Lumbar Sympathectomy Revisited: Current Status in Management of Peripheral Vascular Diseases

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Abstract

Despite lack of objective evidence based-support, lumbar sympathectomy (LS) continues to hold a place in the treatment of refractory ischemic ulceration or persistent rest pain, especially when there is a distal ischemia, which is not suitable for direct arterial surgery. There is no physiological basis to use lumbar sympathectomy for patients with intermittent claudication. The non-specificity of the indications and lack of simple methods to predict success of this procedure have lead to many conflicting reports; however, the toe-temperature response following peripheral nerve block, transcutaneous oxymetry (TCPO2) or ankle-brachial pressure index (ABPI) correlate best with the effect of LS. Among the patients with rest pain and no distal ulcerations, pain relief is obtained in 76% at 3 months after LS in those who did not require amputation.11,19,38 LS does not exempt the patient from a subsequent amputation as the vasomotor tone is usually normalized in 2 weeks to 6 months after operation. Therefore, the healing effect of LS on an ulcer may become negligible after this “grace period”.23 The relapsing and remitting nature of intermittent claudication makes the study of natural history of claudication difficult; hence, the patient selection and results vary considerably and this is the reason for conflicting reports in different studies. No controlled trial has been done till now to compare the natural history of PIDs with the results of LS. LS may not produce the dramatic improvements seen after reconstructive surgery but should be considered as first-line management in selected patients. For many, avoidance of further surgery will be achieved after LS, but should the procedure fail to secure appropriate relief of symptoms, reconstructive surgery can still be offered without disadvantage.39The magnitude of changes in blood flow and sympathetic activity are similar for LS and chemical sympathectomy.

INTRODUCTION

Lumbar sympathectomy (LS) has been used in the treatment of various vascular and neurological disorders of lower extremities for close to 80 years. [1] LS is acknowledged to have a role in the treatment of patients with reflex symptomatic dystrophy (causalgia), vasospastic disorders like acrocyanosis and Raynaud's syndrome, hyperhydrosis of the feet, symptomatic vasospasm, and nonreconstructable arterial occlusive disease. A literature survey finds its miscellaneous uses for frostbites, desiccation of chronically moist ulcerations between the toes, chronic renal pain, rectal tenesmus, and sympathetically maintained intractable pain due to malignant reasons. Although it is the most commonly performed operation in the developing countries for peripheral ischemic diseases (PID), there is considerable controversy about its usefulness.

REVIEW

On one hand, advent of laparoscopic lumbar sympathectomy and reports of LS in conjunction with omental transposition have maintained interest in this procedure. On the other hand, rapid development of various arterial reconstructive procedures, description of distraction osteosynthesis and availability of gene transfer technology has added to the confusion concerning the proper place of this procedure in the management of TAO (Buerger's disease) and other PIDs. Being aware of these inconsistent opinions, we decided to try and define the place of LS for management of TAO by evaluating the currently available evidence, to answer the following questions:

1. What are the physiological reasons for outcome after LS?
2. What are the controversies for use of LS for PIDs?
3. Is it possible to predict the therapeutic response to LS?
4. What are the indications of LS today?

1. WHAT ARE THE PHYSIOLOGICAL REASONS FOR OUTCOME AFTER LS?

Clinical response after lumber sympathectomy is variable and transitory. This can be partially explained by physiological changes in skin and muscle blood flow after sympathectomy. The resting blood flow in human skeletal muscle is 2-5ml/100g/min, elimination of all sympathetic vasoconstrictive activity only increases this flow to 6-9ml/100g/min in contrast with exercising muscle which will have the flow rate of 50-75ml/100g/min. [2] Ischemia and exercise both produce metabolic substances locally, which cause maximal vasodilatation, despite sympathetic discharge; therefore, there is no physiological basis to use lumbar sympathectomy for patients with intermittent claudication since they already have maximal arteriolar vasodilatation. [3,4] While sympathectomy cannot increase exercise hyperemia, it increases the collateral blood flow provided there are enough collateral vessels and vascular pliability. Sympathectomy increases the transient blood flow through the collaterals in an ischemic extremity as a result of decrease in peripheral resistance due to opening of arteriovenous anastomoses with marked reduction in peripheral resistance; thereby increasing blood flow. These arteriovenous anastomoses have little or no intrinsic myogenic tone but are dependent upon sympathetic vasoactivity to control their diameter. [5,6,7] All these mechanisms increase the skin blood flow and result in increased skin temperature, rather than true nutritional capillary blood flow. [8] Therefore, its use in rest pain and ischemic ulceration is well accepted. The vasomotor tone is usually normalized in 2 weeks to 6 months after operation; this transient effect of LS can be explained by Cannon's law of supersensitivty of denervated sympathetic endings to circulating catecholamines and return of vasomotor tone by alternate pathways. [9,10] The division of afferent pain fibers traveling in the sympathetic chain may be an alternative basis for the success of lumbar sympathectomy, especially in rest pain. [11]

2. WHAT ARE THE CONTROVERSIES FOR USE OF LS FOR PIDS?

The place of LS in the treatment of PIDs of the lower limbs remains controversial; inconsistent opinions on its value can be divided in to those who are against and those who are for:

AGAINST

Assessment of cutaneous blood flow in the foot in patients with peripheral vascular disease failed to detect improvement in nutritional blood flow after LS. [12] Investigators assessing microcirculation (with intra-arterial injection of radio-isotopes) in the feet of patients with TAO found that LS does not improve microcirculation, and concluded that there is breakdown of the microvascular defense system from the beginning of the disease. [13] In fact, even the presumed increased sympathetic nerve activity which may respond to LS has not been demonstrated which points to a local vascular abnormality in TAO. [14] LS, like any other surgical procedure, is not without its share of complications which include failure of adequate denervation, brief paralytic ileus, hyperhydrosis in parts of the body which remain normally innervated, sexual dysfunction, and post-sympathectomy neuralgia. The detractors and skeptics conclude that a weak case can be made for sympathectomy for ischaemic rest pain when arterial surgery is impractical but there is no reliable evidence to support its use in intermittent claudication. [15] An additional limitation is that assessment of response to lumbar sympathectomy is difficult because selection of cases is usually empirical as ischemia is difficult to quantitate objectively. Different expectations in different patient groups and continuation of precipitating factors like smoking further compound the issue; thereby illustrating the pitfalls of applying physiological data to such a variability of pathological processes. This makes comparison between different reported series very difficult.

FOR

Empirically derived evidence in favor of LS for management of PIDs comes from innumerable clinical studies, which support the continued use of the procedure, coupled with local tissue management in the treatment of selected patients with localized pre-gangrenous lesions, or superficial ischemic ulcerations in whom arterial reconstructive operation is not feasible or who refuse major vascular surgery. [16,17,18,19,20,21] Studies on long-term outcome of TAO after LS are not completely discouraging. [22] Even if LS provides only short-term pain relief and ulcer healing without long-term benefit in majority of patients, it remains a useful tool. [23] Research workers from Russia have shown that LS reduces pathogenetically reliable orthostatic and post-orthostatic spasm of the diseased arteries. Specific complications after LS are remarkably low and almost always transient and these cannot be arguments against the use of LS; in fact, LS has been safely done under local anesthesia also. LS have been justifiably called a “goal line last ditch stand” and should be considered before a major amputation. [24,25]

3. IS IT POSSIBLE TO PREDICT THE THERAPEUTIC RESPONSE TO LS?

Although lumbar sympathectomy can benefit patients with critical limb ischaemia, many derive no benefit from the procedure. This has prompted research workers to study various predictive tests, which might allow LS to be done only in those patients who are likely to benefit by this procedure. These tests can be classified in to:

Clinical assessment of degree of ischemia: Good response is expected if there is no evidence of a somatic neuropathy, and if the tissue damage is not too extensive i.e., only rest pain, night pain, or digital gangrene is present. [26,27] Deep infection or gangrene is a bad prognostic sign and its presence predicts failure of LS. [24,28]

Tests of vasomotor tone: these include an increase of 2 degrees or more in skin temperature of the ipsilateral great toe after lumbar sympathetic block, preoperative assessment of sympathetic nerve function by means of acetylcholine sweatspot test, foot vascular resistance index, use of Hillestad's reactive hyperemia test, segmental impedance plethysmography (irrigraphy), skin thermometry, measurement of arterial blood flow and resistance in the foot and in the leg, reactive hyperemia under photoplethysmographic control, and thermographic test using Reserpine injected in the femoral artery. [29,30,31,32]

ASSESSMENT OF COLLATERAL CIRCULATION

i) Angiography has been used but quantification of data is difficult and so is prediction of response to LS.

ii) Doppler ultrasound can determine the pressure in the thigh and ankle and has been used as a predictive test. Good response is expected if ankle systolic pressure is above 60mmHg, preoperative Ankle Brachial Index (ABI) is >0.3, or if the distal thigh/arm index is >0.6. [18,22,25,26] Another important predictive parameter is patency of superficial femoral artery which has been found to be related to successful outcome of the patients. [21]

iii) Transcutaneous oximetry ($TCPO_2$) has also been found useful; as there is high correlation between ABI and $TCPO_2$. If transmetatarsal $TCPO_2$ is <30mmHg an amputation is likely to be needed. [35,36]

Tests for verification of completeness of sympathetic denervation, although available, are difficult to perform, and interpret. [32,37] The poor prediction of outcome may be related to pre-existing damage to the sympathetic fibres. [33]

4. WHAT ARE THE INDICATIONS OF LS TODAY?

The majority of the reports show benefits in terms of relief of rest pain after lumbar sympathectomy in the range of 60 to 75%, which is better than the percentage assumed in natural history. This suggests that lumbar sympathectomy has a definite role in PIDs. Short-term efficacy of LS in terms of relief of symptoms is 60%, while in long run the effectiveness of treatment lasted in only 50% of patients. Its results in terms of limb conservation and relapses are disappointing due to extensive breakdown of regional microcirculation by disease process and normalization of vasomotor tone within two weeks to six months after operation. Sympathectomy gives best results in younger co-operative patients with short history who have stopped smoking, in non-diabetics (because microvascular lesions reduce peripheral vasodilatation) and in patients with rest pain and ischemic ulcers, healing of amputation stump, and distal involvement of vessels. Ankle brachial pressure index (ABPI) >0.3 and a patent femoral artery are prerequisites for the success of lumbar sympathectomy.

In summing up, it is difficult to improve upon Smithwick's observation on LS made in 1957: The effect of sympathectomy upon the peripheral circulation is physiological in nature. In order to predict the outcome appropriate studies are needed before and after operation, which will demonstrate the physiological effect. In addition to this, certain physiological information regarding the state of peripheral circulation is essential. Failure to obtain the necessary data before and after operation is the basic reason why the selection of cases for sympathectomy is unsatisfactory today and the outcome unpredictable or speculative for the most part. [40]

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