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Original Research

Efficacy of CT-Guided Lumbar Chemical Sympathectomy for clinical improvement and Ulcer Healing in Patients with Thromboangiitis Obliterans

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Abstract:
Introduction: Thromboangiitis obliterans (TAO), or Buerger's disease, is an inflammatory vasculitis affecting small and medium-sized vessels, leading to ischemia, pain, and non-healing ulcers. In advanced cases, revascularization is often not feasible, making chemical sympathectomy a viable option for symptom relief and ulcer healing. This study evaluates the efficacy of CT-guided lumbar chemical sympathectomy in TAO patients with chronic lower limb pain and non-healing ulcers.
Methods: This retrospective study included 28 TAO patients who underwent CT-guided lumbar sympathectomy from Aug 2017 to Jan 2024 at a tertiary care center. Primary outcomes noted were changes in claudication distance, Ankle-Brachial Pressure Index (ABPI), and Pressure Ulcer Scale for Healing (PUSH) scores assessed at 1 week, 2 months, and 6 months post-procedure.
Results: Significant improvements were observed in initial and absolute claudication distance (ICD: 45.86m to 145.93m, ACD: 111.96m to 211.14m at 6 months, $p<0.001$). ABPI increased from 0.61 to 0.91 ($p<0.001$) indicating improved blood flow. Among 21 patients with ulcers, 28.6% achieved complete healing, while the remaining showed substantial improvement.
Conclusion: CT-guided lumbar sympathectomy is an effective intervention for pain relief and ulcer healing in TAO patients, significantly improving the outcomes. It offers a valuable alternative for patients ineligible for revascularization, reducing the risk of amputation and enhancing quality of life.
Keywords: Thromboangiitis obliterans, Buerger's disease, chemical sympathectomy, pain management, , non-healing ulcers

Introduction:

Thromboangiitis obliterans (TAO), also known as Buerger's disease, is a non-atherosclerotic, inflammatory vasculitis that primarily affects small and medium-sized arteries and veins of the extremities. The disease is strongly associated with tobacco use, and its pathophysiology involves immune-mediated endothelial injury, leading to segmental vessel inflammation, thrombosis, and vascular occlusion.(1) This results in ischemia, pain, claudication, and non-healing ulcers, particularly in the fingers and toes. Histologically, TAO is characterized by a highly cellular thrombus with preserved internal elastic lamina, distinguishing it from atherosclerosis.(2) Over time, progressive ischemia may lead to gangrene and limb amputation if untreated. Currently, there is no definitive cure for TAO, but treatment focuses on halting disease progression, improving blood flow, and preventing complications. Complete tobacco cessation is the cornerstone of therapy, as continued smoking leads to disease progression and limb loss.(3) Pharmacological approaches include vasodilators, antiplatelet agents, and anticoagulants to enhance microcirculation.(4) Sympathetic blockade and hyperbaric oxygen therapy may provide symptomatic relief in severe cases. In advanced disease, revascularization is usually not

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feasible due to diffuse distal vessel involvement, making autologous stem cell therapy and angiogenesis-promoting treatments promising experimental options.(5) For non-healing ulcers and critical limb ischemia, amputation remains a last resort to prevent systemic complications like sepsis.(6)

Chemical sympathectomy plays a significant role in the symptomatic management of TAO, particularly in patients with severe rest pain and non-healing ulcers due to critical limb ischemia. It involves the injection of neurolytic agents such as phenol or alcohol into the lumbar or stellate ganglion, leading to temporary or permanent sympathetic blockade.(7) A study by Kothari et al., among 147 subjects has showed >80% pain relief with chemical sympathectomy.(9) Another study by Anurag et al., among 38 subjects with critical limb ischemia all patients achieved limb salvage after chemical sympathectomy.(8) In a review of 216 TAO subjects, it was noted that sympathetic tone was normalized within 6 months after sympathectomy and within this period usually blood flow alterations resulted in healing of ulcer.(9)

By inhibiting vasoconstriction, chemical sympathectomy enhances blood flow to ischemic tissues, reduces ischemic pain, and may promote ulcer healing.(10) Sympathectomy improves tissue oxygenation.(11) Although its effects are often temporary, repeated injections or adjunctive therapies (e.g., prostaglandins, hyperbaric oxygen) can prolong symptom relief. While not a curative treatment, chemical sympathectomy is particularly beneficial for patients ineligible for revascularization, offering improved quality of life and delaying the need for amputation. In their Cochrane review, Mailis and Furlan noted that chemical sympathectomies, have a temporary effect due to the eventual regeneration of the sympathetic chain.(12) A systematic literature review assessed the effectiveness of chemical sympathectomy for neuropathic pain and concludes that the procedure offers, at best, temporary relief in TAO patients.(13) Therefore, a study is undertaken with objective to evaluate the efficacy of CT-guided lumbar chemical sympathectomy for pain relief and ulcer healing in patients with thromboangiitis obliterans.

Methodology:

In a retrospective study, patients who underwent LCS were observed for clinical outcomes at a teaching medical college. The Institutional Review Board and Institutional Ethics Committee reviewed and approved the study protocol.

Subject characteristics:

From the hospital records, the details of all subjects who had undergone LCS from Aug 2017 to Jan 2024 for various reasons as outlined in inclusion criteria and who had follow-up visits at for 1 week, 2 months and 6 months were selected.

Inclusion criteria: adult patients aged 18 years and above diagnosed with chronic lower limb pain and / or non-healing ulcer due to TAO were selected. Those with pain refractory to standard medical management (e.g., medications, physical therapy) for more than 1 year were also included. Presence of ischemic or vasospastic conditions benefitting from sympathetic blockade were included.

Exclusion criteria: Patients who have undergone lumbar sympathectomy or other sympathetic ablation in the same region were excluded. Patients with untreated major psychiatric conditions that may interfere with participation or outcome evaluation were not included. Active drug or alcohol abuse that may compromise compliance or outcomes were excluded. Subjects with malignancy-related pain conditions or ongoing chemotherapy in the lumbar region were not included. Patient records where any of the follow-up visits were missing or incomplete were excluded.

On retrospective assessment it was noted that the procedure was not done for patients with bleeding disorders or the patients on anticoagulants that cannot be discontinued safely, uncontrolled diabetes mellitus, severe cardiovascular disease, or other life-threatening conditions. In addition, it was noted that the procedure was also not done for patients with known allergies or hypersensitivity to the chemical agent used in sympathectomy (e.g., alcohol, phenol) and the procedure was also not done in patients with severe anatomical abnormalities, active infections, or contraindications to lumbar intervention and hence such cases were not included.

Baseline parameters: demographic details such as age, sex, primary symptom for which LCS was undertaken was noted. Details about diagnosis, site of pain, pre-procedure size of ulcer were noted. Pre-procedure Ankle-Brachial Pressure Index was noted.

Pre-procedure CT evaluation:

64 slice CT scan was undertaken in each subject for clear identification of the lumbar sympathetic chain location (typically anterolateral to the L2-L4 vertebral bodies). During this analysis anatomical abnormalities or obstructions in the lumbar region were ruled out and assessment of surrounding organs, vessels, and nerves to avoid complications during chemical injection were undertaken.

Procedure:

LCS was performed at single level (at the level of L2/L3). Patients were positioned prone on the CT table.

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Adequate monitoring was provided by pulse oximetry. Under aseptic precautions, local anesthetic (lignocaine 10 ml) was infiltrated in the posterior paraspinal region, in paramedian location at the level of L2, L3 vertebra. With CT guidance, 22-gauge needle of length 150 mm was inserted towards anterolateral aspect of the body of L2 / L3 vertebra.Lumbar sympathetic chains are usually located in paravertebral region in the anterolateral aspect of corresponding lumbar vertebrae, along the medial borders of the psoas major muscles and lateral to the aorta in left side and lateral to inferior vena cava in right side. While viewing the axial CT section at the level of L3 vertebra needle was inserted at an angle of 45 degrees parallel to the axial section through psoas muscle to the location of lumbar sympathetic trunk at the side of symptoms. Injection of 2 ml of contrast done through the needle prior to neurolytic injection to assess the spread of the neurolytic agent and to confirm the location of needle tip. Aspiration done prior to neurolytic injection to rule out needle tip in vessels. L2 and L3 ganglia are usually fused. Therefore, a single injection of neurolytic solution done at this level. Absolute alcohol 5 to 8 ml with Bupivacaine 2 ml injected slowly over 2 minutes. After successful ablation, patients experienced burning sensations over lower back and groins. After clearing the needle with 2 ml of air, the needle is withdrawn.

Claudication distance:

Claudication distance was assessed using a standardized treadmill test using the Gardner et al. treadmill protocol, at a constant speed and incline.(14) Patients were instructed to walk until the onset of moderate-to-severe pain, at which point the distance covered was recorded as the initial claudication distance. This measurement was obtained prior to procedure and compared with follow-up assessments at 1 week, 2 months, and 6 months post-LCS. Patients unable to perform the treadmill test due to non-ambulatory status were excluded from this assessment.

Two key parameters are recorded: Initial Claudication Distance (ICD)—the distance at which pain first appears—and Absolute Claudication Distance (ACD)—the total distance walked before stopping due to intolerable pain. Patients undergo pre-test preparation, including refraining from caffeine or nicotine, and are continuously monitored for heart rate, blood pressure, and pain levels.

Ankle-Brachial Pressure Index (ABPI)

ABPI was measured prior to procedureand at 1-month post-procedure using a handheld Doppler device. Systolic blood pressures were recorded at the brachial artery and posterior tibial/dorsalis pedis arteries of the affected limb. The ABPI was calculated as the ratio of ankle systolic pressure to brachial systolic pressure. Mean of three blood pressure measurements at each assessment was taken to reduce interobserver variability. Changes in ABPI were analyzed to assess improvements in limb perfusion following LCS.

Ulcer healing:

The Pressure Ulcer Scale for Healing (PUSH) tool was used for the objective assessment of ulcer healing over time. This validated tool tracked wound healing progress based on three key parameters: wound size measurement, exudate amount and tissue type in wound bed. Wound size was measured using a transparent grid. The longest length and widest perpendicular width were multiplied to estimate the total wound area. A score from 0 to 10 was assigned based on the wound size, 0 indicated closed wounds, scores 1 to 4 indicated smaller wound size (from 0.3 cm^2 to 2 cm^2) and 5 to 9 indicated larger wound size (from 2.1 to 24 cm^2). The amount of wound exudate was recorded before dressing changes. Exudate score was classified as 0 for no exudate, 1 for light, 2 for moderate and 3 for heavy exudate. Predominant tissue type at the ulcer bed decided the score for wound bed. Ulcers that are closed completely were given 0 score. Those with new pink epithelial tissue or with shiny skin were scored as 1. Ulcers with granulation tissue were scored as 2. Yellow/white slough with non-viable tissue at bed were assigned with score 3 and those with necrotic tissue (black, devitalized eschar) were assigned score 4.

Analysis: all continuous variables, such as age, ulcer area and ABPI were expressed as mean ± standard deviation (SD) for normally distributed data. Ulcer area and ABPI before and after the procedure was compared using paired t-test. All statistical tests were two-tailed, and p-values less than 0.05 were considered statistically significant.

Results

Overall, 28 TAO subjects were included in the study with mean age of 38.75 (± 2.85) years.

Claudication distance

There was a significant improvement in ICD and ACD over time, reflecting better walking ability. ICD increased from 45.86 m (pre-procedure) to 145.93 m at 6 months. ACD increased from 111.96 m (pre-procedure) to 211.14 m at 6 months, showing an 89% improvement. Major improvement occurred between 1 week and 2 months, with a steady increase thereafter (Figure 1).

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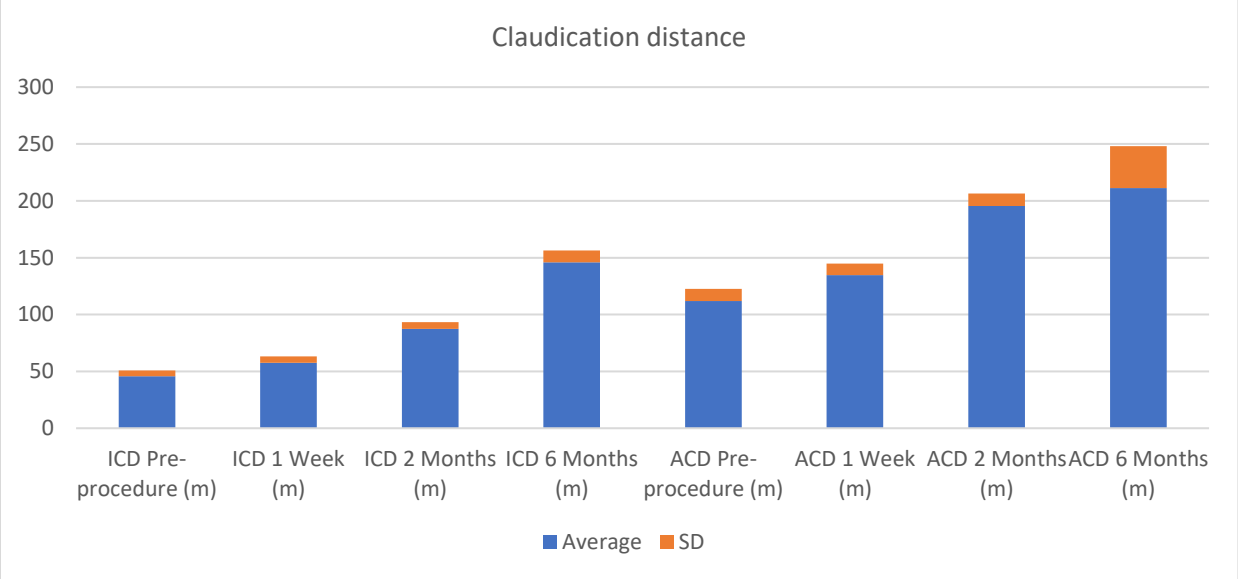

Figure 1: clustered column chart to show mean initial claudication distance (ICD) and absolute claudication distance (ACD) in meters among participants (n=28)

ABPI index: ABPI index improved significantly from pre-procedure level within 1 week (0.61 ± 0.03 vs 0.74 ± 0.03, p<0.001). Average ABPI index at 2 months and 6 months was 0.86 (± 0.03) and 0.91 (± 0.03) respectively which also showed statistically significant improvement in comparison to 1 week value (p<0.001).
Ulcer healing: out of 28 TAO subjects, 21 had different grades of non-healing ulcers at baseline. The details are compiled in table 2. Six subjects (28.6%) had completely healed ulcers (PUSH Score = 0) at 6 months. 15 subjects (71.4%) showed improvement but had residual ulcers. PUSH scores decreased significantly over time, indicating overall healing progress.

Table 1: Ulcer Location and PUSH Score Parameters Over Time (n=21)

Subject	Location of Ulcer	PUSH Score Parameters (1 Week)	PUSH Score Parameters (2 Months)	PUSH Score Parameters (6 Months)
1	Medial side of left great toe	7 (Size: 4.5 cm², Exudate: 2, Tissue: 3)	4 (Size: 1.8 cm², Exudate: 1, Tissue: 2)	0 (Closed)
2	Amputated site of right great toe	6 (Size: 3.8 cm², Exudate: 2, Tissue: 3)	3 (Size: 1.0 cm², Exudate: 1, Tissue: 2)	0 (Closed)
3	Dorsal aspect of second toe, right foot	8 (Size: 6.2 cm², Exudate: 3, Tissue: 3)	5 (Size: 2.6 cm², Exudate: 2, Tissue: 2)	2 (Size: 0.5 cm², Exudate: 1, Tissue: 1)
4	Heel, left foot	9 (Size: 10.5 cm², Exudate: 3, Tissue: 4)	7 (Size: 5.1 cm², Exudate: 2, Tissue: 3)	3 (Size: 1.2 cm², Exudate: 1, Tissue: 2)
5	Lateral side of right heel	7 (Size: 4.2 cm², Exudate: 2, Tissue: 3)	5 (Size: 2.3 cm², Exudate: 1, Tissue: 2)	1 (Size: 0.2 cm², Exudate: 0, Tissue: 1)
6	Dorsum of left foot	8 (Size: 6.8 cm², Exudate: 3, Tissue: 3)	6 (Size: 3.5 cm², Exudate: 2, Tissue: 2)	2 (Size: 0.7 cm², Exudate: 1, Tissue: 1)
7	Dorsum of right foot	7 (Size: 5.0 cm², Exudate: 2, Tissue: 3)	4 (Size: 1.9 cm², Exudate: 1, Tissue: 2)	0 (Closed)
8	Tip of left great toe	6 (Size: 3.9 cm², Exudate: 2, Tissue: 3)	3 (Size: 1.1 cm², Exudate: 1, Tissue: 2)	0 (Closed)
9	Lateral aspect of right second toe	8 (Size: 7.2 cm², Exudate: 3, Tissue: 3)	6 (Size: 3.7 cm², Exudate: 2, Tissue: 2)	3 (Size: 1.3 cm², Exudate: 1, Tissue: 2)

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10	Medial malleolus, left foot	9 (Size: 9.1 cm², Exudate: 3, Tissue: 4)	7 (Size: 5.5 cm², Exudate: 2, Tissue: 3)	4 (Size: 2.0 cm², Exudate: 1, Tissue: 2)
11	Plantar aspect of right great toe	7 (Size: 4.7 cm², Exudate: 2, Tissue: 3)	5 (Size: 2.5 cm², Exudate: 1, Tissue: 2)	1 (Size: 0.2 cm², Exudate: 0, Tissue: 1)
12	Heel, right foot	8 (Size: 7.5 cm², Exudate: 3, Tissue: 3)	6 (Size: 3.9 cm², Exudate: 2, Tissue: 2)	3 (Size: 1.2 cm², Exudate: 1, Tissue: 2)
13	Distal phalanx of left great toe	6 (Size: 3.7 cm², Exudate: 2, Tissue: 3)	4 (Size: 1.8 cm², Exudate: 1, Tissue: 2)	0 (Closed)
14	Dorsum of left foot near metatarsal head	7 (Size: 5.2 cm², Exudate: 2, Tissue: 3)	4 (Size: 2.0 cm², Exudate: 1, Tissue: 2)	1 (Size: 0.3 cm², Exudate: 0, Tissue: 1)
15	Lateral malleolus, right foot	9 (Size: 9.8 cm², Exudate: 3, Tissue: 4)	6 (Size: 4.3 cm², Exudate: 2, Tissue: 3)	2 (Size: 0.6 cm², Exudate: 1, Tissue: 1)
16	Ventral surface of right great toe	8 (Size: 7.0 cm², Exudate: 3, Tissue: 3)	6 (Size: 3.6 cm², Exudate: 2, Tissue: 2)	3 (Size: 1.1 cm², Exudate: 1, Tissue: 2)
17	Dorsal aspect of left second toe	7 (Size: 4.8 cm², Exudate: 2, Tissue: 3)	5 (Size: 2.3 cm², Exudate: 1, Tissue: 2)	0 (Closed)
18	Posterior aspect of right heel	9 (Size: 10.2 cm², Exudate: 3, Tissue: 4)	7 (Size: 5.6 cm², Exudate: 2, Tissue: 3)	3 (Size: 1.5 cm², Exudate: 1, Tissue: 2)
19	Dorsum of right foot near ankle	8 (Size: 7.3 cm², Exudate: 3, Tissue: 3)	6 (Size: 3.8 cm², Exudate: 2, Tissue: 2)	3 (Size: 1.2 cm², Exudate: 1, Tissue: 2)
20	Medial side of right great toe	7 (Size: 4.9 cm², Exudate: 2, Tissue: 3)	5 (Size: 2.4 cm², Exudate: 1, Tissue: 2)	1 (Size: 0.3 cm², Exudate: 0, Tissue: 1)
21	Lateral malleolus, left foot	8 (Size: 6.9 cm², Exudate: 3, Tissue: 3)	6 (Size: 3.5 cm², Exudate: 2, Tissue: 2)	2 (Size: 0.7 cm², Exudate: 1, Tissue: 1)

Discussion:

This study evaluated the clinical outcomes of lumbar chemical sympathectomy in patients with TAO, focusing on improvements in claudication distance, ABPI, RI, and ulcer healing. The findings demonstrate significant and sustained benefits in walking ability, perfusion indices, and wound healing over a six-month follow-up period.

One of the key findings of this study is the significant improvement in both ICD and ACD. ICD increased from 45.86 m at baseline to 145.93 m at six months, while ACD improved from 111.96 m to 211.14 m, representing an 89% increase. These results align with previous studies that have shown sympathectomy to be beneficial in improving walking ability in patients with severe ischemic pain.(15,16) The greatest improvement was observed between one week and two months post-procedure, suggesting that the early effects of chemical sympathectomy contribute to vascular relaxation and increased collateral circulation. This improvement continued steadily up to six months.

ABPI, a reliable indicator of arterial perfusion, showed a significant increase from 0.61 ± 0.03 preoperatively to 0.74 ± 0.03 at one week ($p<0.001$), with further improvements to 0.86 ± 0.03 at two months and 0.91 ± 0.03 at six months. These findings indicate that sympathectomy effectively enhances limb perfusion, potentially by reducing sympathetic vasoconstriction and improving collateral blood flow. The improvement in ABPI over time further supports the hypothesis that sympathectomy contributes to sustained vascular changes rather than just transient relief. ABPI improvement post chemical sympathectomy is reported in earlier studies.(17,18) In a study Rashid and Jamil have shown that among 105 subjects who underwent chemical sympathectomy, pain relief was maximum in patients with ABPI of 0.3 or more.(19) In our study, none of the subject had 0.3 or less ABPI.

Ulcer healing was another critical parameter assessed in this study. Among 21 subjects with non-healing ulcers at baseline, six patients (28.6%) achieved complete ulcer closure by six months. The remaining 15 (71.4%) demonstrated significant improvements in PUSH scores, indicating progressive wound healing. The consistent decrease in PUSH scores suggests that sympathectomy facilitates tissue healing by improving local perfusion, reducing ischemic pain, and promoting angiogenesis. The results reinforce the role of sympathectomy as a valuable adjunct to wound management in TAO patients with chronic ischemic ulcers. The outcomes of the present study are inline with similar studies in the past.(10,20)

Limitations of the study: As a retrospective study, it is subject to potential biases in data collection and completeness. This study included only 28 TAO patients, which limits the generalizability of the findings. Other concurrent treatments (e.g., medications, lifestyle changes) may have influenced the results.

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Conclusion:
This study provides strong evidence that sympathectomy is a beneficial intervention for TAO patients with chronic ischemic pain and non-healing ulcers. The significant improvements in claudication distance, ABPI and ulcer healing demonstrate the efficacy of CT-guided lumbar sympathectomy in enhancing lower limb perfusion. Future research should focus on larger, prospective studies to further validate these outcomes and optimize patient selection criteria for the procedure.

Conflict of Interest: authors declare no conflict of interest.

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