Percutaneous Chemical Lumbar Sympathectomy for Buerger’s Disease: Results in 147 Patients

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Abstract

Objectives: The objective of this study was to evaluate the efficacy, safety, and clinical outcome of percutaneous chemical lumbar sympathectomy (PCLS) in Buerger’s disease (thromboangiitis obliterans [TAO]). Design: This was a retrospective comparative study. Methods: TAO patients who underwent PCLS in surgery department of a teaching hospital in Central India. Diagnosis of TAO was made on clinical grounds and color Doppler study. PCLS was done under image guidance after amputation of gangrene or before if a clear line of demarcation was lacking. After PCLS, patients were followed up on next day and after 2, 4, 8, and 12 weeks. Outcome monitored were improvement in rest pain (using visual analog scale) and healing of ischemic ulcers. Results: All patients were males, chronic bidi smokers, mostly in the third decade of life. All had involvement of lower limbs either ischemic rest pain or ischemic ulcers or gangrene of toes/forefoot. A total of 167 PCLS (20 bilateral) were performed on 147 TAO patients from June 2008 to January 2016. Imaging modalities were computed tomography scan (n = 67), digital X-ray (n = 50), and C-arm fluoroscopy (n = 50). Success rate for chemical neurolysis was > 82%. Excellent long-lasting rest pain relief was obtained in > 80% patients. Ulcer healing was seen in majority of patients. Large number of limbs (103/167) had gangrene of toe/multiple toes/part of forefoot. Those with patent popliteal artery fared better. Conclusions: PCLS can provide safe and efficient treatment for rest pain and healing of ischemic ulcers in TAO.

Keywords: Buerger’s disease, gangrene, ischemic ulcer, percutaneous chemical lumbar sympathectomy, rest pain

Introduction

Buerger’s disease (thromboangiitis obliterans [TAO]) is a common cause of peripheral arterial disease (PAD) in India. Chronic bidi (country-made filterless cigarette containing low-grade tobacco) smoking is central to the initiation and progression of the disease. TAO patients have limited therapeutic options as there is a minimal possibility of endovascular intervention or vascular reconstruction. Mainstay of treatment is complete abstinence from tobacco; however, lumbar sympathectomy (LS) surgical or percutaneous chemical LS (PCLS) continues to hold a place in the treatment of these patients.[¹] The aim of this retrospective observational study was to evaluate the efficacy, safety, and results of PCLS in TAO patients.

Methods

This is a retrospective study conducted on TAO patients who underwent PCLS in the surgery department of a teaching hospital in central India. It received due clearance from Institutional Ethics Committee. Diagnosis of TAO was made on clinical grounds, supplemented with two-dimensional (2D) color Doppler study as per Shionoya criteria.[²] Limbs with absent popliteal pulsation on 2D color Doppler study were labeled as with “high” block and those who had popliteal pulsation present but absent dorsalis pedis and posterior tibial artery pulsations were labeled as with “low” block.

Patients with frank gangrene of foot requiring below-knee amputation were excluded from the study. Other patients were subjected to PCLS after amputation of gangrenous toes/part of foot. Patients with impending gangrene were subjected to PCLS before amputation of gangrenous toes/part of foot.
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PCLS and amputation of gangrenous toes/part of foot was done after a clear line of demarcation appeared. Decision for amputation was made on clinical grounds as expansive investigations such as transcutaneous oxygen tension (TePO$_2$) are not available in our hospital. Amputation of one or two toes was graded as minor amputation, while amputation of more than two toes or forefoot was graded as major amputation.

Patients with coagulation disorder, diabetes, and hypertension were excluded ($n = 11$).

**Technique**

After relevant investigations and informed consent, PCLS was performed in prone position with the arms abducted to 90°. Upper border of L2 (second lumbar) vertebra was palpated; confirmed by imaging (first film for computed tomography [CT]/X-ray or fluorescent screening by C-arm), and marked. 5 ml of 2% lignocaine hydrochloride was instilled in a track from about 8 to 10 cm lateral (on the affected side) up to the vertebral body at the level of L2 vertebra.

A 20-gauge spinal needle with stylet was inserted (under fluorescent screening when using C-arm) at the angle of approximately 70° from the surface and was directed forward and medially, parallel to and maintaining relation with L2 vertebra so as to touch the tip of its transverse process [Figure 1]. Then, the needle was guided forward and medially 2–3 cm maintaining the same angle till the bony resistance was felt against the L2 vertebral body. Second film for CT/X-ray (or fluorescent screening when using C-arm) was taken at this time to confirm final position of needle at the anterolateral aspect of L2 vertebral body. The stylet had entered into a vessel. Next, 1.5 ml of water soluble nonionic contrast Iohexol (SRS Pharmaceuticals Pvt. Ltd., Mumbai, India), 3% dye was injected (under fluorescent screening when using C-arm), and third film for CT/X-ray or third exposure for C-arm was taken at this time to confirm the anterolateral part of vertebral body and typical pattern of spread [Figure 2]. The final step was to inject 10 ml of absolute alcohol (99%) in a single rapid shot, which led to patient experiencing a sharp shooting pain and giddiness.

In addition, when indicated, contralateral PCLS was also done at the same sitting.

In the immediate postprocedure period, pulse and blood pressure were monitored. Patient was kept under observation for 6 h and discharged. Follow-up was done on next day and after 2, 4, 8, and 12 weeks. Outcome parameters monitored were improvement in rest pain by 1–10 visual analog score (VAS, 1–3 = excellent, 4–6 = good, 7–10 = unsatisfactory) and healing of ischemic ulcer.

Standard foot care was given to all patients. Benefit of complete abstinence from tobacco smoking/chewing was vigorously counseled at every follow-up and its compliance/noncompliance noted.

Results were noted across the three groups: DX-LS, CT-LS, and CA-LS.

**Results**

A total of 167 PCLS (20 bilateral, 147 unilateral) procedures were performed on 147 TAO patients in the surgery department of a teaching hospital in Central India from June 2008 to January 2016.

The imaging modality for the first 67 PCLS (5 bilateral) was CT scan (Group CT-LS), then digital X-ray (total 50, 7 bilateral; Group DX-LS) and C-arm image intensifier (total 50, 8 bilateral; Group CA-LS) were used for the next 100 patients. This choice was determined by the availability of imaging modality from the radiology department. Time taken to perform the procedure was 15–30 min and was similar across the three groups.

All patients were chronic bidi smokers, males; most patients were in the third decade (mean age 32, range 25–60 years, only 7 patients were older than 50 years of age.). All patients had involvement of lower limbs either ischemic rest pain or ischemic ulcers or gangrene of toes or foot. Ankle pressure index could not be measured in large number of patients as their...
dorsalis pedis and posterior tibial arteries were not palpable. Hyperlipidemia was not found in any patients.

Success rate for chemical neurolysis was 82%–86.7% across the three groups as seen by increased warmth of the limb [Table 1]. Results were similar between the three groups. Excellent rest pain relief was obtained, which lasted for 3 months of follow-up in >80% patients, while ulcer healing was seen in majority of patients across the three groups [Table 1]. All of these limbs had low block on Doppler study.

Large number of limbs (103/167) had gangrene of toe/multiple toes/part of forefoot. Of 103 limbs, 57 limbs (55.33%) had the presence of popliteal pulsation (low block); all these limbs healed after amputation of toes/forefoot and PCLS. 46/103 limbs had absent poplitical pulsation on Doppler study, one-third (15/46) of these “high-block” limbs healed after amputation of toes/forefoot and PCLS. Two-third (31/46) did not heal after amputations (of toes/forefoot) and PCLS; these had to be subjected to below-knee amputations [Table 2].

The patients with ulcer, rest pain, and gangrene were not having exclusively one of these symptoms, but many had combination of these symptoms; hence, the total among Table 1 is not 100% every time.

Transient paresthesia (lasting a week’s time), over the lateral side of thigh, was the only complication seen in a small number of patients. Only 5/167 limbs (2.99%) had persistent paresthesia which lasted for more than 12 weeks [Table 1]. None of the patients with bilateral sympathectomies complained of sexual dysfunction.

Some patients who benefitted in healing of ulcer and/or improvement in rest pain did not complete the follow-up; but most patients could complete the regular follow-up [Table 1].

### Table 1: Incidence and outcome of rest pain and ulcer healing in three groups

| Imaging modality | Skin temperature (warm), n (%) | Rest pain (VAS score) | Ulcer healing | Complication (PTA), n (%) |
|------------------|--------------------------------|-----------------------|---------------|-------------------------|
|                  |                               | 0-3, n (%)            | 4-6, n (%)    | 7-10, n (%)             | <2 cm × 2 cm, n (%)   | >2 cm × 2 cm, n (%) | Healed, n (%) |                  |
| CT-LS (r=67) (9°) | 58 (86.5)                     | 54 (80.5)             | 2 (2.9)       | 11 (16.4)               | 4 (5.9)               | 5 (7.4)             | 0             | 16 (23.8)       |
| A                | 54 (80.5)                     | 3 (4.4)               | 10 (14.9)     |                         | 5 (7.4)               | 3 (4.4)             | 4 (5.9)       | 2 (2.9)         |
| B                | 54 (80.5)                     | 3 (4.4)               | 8 (11.9)      | 4 (5.9)                 | 2 (2.9)               | 7 (10.4)            |               |                |
| C                | 55 (82)                       | 2 (2.9)               | 5 (7.4)       | 0                       | 2 (2.9)               | 4 (5.9)             | 2 (2.9)       |                |
| D                | 56 (83.5)                     | 2 (2.9)               | 3 (4.4)       | 0                       | 2 (2.9)               | 4 (5.9)             |               |                |
| CA-LS (n=50) (6°) | 44 (86.7)                     | 38 (76)               | 5 (10)        | 7 (14)                  | 6 (12)                | 7 (14)             | 0             | 15 (30)         |
| A                | 41 (82)                       | 2 (4)                 | 7 (14)        | 9 (18)                  | 4 (8)                 | 8 (16)             |               |                |
| B                | 42 (84)                       | 3 (6)                 | 3 (6)         | 4 (8)                   | 1 (2)                 | 8 (16)             |               |                |
| C                | 43 (86)                       | 3 (6)                 | 3 (6)         | 4 (8)                   | 0                     | 7 (14)             |               |                |
| CA-LS (n=50) (6°) | 56 (86.5)                     | 2 (2.9)               | 3 (4.4)       | 0                       | 2 (2.9)               | 4 (5.9)             |               |                |
| D                | 43 (86)                       | 3 (6)                 | 1 (2)         | 1 (2)                   | 0                     | 9 (18)             | 1 (2)         |                |
| DX-LS (n=50) (7°) | 41 (82)                       | 35 (70)               | 6 (12)        | 9 (18)                  | 12 (24)               | 13 (26)            | 0             | 10 (20)         |
| A                | 36 (72)                       | 6 (12)                | 8 (16)        | 11 (22)                 | 8 (16)                | 6 (12)             |               |                |
| B                | 39 (78)                       | 6 (12)                | 5 (10)        | 10 (20)                 | 5 (10)                | 9 (18)             |               |                |
| C                | 41 (82)                       | 6 (12)                | 3 (6)         | 9 (18)                  | 3 (6)                 | 12 (24)            |               |                |
| D                | 41 (82)                       | 4 (8)                 | 1 (2)         | 8 (16)                  | 4 (8)                 | 11 (22)            |               |                |

Patients who benefitted were lost to follow-up at different times; hence, the numbers do not add up to 100% at the time of last follow-up. *Number of patients who did not complete follow-up, many of these benefitted in healing of ulcer and/or improvement in rest pain so did not complete the follow-up; A: First postoperative day, B: At 2 weeks, C: At 4 weeks, D: At 8 weeks, E: At 12 weeks, PTA: Paresthesia along the lateral side of thigh, VAS: Visual analog scale

### Table 2: Incidence of gangrene in three study groups based on presence/absence of popliteal pulsations

| Imaging modality | Number of limbs with gangrene/ out of total | Benefitted: Healed After PCLS + amputation, number/out of total (%) | Not benefitted: Not healed Needed higher amputation, number/out of total (%) | No who benefitted and did not complete follow-up |
|------------------|---------------------------------------------|---------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------|
|                  |                                             | High block                                                          | Low block                                                                   |                                               |
| CT-LS            | 44/67                                       | 4 (2±2')                                                            | 26*                                                                         |                                               |
| CA-LS            | 38/50                                       | 4 (2±4')                                                            | 21*                                                                         |                                               |
| DX-LS            | 21/50                                       | 5 (4±1')                                                            | 10*                                                                         |                                               |
|                  |                                             | High block                                                          | Low block                                                                   |                                               |
| CT-LS            | 14                                           | 0                                                                   | 5/30 (benefitted)                                                          |                                               |
| CA-LS            | 11                                           | 0                                                                   | 3/27 (benefitted)                                                          |                                               |
| DX-LS            | 6                                            | 0                                                                   | 3/15 (benefitted)                                                          |                                               |

*Minor amputation - amputation of one or two toes, Major amputation - amputation of more than two toes or forefoot. High block: Absent popliteal and distal pulsations. Low block: Present popliteal but absent dorsalis pedis and posterior tibial pulsations. PCLS: Percutaneous chemical lumbar sympathectomy.
DISCUSSION
The concept of sympathetic denervation as a mode of therapy for arterial occlusive disease was first described by Jaboulay in 1889; however, operative section of lumbar sympathetic chain, in the form of LS, was introduced in the 1920s. [3,4] “Chemical sympathectomy” was demonstrated around the same time when phenol and alcohol were applied therapeutically on various arteries and nerves. [3] Like most surgical procedures, less invasive version of LS appeared in the form of PCLS in 1949 and has gained popularity since the 1970s due to availability of CT and C-arm imaging techniques. [6,7] Of late, increasing acceptance of nerve blocks for pain has led to a renewed interest in this procedure.

Role of sympathectomy in treatment of PADs has been debated right from its inception. Alexander, author of one of the largest series of 544 PCLSs, wrote “perhaps no procedure has generated more controversy in the treatment of peripheral vascular disease (PVD) than LS.” [8] Belief in benefits of LS has been termed a “faith” and called “sympathectomism;” and its author wrote: “It is not good for surgeons, nor for surgery that any operation be done because we cannot think of another one to do… Embarrassed by my vacillation and uncertainty, I find myself in the position of defending LS as one would defend a faith.” [9] Authors believe that the science of sympathectomy follows logic and benefits can be predicted in most cases and disappointments can be avoided. Various controversies about sympathectomy in PAD, physiological reasons for variable outcome, predictability of success, efficacy, and current indications have been recently addressed and decoded by us. [1]

Even though there are no clear guidelines or randomized control trials (RCTs); two independent surveys have shown that majority of physicians involved in care of PVD patients utilize PCLS to alleviate symptoms of rest pain and as an adjunct to other treatments for ulcers. [10,11] Similarly, a “best evidence topic in vascular surgery” summarized that subjective improvements in symptoms for patients with highly symptomatic critical leg ischemia have been consistently demonstrated in multiple cohort studies. [12]

High-quality RCTs assessing efficacy of different methods of LS (by open, laparoscopic, and percutaneous methods) are lacking; [13] however, over the years, many comparative studies and systemic reviews have shown that results of chemical sympathectomy are “at par” with surgical sympathectomy. [14-20]

We have come a long way since the first reported use of “blind” PCLS. [3] This retrospective comparison of three imaging techniques showed similar success rate. Theoretically, CT-guided PCLS is the easiest as CT allows the calculation of distance from skin to vertebra as well as the angle required to insert the needle. C-arm fluoroscopy is, of course, the most convenient and user-friendly.

Rate of successful neurolysis in PCLS, as measured with increased warmth of the affected limb, was consistently over 82%, spread over 10 years of this study [Table 1]. We chose L2 as the most suitable point for placement of the tip of the needle due to the anatomical location of the second and third sympathetic ganglia. [21-23]

A literature review reveals a strikingly wide variation in most of the parameters about PCLS – right from its execution by anesthetists/radiologists/surgeons, technical aspects such as different sites L2/L3/L4, use of single needle/double needle, selection of patients, measurement of outcome/results, and length of follow-up. This discrepancy makes interpreting the results difficult; immediate increase in peripheral circulation after the intervention was shown in 72%–96% patients, pain relief was found in 76%–83.5% patients, 60%–72% had ulcer healing, and long-term relief was found in 30%–88% of patients in different studies. [8,10,12,17,24-35]

Our results with rest pain relief and ischemic ulcer healing compare favorably with these results [Table 1]. Sympathectomy works for rest pain and healing of ischemic ulcers because marked reduction in peripheral resistance leads to opening of arteriovenous anastomoses (both dependent on sympathetic vasoactivity) thereby increasing blood flow in skin. [11] Alleviation of rest pain also occurs because of the neurolysis of afferent pain fibers traveling in the sympathetic chain. [36] Effect of sympathectomy on rest pain has been studied in only one randomized, controlled, prospective double-blind trial of phenol chemical sympathectomy against placebo bupivacaine injection. This study done in 41 limbs (24 treatments and 17 controls) showed that rest pain was relieved in 83.5% of patients at 1 week with a placebo response of 23.5% (P < 0.002). In addition, 66% of patients remained free from rest pain at 6 months. [27] Science of sympathectomy is quite logical and its use should not be confined to being a last ditch-penultimate operation before amputation. [37]

Most research workers have relied on clinical improvements such as alleviation of rest pain, healing of ischemic ulcer, and increase in claudication distance; in measuring the results of PCLS. [8,10,11,16,17,24-35] However, the benefits of PCLS have also been objectively demonstrated by measurement of increased skin temperature by thermal imaging, increased blood flow by Doppler, magnetic resonance imaging, laser Doppler flowmetry, plethysmography, thallium scintigraphy, and TcpO2 techniques. [17,28,31,37,39]

All our patients were males, and all had involvement of lower limbs. In our experience, TAO in female patients and involvement of upper limb are rare. [40] We had no patients with claudication pain, as all patients presented with rest pain, or ischemic ulcers or gangrene; in fact patients with claudication pain are very rarely seen by us at a tertiary teaching hospital. In addition, sympathectomy does not and cannot work for claudication (ischemic) pain of muscle because metabolic substances produced locally due to preexisting ischemia have already caused maximum arteriolar vasodilatation in the muscles. [11] There has been only randomized study, done on 25 patients, to assess effect of LS on intermittent claudication; and it failed to show any
improvement.\[^{[41]}\] Similarly, most studies did not show any improvement in claudication distance, with an occasional exception.\[^{[29,31]}\]

The presence of popliteal artery pulsations is generally considered crucial for perfusion and viability of lower limb in PVD. This was also reflected in our study; limbs with patent popliteal artery did well and benefited. However, majority of limbs with absent popliteal artery pulsations did not benefit after PCLS and their toe/forefoot amputations did not heal and in few patients gangrene spread proximally. These required higher– below-knee amputations [Table 2]. Some of those who did not benefit were those who continued to smoke. These patients did not fare well, perhaps due to on-going damage due to smoking. Patients with diabetes also do not respond well to PCLS; and very few studies have shown patients with diabetes responding to PCLS as well as nondiabetics\[^{[29,30]}\].

Nonetheless, one-third of limbs with gangrene and absent popliteal artery pulsations benefitted after PCLS and their amputations healed [Table 2]. It is possible that gradual blockage of popliteal artery prompted the genicular arterial anastomosis around the knee to open up and provide the necessary arterial supply. This genicular arterial anastomosis is rarely demonstrated by angiography or cadaveric anatomical dissections. However, its potential to supplement collateral circulation (following gradual obstruction to normal arterial flow) and as a site for surgical bypass (in cases of popliteal block) is well recognized.\[^{[42,43]}\]

During PCLS, complications may occur due to inadvertent damage to surrounding structures by neurolytic agent. Only one complication– paresthesia over lateral surface of thigh – was seen in the present study. It was noted in 20%–30% cases across the three study groups and was mostly transient [Table 1]. This compares favorably with other studies, which have documented infrequent self-limiting complications such as dysesthesia over L3 dermatomes in thigh, erectile dysfunction, compensatory hyperhidrosis, and retroperitoneal hematoma/abscess.\[^{[8,28,32,35,44]}\]

Catastrophic complications such as paraplegia following inadvertent extradural injection and ureteric necrosis are, fortunately, extremely rare in literature.\[^{[11,45-47]}\]

Most Indian surgeons hold the belief that TAO is – by definition – multisegmental, involving small- and medium-sized arteries, and therefore, revascularization is not a suitable option in these patients.\[^{[48-50]}\] This was confirmed in the present study, objectively, by 2D color Doppler study. There is emerging evidence that prostanoids can help in TAO and may decrease objective of pain relief or tissue healing is caused by several factors. These include a technically incomplete neurolysis or cross innervation that makes a complete sympathectomy impossible. Late recurrence may be caused by regenerating nerves or increased function of previously inconsequential crossed fibers or physiological return of vasomotor tone. One must understand that surgical/chemical-neurolytic completion of LS is only one part of the treatment in TAO. The continued/recurrent usage of tobacco by TAO patients and the difficulty of these patients encounter in giving up this addiction are rarely taken into account. All results can and do get affected by this fundamental and overriding determinant. Total abstinence from tobacco is of paramount importance for halting the progression of disease and its importance cannot be overemphasized.

**Conclusions**

PCLS can provide safe and efficient treatment for TAO patients with rest pain and healing of ischemic ulcers and in selected patients of gangrene who have a patent popliteal artery.

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**Conflicts of interest**

There are no conflicts of interest.

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