Lumber sympathectomy: A review
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Introduction
The concept of sympathetic denervation as a mode of therapy for arterial occlusive disease was first elaborated and tested by Leriche and Jaboulay in 1913. Their experience with periarterial sympathectomy was disappointing because of reinnervation and vasospasm recurring within weeks of operation. Lumber sympathectomy (LS) or section of the lumber sympathetic chain and excision of one or more ganglia, was introduced by Royle in 1923 in the treatment of spastic paralysis of the lower extremities. By the 1940s, lumber sympathectomy became the primary surgical treatment of arteriosclerotic occlusive disease and its sequelae in the lower extremity. However, the development of direct arterial reconstructive procedures in the 1950s diminished the importance of LS as a primary operation. While the superiority of results achieved with arterial grafting and endarterectomy became well established, the use of LS declined considerably. Now except for selective circumstances, sympathectomy is rarely performed for lower extremity atherosclerotic vascular disease. Even with best indications, the effectiveness of LS remains controversial.

Anatomy
In the lower extremity the lumbar sympathetic system exerts anatomic control over the vasoconstriction, sweating and arrectores pilorum activity. Preganglionic neurons in the lateral grey substances of the spinal cord from the level of T10 to L2 or L3 send axons along the ventral nerve roots to the lumbar sympathetic ganglia via white rami communicantes. Preganglionic fibres then synapse within the ganglion or ascend or descend as the interganglionic part of the sympathetic chain to synapse with postganglionic neurons in the ganglion of the chain. The postganglionic fibres exit through grey rami communicantes to accompany the peripheral nerves. Postganglionic fibres may arise from the 1st to the 4th or even 5th lumbar ganglion to travel with the lumbar and sacral nerves to the lower extremities. The foot and leg below the knee are primarily supplied by postganglionic fibres from the L3 level and below.

The lumbar sympathetic trunk contains 4-5 ganglia. They lay retroperitoneally in front of the vertebral column along the medial borders of the psoas major muscles. Four ganglia are usually found in the lumbar chain, but the number may vary between 2 and 8 and rarely one continuous ganglion is found.

Although the variations in position of the ganglia are common, the 2nd and the 4th lumbar ganglia are the more constant ones. The number of rami of any ganglion and their position between the spinal nerves and lumbar sympathetic trunk show considerable variation. Cross communication between the right and left sympathetics are also variable. Knowledge of these variations in the anatomic structure may be helpful in performing correctly a lumber sympathectomy. It is to be mentioned here that, because most vascular problems that may require sympathectomy are confined to the foot, resection of 2nd-4th lumbar ganglia is necessary.

Effects of Sympathectomy
Studies to evaluate the effects of lumber sympathectomy on lower extremity blood flow have been done in animal models as well as humans: Cronenwett et al.5 in the canine model demonstrated increased capillary flow. They assumed this arteriovenous shunting was nonnutritive. Hoffman and Jepson6 using the clearances of 133 xenon in patients found no increase in muscle blood flow after sympathectomy. In summary post

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sympayhectomy increase in blood flow appears to be mainly in the skin, and its is nonnutritive. Muscle blood flow in the other hand is unaffected.

**Indications**
Measurement of the physiological effects of lumber sympathectomy would suggest that its indications are very limited. At present time all would certainly agree that direct reconstruction will deliver more blood flow to an ischaemic limb then lumber sympathectomy.

1. **Intermittent claudication:** Strandness and Bell \(^7\), Taylor and Calo \(^8\) did not find favourable response for lumbar sympathectomy in patients with claudication. The experimental and objective haemodynamic studies of patients before and after lumbar sympathectomy do not support a beneficial effect of lumber sympathectomy for claudication. Patient with claudication for whom reconstruction is not indicated should rather be advised to stop smoking, attain an ideal body weight and begin a graded exercise program. Associated medical problems should be vigorously treated.

2. **Rest pain, nonhealing ulcers, gangrene:** Patients with mild rest pain who may or may not have superficial nonhealing ulcer of the toes or foot and patients with digital gangrene are best treated with direct revascularisation procedures even to the tibial level \(^2\). Taylor and Calo \(^8\) noted that 60% of patients with rest pain and localized lesions improved to only 28% in unoperated nonrandomized controls. Kim et al. \(^9\) obtained 62% and 47% improvements in patient with ulcers and rest pain respectively. These enthusiastic results are balanced by report of Froysaker \(^10\) who noted only 2 of 32 limbs with ulceration were improved by LS. Similar reports were also published by Pairoelero et al \(^11\). When comparing these somewhat favourable clinical results to the experimental work that indicated the increase in skin blood flow was nutritive, we have an apparent paradox. It may well be that patient selection is the key.

Walker and Johnston \(^12\) looked at 7 variables prior to and after phenol LS. These Variables were ankle systolic pressure, presence or absence of a somatic neuropathy, extent of ischaemic damage, presence or absence of diabetes mellitus, infection, age and sex. Among these the most important predictive variables were the level of ankle systolic pressure (greater than 30 mm Hg), absence of somatic neuropathy and minimal tissue damage. All authors \(^5,12\) are in agreement on 2 points concerning patients with gangrenous lesions. First, extensive gangrene (deeper than skin and subcutaneous tissue) will not respond to LS alone. Second, all patients with reconstructable peripheral blood vessel should undergo revascularisation. The debate concerns the value of LS in those patients for whom no reconstruction is possible. Enthusiasts rarely perform LS, sceptics do so often.\(^2\)

3. **Causalgia and vasospastic phenomena:** All these may occur as isolated manifestations but are more often associated with occlusive arterial disease. The central role of the sympathetic nervous system is perpetuating causalgic pain makes sympathetic denervation particularly suitable for this entity. Lower extremity vasospasm, cold intolerance and hyperhydrosis respond remarkably well to LS. However, prior to consideration of LS, maximal medical therapy with calcium channel blockers, cold avoidance and cessation of smoking must be earnestly pursued to overcome vasospasm. In the same way analgesics, tricyclic antidepressants, \(^2\) adrenergic blockers and physiotherapy should tried in a stepwise manner according to symptom of responsiveness of causalgia.

**Predictive testing**
In a search to better select patients who might have a favorable outcome from LS, numerous testing modalities like ankle brachial index (ABI), distal thigh arm pressure, toe temperature after nerve block, pedal arterial resistance index etc. have been offered. From a clinical standpoint a moist, cool foot with intact sensation would seem more favourable
than a dry, insensitive foot. Most patients, however, do not fit these extremes. According to most of the authors, selection of patients for LS should be based on 3 simple assessment criteria, which were derived retrospective, multifactorial analysis designed to differentiate responders from nonresponders. These criteria are:
1. An ABI of greater than 0,3
2. Absent neuropathy on physical examination and
3. Limited forefoot tissue loss 1, 12, 13.

The procedure
The anterolateral approach of Flowthow is most popular because the incision is well tolerated, dissection remains retroperitoneal and exposure is adequate. After proper dissection the lumbar sympathetic chain is located medial to the psoas muscle and lies over the transverse process of lumbar spine. The left lumbar ganglia lie adjacent and lateral to the abdominal aorta and on the right, just beneath to edge of the inferior venacava. Tactile identification of the lumber chain by plucking discloses a characteristics "Snap" as a result of tethering of the nodular chain by rami communicates. Other vertical band like structures in this region like genitofemoral nerve, paravertebral lymph nodes or ureter, do not recoil as briskly. Once identified the mid portion of the sympathetic chain is dissected free of surrounding tissues and retracted with a right angled clamp or a nerve hook to draw it up. The surgeon facilitates orientation and gangleion numbering by identifying the sacral promontory and an adjacent lumbar vein that usually crosses the sympathetic chain in front of or behind the third lumbar ganglion. The chain and at least two lumbar ganglia are removed and hemostasis done. Other approaches for lumber spine are the posterior one of Royle and anterior of Adson. The posterior approach is not favoured because of significant postoperative paraspinal nerve spasm. The anterior approach is applicable only for LS combined with an abdominal aortic or other intraperitoneal procedure 1.

In developed countries, the technique of laparoscopic LS has gained popularity in recent times. The time tested instruments, dissection maneuvers along with videoesopic magnification, that have proved so effective in thoracoscopic dorsal sympathectomy are employed in LS 14, 15.

Complications of lumbar sympathectomy
Major complications result from failure to appreciate normal anatomic relationships with resultant injury to the genitofemoral nerve, ureter, lumber veins, aorta and inferior venacava. Most common complications following LS are postsympathectomy neuralgia, sexual dysfunction and failure to achieve the desired objectives of pain relief or tissue healing.

Post sympathectomy neuralgia
It usually begins 1-2 weeks after LS and appears in upto 50% of patients. It is localised to the thigh (anterolateral), worse at night and rarely responds to medications. It usually remits spontaneously within 8-12 weeks.

Sexual dysfunction
It consists of retrograde ejaculation, and occurs in 25-50% patients undergoing bilateral LS including the L1 sympathetic ganglia.

Failure lumber sympathectomy
Failure to achieve the desired objective of pain relief or tissue healing is blamed on several factors. These include an incomplete sympathectomy as a result of a technically incomplete operation or as a result of cross innervation that makes a complete sympathectomy impossible. Latter recurrence may be caused by regenerating nerves or increased function of previously inconsequential crossed fibres.

Conclusion
LS has been included in the armamentarium of the vascular surgeon since 1924. Since the development of reconstructive arterial procedures, LS is much less commonly performed, because its effect do not support the clinical benefits of the operation. At present the role of LS in the modern...
management of lower extremity vascular disease is quite minor. Causalgic pain remains its best indication. In addition there does remain a small group of patients with non-reconstructable vascular occlusive disease, who will have a favourable response to LS. However, these benefits are usually short term. Proper patient selection and preoperative noninvasive vascular evaluation will render best results of LS in selected group of patients.

References