Lumbar Sympathectomy by Laser Technique
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Citation

Abstract
Two common syndromes in which sympathetic pain appears to be the cause are causalgia and reflex sympathetic dystrophy. In the past, permanent interruption of the lumbar sympathetic chain has been accomplished by open surgery or phenol or alcohol injection. Subsequently, percutaneous lumbar sympathectomy by radiofrequency lesions involved less morbidity. The Holmium: YAG laser has now been found to be even more effective and longer lasting than the radiofrequency technique.

An increasing number of patients are seeking medical treatment for pain associated with sympathetic nervous system. Two common syndromes in which sympathetic pain appears to be the cause are causalgia and reflex sympathetic dystrophy. True causalgia follows partial injury to a major nerve trunk such as the sciatic nerve or its large branches. Reflex sympathetic dystrophy may occur following minor trauma to the neural structures that accompany fractures, soft-tissue injuries, and surgical incisions. Clinical characteristics include burning, poorly localized dermatomal distribution of stabbing pain, hyperesthesia, vasomotor alterations leading to trophic changes, changes in skin temperature, alteration of sweating patterns, piloerection, and swelling. Other conditions complicated by sympathetic dysfunction are amputation stump pain, circulatory insufficiency in the legs, arteriosclerotic disease of the lower limbs, intermittent claudication, and arterial embolism. Following endoscopic or percutaneous discectomy, some patients experience a burning pain with skin trophic changes and allodynia due to irritation of the sympathetic nervous system during manipulation of surrounding structures. This procedure, performed in patients who present with symptoms of causalgia following discectomy is highly effective in relieving this type of pain.

METHODS AND MATERIALS
Anatomically, the lumbar sympathetic chain lies at the anterolateral border of the vertebral bodies (fig 1). The aorta is positioned anteriorly and slightly medial to the chain on the left side. The inferior vena cava is more closely approximated to the chain on the right in an anterior plane. Many other small lumbar arteries and veins are positioned near the sympathetic chain. The psoas muscle is situated posteriorly. Blockade of the sympathetic nerves can also be performed with spinal, epidural or peripheral nerve blocks, but relief of pain after lumbar sympathetic block will definitely confirm the painful etiology as sympathetically mediated. Most fibers headed for the lower extremity pass through the second and third lumbar ganglia, so that a sympathetic block placed at the L4 level provides almost complete sympathetic denervation to the lower extremity. The pain relief obtained is usually immediate and can be long-lasting, outlasting the duration of action of the local anesthetic. If the pain relief is transient, then sympathetic denervation can be performed with laser.
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Figure 1
Figure 1: Artist's drawing of needle placement for sympathectomy.

Site for needle placement for the sympathetic chain at the L4 vertebral level is identified on projection fluoroscopy on an anteroposterior, lateral, and oblique projection. (Fig. 2). Subcutaneous and deep tissue is infiltrated with 1% lidocaine. Small skin incision is made with a scalpel blade. A guidewire is advanced to the anterolateral aspect of the vertebral body. A 14 gauge cannula is then advanced over the guidewire to the anterolateral aspect of the vertebral body. A 22 gauge, 15cm long needle is inserted through the cannula and radiocontrast dye is injected to outline the sympathetic chain to confirm placement. A side-firing Ho:YAG laser probe (Trimedyne, Irvine, California) is passed through the cannula, and laser heat applied at 5 hertz, 10 watts for a total of 90 to 100 joules. The laser probe is rotated superiorly, medially, inferiorly, and laterally to thermocoagulate the sympathetic chain. A guide wire is inserted and needle is removed. A side-fire Ho:YAG laser probe (Trimedyne, Irvine, California) is passed through the cannula, and laser heat applied at 5 Hz, 10 watts for a total of 150 joules at three sites, one millimeter apart at 50

Joules each site, and the probe is rotated 360 degrees while the laser heat is applied to thermocoagulate the sympathetic chain completely.

Figure 2
Figure 2a: Radiocontrast dye outlining the sympathetic chain.

Figure 3
Figure 2b: AP view of cannula placement.
Figure 4
Figure 2c: AP view of laser probe at the sympathetic chain.

Figure 5
Figure 2d: Lateral view of laser probe at the sympathetic chain.

DISCUSSION
The sympathetic nervous system becomes involved due to damage to A delta and C fibers which develop hypersensitivity to circulating norepinephrine, pressure, and movement. Spontaneous firing causes the typical pain of sympathetic origin. Shortly afterwards, small neuromas form which sprout small myelinated and unmyelinated fibers. Normally silent fibers then generate, even in the absence of stimulation, an ongoing barrage of impulses that traverse the afferent fibers to the spinal cord.

Application of Holmium:YAG laser heat or radiofrequency heat is more precise and has fewer complications than use of a neurolytic solution for chemical sympathectomy. There is no spread to the psoas muscle, somatic nerves, or subarachnoid space. No ureteral strictures occur. Hypotension is less frequent. Post sympathectomy sympathalgia is virtually absent. Impotence is rare.

Potential complications include puncture of major blood vessels or renal pelvis, genitofemoral neuralgia, perforation of the disc, and puncture of the ureter. Advantages include fewer postoperative thromboembolic phenomena occur in the elderly, since an operation and bed rest are avoided. The procedure can be repeated with minimal morbidity since the anatomical landmarks are not altered.

Lesion by laser is controllable and discrete. The laser heat spread is only 0.5 to 1.0 mm in depth. The area covered, nonetheless, is wider than that created by radiofrequency, as the side-firing fiber can be rotated to thermocoagulate a broader area. The settings of 5 herz and 10 watts do not cause bone damage while in contact with the vertebral body.

In comparison to the laser technique, surgical or chemical sympathectomy induces an extensive fibrous reaction and obliterates the potential space in which the sympathetic chain lies and makes the space impossible to identify during a subsequent procedure. Lumbar disc surgery, including percutaneous or endoscopic discectomy, may cause mechanical trauma to the somatic nerves; and a certain percentage of patient complain of buring pain, lower extremity swelling, color changes, and hypersensitivity of the skin. Diagnostic lumbar sympathetic blocks can identify sympathetic nervous system involvement as the causative factor.

In the past, permanent interruption of the lumbar sympathetic chain has been accomplished by open surgery or phenol or alcohol injection. Subsequently, percutaneous lumbar sympathectomy by radiofrequency lesions involved less morbidity. The Holmium:YAG laser has now been found to be even more effective and longer lasting than radiofrequency procedures.

CONCLUSIONS
With strict selection of patients and technically accurate technique employing the Holmium:YAG laser, the treatment method described is a viable option for causalgia, reflex sympathetic dystrophy, and neuritis causing symptoms in the lower extremities following surgical and nonsurgical trauma. Laser lumbar sympathectomy is equally effective as open
surgery but with a minimally invasive operation. Fluoroscopic localization and attention to proper probe placement assure relief of burning pain, hyperesthesia, and allodynia.

References
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