing inguinal herniorrhaphy [8, 19]. Cunningham et al. [8] reported that 11.9% of patients enrolled in the Cooperative Hernia Study had moderate to severe pain after undergoing Bassini, McVay, or Shouldice herniorrhaphies. Bay-Nielsen et al. [3] reported functional impairment in work and leisure activities in 16.6% of patients participating in a pain survey study after inguinal herniorrhaphy.

Chronic postherniorrhaphy pain typically results from tissue ischemia related to repairs performed under tension, or to sensory neuropathy resulting from nerve

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entrapment or injury [7]. Although diffuse groin pain caused by tension can be difficult to localize, neuropathic sensory disturbances typically follow the dermatomal distributions of either the ileoinguinal or genitofemoral nerves, and sometimes involve both nerves. Chronic neuropathic pain also may result from local nerve trauma related to inguinal dissection, injections for regional field blocks, mechanical entrapment with suture or mesh, scar entrapment during tissue remodeling, or nerve transection with neuroma formation [7, 10].

The treatment of postherniorrhaphy neuropathic pain remains challenging for surgeons and patients alike. Patients often are referred to pain management specialists because of the complexity involved in diagnosing and managing chronic neuropathic pain. Typical management includes oral analgesics such as nonsteroidal antiinflammatory drugs (NSAIDs) and narcotics, antiepileptics, transdermal systems that deliver local anesthetics or narcotics, and neuroablative therapies performed either percutaneously or operatively. Inguinal exploration with nerve sectioning was formerly offered routinely to patients with chronic postherniorrhaphy neuropathic pain, with mixed success [5]. Cryoanalgesia has been used with variable success as a neuroablative method for the treatment of chronic hip adductor spasticity, postthoracotomy pain, and peripheral neuropathy [4, 9, 13, 17, 18, 22]. We report our initial experience with focused cryoanalgesic ablation for the treatment of chronic postherniorrhaphy neuropathic pain resulting from ileoinguinal and genitofemoral neuralgia.

Methods

Ten patients with ileoinguinal, genitofemoral, or combined neuralgia underwent a trial of cryoanalgesic ablation for postherniorrhaphy chronic neuropathic pain between April 1996 and June 2001. Table 1 describes the characteristics of these patients. All were evaluated in a multidisciplinary pain management clinic, and were referred for surgical treatment when noninvasive measures failed. The patients were evaluated preoperatively using focal low-volume nerve blocks to identify which nerves were involved as follows. The distribution of pain was mapped with a temporary marker by palpating the inguinal region with a fingertip and constructing a line along which the chronic pain traveled. At a point along the line constructed, 1 ml of 0.5% bupivacaine with epinephrine 1:100,000 was injected 1 cm proximally to the origin of the patient's pain. For patients with ileoinguinal neuralgia, the injection typically was placed between the anterior superior iliac spine and the prior inguinal incision. For patients with genitofemoral neuralgia, the injection typically was placed deep to the cord structures from a lateral approach while the cord was rolled medially against the pubic tubercle. This mapping procedure was repeated at the time of surgery to guide incision placement.

All operative procedures were performed with the patient under local anesthesia without sedation using a mixture of equal volumes of lidocaine 1% with epinephrine 1:100,000 and bupivacaine 0.25% sequentially injected into soft tissue beneath the incision, avoiding infiltration that would effect a nerve block. Ensuring patient comfort can be difficult during the final isolation of nerves, yet can be accomplished through repeated meticulous low-volume injections of local anesthetic into tissues above the nerves, carefully avoiding the creation of a field block. Affected nerves were dissected proximally to the herniorrhaphy site, and interrogated with a nerve stimulator to ensure accuracy in identification and treatment. Stimulation is useful for replicating the patient's chronic pain, and helps to ensure procedural accuracy. In this study, no attempt was made to identify the underlying cause of the neuropathic pain in any patient, and dissection was limited to that necessary to expose the affected nerve or nerves. Once identified through stimulation, cryoanalgesia was applied liberally to affected nerves using the Lloyd Neurostat (Westco Medical Corporation, San Diego, CA, USA). The nerve or nerves and surrounding tissues were cooled to −70°C for 3 min, creating a 5-mm ice ball around the neural sheath, at a minimum of three locations proximal to the area of suspected nerve injury or entrapment. Patients were examined for residual pain using palpation and electrical nerve stimulation, and additional cryoanalgesic treatments were delivered until the patient reported complete pain relief with further testing. Twelve treatments were performed for 10 patients. All the patients were seen 2 weeks postoperatively and offered monthly follow-up evaluation. A standardized follow-up interview addressed patient satisfaction, residual pain, physical activity, and analgesic usage, and patients rated their residual pain from 0 to 100 using a linear percentile scale.

Table 1. Characteristics of 10 subjects undergoing cryoanalgesic ablation for chronic neuropathic pain after inguinal herniorrhaphy

Subjects	
Age (years)	10
Mean	42.6
Median	44.5
Range	20–54
Male sex *n* (%)	9 (90)
Anatoniic site *n* (%)	
Right	2 (20)
Left	8 (80)
Nerve(s) involved *n* (%)	
Ileoinguinal	4 (40)
Genitofemoral	1 (10)
Both	5 (50)
Procedure	
Operative modality *n* (%)	
Open	8 (80)
Laparoscopic	2 (20)
Recurrence/reoperation	
Mean	1.8
Median	1.0
Range	1–5
Cryoanalgesic ablation	
Time of injury to cryoablation (years)	
Mean	6.3
Median	6.5
Range	0–4
Noncryoablation treatments	
Mean	1.3
Median	2.0
Range	0–3
Cryoablation sessions needed	
Mean	1.2
Median	1.0
Range	1.2
Follow-up evaluation	
Number of visits	
Mean	1.2
Median	1.0
Range	0–2
Longest follow-up (months)	
Mean	8.2
Median	3.0
Range	0.5–48

Results

Nine men and one woman ages 20 to 54 years (mean, 42.6 years) were treated during 58 months, with a mean

follow-up period of 8.2 months for ileoinguinal ($n = 4$), genitofemoral ($n = 1$), and combined ($n = 5$) neuralgia (Table 2). Two patients each received one additional treatment for incomplete pain relief ($n = 1$) and recurrent neuropathic pain ($n = 1$). Wound infection ($n = 1$) was the only complication. Most of the patients had previously been treated for recurrent inguinal hernias, reporting one to five prior herniorrhaphies (mean, 1.8). Of these herniorrhaphies, 80% had been performed using an anterior inguinal approach, and none had been performed by the authors. Patients reported 6.3 years mean duration of neuropathic pain (range, 0–14 years) before referral to a multidisciplinary pain clinic. They reported a mean pain reduction of 77.5% (median, 100%) after cryoanalgesic ablation (Table 3). They also reported decreased analgesic usage (80%) and significant improvement in physical activity (90%).

Discussion

Chronic postherniorrhaphy neuropathic pain is disabling for patients and challenging for physicians. Decreased activity levels, loss of work, social discord, and narcotic dependence all accompany chronic pain and diminish the quality of life for those affected and those living with them [19]. Persistent chronic pain unresponsive to pharmacologic therapy substantially impedes a normal lifestyle, and must be treated aggressively to limit postherniorrhaphy disability. Cryoanalgesic ablation is a successful treatment for chronic postherniorrhaphy neuropathic pain that affords patients increased activity, decreased reliance on analgesics, and durable success even if applied many years after the onset of chronic pain.

Surgeons, primary care providers, neurologists, physiatrists, and more recently, pain management specialists, all treat patients with chronic postherniorrhaphy neuropathic pain. Typical treatments include oral analgesics such as narcotics and NSAIDs, antiepileptics, antidepressants, anxiolytics, transdermal drug delivery systems, percutaneous nerve blocks, operative exploration, neurolysis, and neurectomy [8]. Pharmacologic therapy is easily prescribed, typically well tolerated, yet mostly ineffective for the treatment of chronic neuropathic pain [15]. Whereas early persistent postoperative pain after inguinal herniorrhaphy is managed effectively with oral analgesics, NSAIDs, or COX-2 inhibitors, chronic neuropathic pain related to entrapment or mechanical nerve injury rarely responds to these agents, antiepileptics, or antidepressants [2]. Transdermal drug delivery systems releasing local anesthetics have been approved by the U.S. Food and Drug Administration for the treatment of postherpetic neuralgia, and have been used to treat chronic postherniorrhaphy neuropathic pain, although their effectiveness for this indication has not been established [2]. When used for chronic postherniorrhaphy pain, our experience with these transdermal systems is one of continual expense, patient inconvenience, and partial efficacy limited to ileoinguinal neuralgia, with little impact on genitofemoral neuralgia.

Table 2. Results of cryoanalgesic ablation for chronic postherniorrhaphy neuropathic pain in 10 patients

Patient	Gender	Age	Anatomic site (groin)	Inciting operation (year)	Nerve(s) involved[a]	Year(s) from injury	Number of operations for hernia	Number noncryo of operations for pain	Number of cryo treatment	Follow-up: visits n (mos)	Pain reduction %	Analgesic use[b]	Physical activity[b]
1	M	49	Left	Open (1988)	I	8	1	0	1	1 (1)	100	D	I
2[c]	M	48	Right	Open (1982)	B	14	3	2	2	Leach (48)	80;100	D	I
3	M	38	Left	Open (1994)	B	6	2	2	1	1 (2weeks)	100	D	I
4[d]	F	54	Left	Open (1994)	B	7	1	2	1	2 (1)	0	NC	NC
5	M	53	Right	Open (1987)	B	13	2	2	2	leach (8)	100; 100	D	I
6	M	52	Left	Laparoscopic (1999)	I	2	1	0	1	1 (4)	100	D	I
7	M	37	Left	Open (1997)	I	1	1	0	1	1 (2)	100	D	I
8	M	20	Left	Open (1995)	G	2	1	3	1	2 (7)	75	D	I
9	M	34	Left	Laparoscopic (1997)	I	0	1	0	1	1 (2weeks)	100	D	I
10[e]	M	41	Left	Open (1986)	B	10	5	2	1	2 (10)	75	NC	I

[a] Ileoinguinal (I), genitofemoral (G), and ileoinguinal/genitofemoral (B)
[b] Decreased (D), increased (I), no change (NC)
[c] Patient 2 had two cryoablation treatments with 80% initial pain reduction, and complete pain relief after second treatment at the 48-month follow-up assessment
[d] Patient 4 had a wound infection after cryoanalgesic ablation as the only postcryoablation complication and remained on oral medications for neuropathic pain
[e] Patient 10 underwent spinal cord stimulator (SCS) placement for continued neuropathic pain

Table 3. Results of cryoanalgesic ablation for treatment of chronic postherniorrhaphy neuropathic pain

Reduction of pain (%) (n = 12)[a]	
Mean	77.5
Median	100
Decreased analgesic (%)	8 (80)
Increased physical activity (%)	9 (90)
Additional pain treatments (%)[b]	
Yes	2 (20)
No	8 (80)

[a] Two of 10 subjects received additonal (1 each) cryoanalgestic ablation treatment

[b] One patient continued on oral medication; the other received a spinal cord stimulator

Surgical neurolysis and neurectomy are the most commonly used invasive therapies for ileoinguinal and genitofemoral neuralgias resulting from inguinal hernia repair. Focal nerve blocks, paravertebral nerve blocks, and careful physical examinations are first used to identify the affected nerves accurately. The ileoinguinal nerve usually is approached through an anterior inguinal incision, whereas exposure of the genitofemoral nerve traditionally has been accomplished in the retroperitoneum through an open flank incision, or more recently, laparoscopically. Once exposed, the ileoinguinal and genitofemoral nerves are transected and the proximal ends implanted into the internal oblique and psoas muscles, respectively [15, 20, 21]. While neurectomy is an effective treatment for some patients, the extensive dissection typically required may be associated with a greater likelihood of additional chronic neuropathic pain. Most studies report greater success with ileoinguinal neurectomy (78–89%) than with genitofemoral neurectomy (50–77%) [11, 14, 15, 20, 21]. Patients presenting with testicular pain in addition to genitofemoral neuralgia had even less benefit from genitofemoral neurectomy. Recently, the Lichtenstein Hernia Institute reported complete analgesia in 80% of patients undergoing a one-stage triple neurectomy, involving ileohypogastric, ileoinguinal, and genitofemoral nerves, with implantation of proximal nerve ends using local anesthesia [1].

Cryoanalgesia has been applied to the ileoinguinal nerve and dissected tissues at the time of inguinal herniorrhaphy without significant impact on the level of acute postoperative pain or prevention of chronic postherniorrhaphy pain [6, 12]. We have not investigated the use of preemptive cryoanalgesia applied at the time of surgery because it is our belief that not all patients would benefit from the persistent inguinal anesthesia that results, and because acute postoperative pain is so adequately addressed by NSAIDs, COX-2 inhibitors, and narcotic analgesics. Our success with this technique is attributable to meticulous patient selection, precise anatomic isolation of the affected nerve or nerves, confirmation through electrical stimulation, and avoidance of extensive tissue disruption, dissection, and traction of the affected sensory nerves.

In this series of patients treated with cryoanalgesic ablation, six patients (60%) underwent 13 prior operative procedures, exclusive of hernia repairs, seeking to provide analgesia. These procedures were described as neurolysis or neurectomy by the treating surgeons, and all failed to provide significant analgesia. The mean duration of symptoms before evaluation in our muitidisciplinary pain clinic was 6.3 years. After cryoanalgesic ablation for ileoinguinal, genitofemoral, or combined neuropathy, 7 of 10 patients reported complete analgesia, two patients experienced 75% relief from their chronic pain, 80% reported decreased oral analgesic use, and 90% described increased physical activity including the return to work and normal life activities. In our experience, cryoanalgesic ablation for ileoinguinal and genitofemoral neuralgia was more effective than neurectomy, and significantly less invasive than the classical procedure.

The chief advantages of cryoanalgesic ablation over neurectomy for the treatment of chronic postherniorrhaphy neuropathic pain are superior rates of total analgesia, a more superficial anterior dissection, and less likelihood that dissection will compromise the integrity of the previous herniorrhaphy. When cryoanalgesic ablation is used to treat genitofemoral neuralgia, the large flank incision required for neurectomy is eliminated, sparing the patient significant morbidity and speeding healing and recovery. Additionally, our limited genitofemoral nerve dissection at the level of the pubic tubercle allows us to isolate the genital branch, the branch of the genitofemoral nerve most commonly impinged, while shielding major cord structures from cooling. Our results equal those reported by the Lichtenstein Hernia Institute, and our technique involves less tissue disruption than even this minimally invasive method of performing triple neurectomy.

Our only treatment failure and operative complication occurred in the same subject (Table 2, patient 4). This 54-year-old obese woman presented with combined ileoinguinal and genitofemoral neuralgia 7 years after primary anterior repair of a left inguinal hernia. She had undergone two prior groin explorations recommended by her referring surgeon, one for suspected recurrent hernia and one for ileoinguinal and genitofemoral neurectomy without proximal implantation. Both nerves were exposed during her cryoanalgesic ablation, and she reported complete analgesia during the procedure. She was treated with incisional packing and oral antibiotics for a wound infection diagnosed 2 weeks postoperatively, which healed well by secondary intention. The patient reported complete treatment failure at the 1-month visit. She declined all offers of further intervention except continued narcotic analgesics and also declined additional surgical follow-up evaluation. We have been unable to determine whether her treatment failure is related to the wound infection, or whether social issues related to narcotic dependence were involved.

One subject (Table 2, patient 10) who reported 75% analgesia and improved activity levels chose to pursue spinal cord stimulator implantation for further relief after cryoanalgesic ablation for combined ileoinguinal and genitofemoral neuropathy after five herniorrhaphies and two neurectomies. Although effective for the treatment of various neuropathic pain syndromes, spinal cord stimulation rarely is indicated for the treatment of ileoinguinal and genitofemoral neuralgia, and is considered

a last line of therapy for chronic postherniorrhaphy neuropathic pain.

Conclusion

Chronic neuropathic pain develops in a significant number of patients undergoing inguinal hernia repair. The incidence is lower after laparoscopic repairs and tension-free anterior repairs, and highest after nonmesh primary hernia repairs. Oral analgesics, antiepileptics, transdermal systems, and groin exploration for mechanical neuroablation are associated with limited success and high morbidity. Cryoanalgesic ablation is well tolerated and highly effective in the treatment of chronic postherniorrhaphy neuropathic pain, and has a durable effect that permits patients to enjoy decreased analgesic use and significantly increased activity.

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