Chapter 4

Chemical Neurolysis and Radiofrequency Ablation of Lumbar Sympathetic Ganglion in Peripheral Vascular Diseases of the Lower Limbs

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Abstract

Peripheral vascular diseases (PVD) with impaired circulation is prevalent in 40-60% of Asian population. The resulting ischemic manifestations are cold lower extremities, claudication, discoloration, nonhealing ulcer/ gangrene of toes. Risk factors are atherosclerosis, hypertension, scleroderma, diabetes, dyslipidemia and thromboembolism or it may be associated with chronic regional pain syndrome (CRPS). Thromboangitis-obliterans (TAO) or Berger's disease affects very young/ adult smokers. On Doppler ultrasonography, there is reduced/absent flow in peripheral arterial system usually in iliofemoral, popliteal, tibialis posterior and dorsalis Pedi's artery in patients with ischemic lower limb. Major presenting symptoms are moderate to severe pain in the limbs, affection of sleep and significant work disability. Over last 5-6 decades, lumbar sympathetic ganglion block (LSGB) has become a technique of choice over complex surgical sympathectomy in managing ischemic limb ulcers. Chemical neurolysis of lumbar sympathetic ganglion using alcohol or phenol is a well-established method for prolonged effects especially in patients with limb ulcers. Currently radiofrequency (RF) ablation of lumbar sympathetic ganglion (LSG) is considered to be safe and effective option but have concerns of high cost and availability. This review is supported by information's obtained from current literature search in PubMed, Science Direct and Google for similar research work. The aim is to provide an overview of efficacy and safety of RF ablation and chemical lumbar sympatholytic for the management of ischemic limbs.

Keywords: Peripheral vascular diseases; Lumbar sympathetic ganglion block; Chemical neurolysis; Radiofrequency ablation

I. Introduction

Lumbar sympathectomy is indicated in the treatment of PVDs causing ischemic claudication or rest pain in legs due to Buerger's disease, chronic regional pain syndrome (CRPS type I,II), hyperhidrosis, Paget's disease of the bone, thromboembolic phenomena, diabetic ulcers and neuropathy pain, acute herpes pain, chronic pancreatitis, malignant visceral pain and pain due to lumbar disc diseases.

Lumbar sympathetic ganglia are present from L2 to L5 paravetebral region where blocking of L2-L3 ganglia blocks the sympathetic fibers of the lower extremities and produces vasodilatation. There are surgical and nonsurgical options available for the treatment of ischemic pain and non-healing ulcers. Surgical sympathectomy causes lot of trauma and tissue damage, chemical sympathectomy may harm surrounding vital tissue due to drug diffusion but still popular method of neurolysis. Currently radiofrequency (RF) ablation is gaining popularity for lesser incidence of complications. Lumbar sympathetic ganglion block (LSGB) with local anaesthetics (LA) or with adjuvants like alpha 2 agonists clonidine, opioids, NMDA receptor antagonist ketamine, steroids or botox are used to prolong the pain relieving effects. A diagnostic LSGB with LA followed by neurolysis of lumbar sympathetic chain was considered to be safe and useful method over invasive operative procedure [1,2]. During1930s-1950s chemical lumbar sympathectomy was widely used in treating occlusive arterial disease of the lower limbs as an alternative to amputation [3]. Sympathetic denervation results in increased blood flow, improves the collateral circulation and nutritive value of blood flow and thus decreases the pain transmission [4,5]. An alternative to chemical neurolysis is thermal destruction by using RF currents to destroy the sympathetic ganglion which is currently recommended technique as it increases precision and safety [6]. However availability of RF machine and the cost of treatment is still a major concern in undeveloped areas.

2. History of Chemical Sympathectomy

Felix Mandl first described the Selheim's technique of lumbar sympathetic plexus block in 1924. He used 6% phenol at cervical ganglion in cats and suggested phenol for permanent sympathectomy [7]. A Boston surgeon James White in 1935 used 95% alcohol to destroy sympathetic chain for hyperhidrosis of extremities. Dr. White in 1944 injected lipiodol following alcohol to visualize the position of needle in antero-posterior (AP) and lateral (LAT) spinal X-ray films. Later Alexander in 1947 used contrast media before injection of neurolytic solution and Boas in 1976 used radio-opaque neurolytic solution to confirm the needle position and spread on fluoroscopy and that became a routine procedure. In 1949 British surgeon H A Huxton published a report of use of 10% phenol to destroy sympathetic ganglion in patients with occlusive arterial disease of lower limbs with good success [8]. PVD in elderly patients having comorbidities are at significant risk for surgical sympathectomy where chemical sympathectomy with phenol was reported to be safe as well as effective method and the results were comparable to surgical treatment. Multiple needle technique under fluoroscopic control for accurate needle placement was widely used and described [9,10]. Later it became a procedure of choice for treatment of critical limb ischemia Reid and colleagues [9] described a lateral approach and Mandl [1] initially reported a classical paramedian approach in prone position which are still the preferred method. Reid et al [9] later described a single needle technique and he found it useful in most of the cases. Richard Rauck observed better spread with two needle technique (at L2 and L3) however no difference in efficacy reported with the use of one, two or three needle approaches on comparative study [2]. Dondelinger et al [11] in 1984 using phenol and Zagzag et al [12] in 1986 using alcohol, performed CT guided percutaneous chemical lumbar sympathectomy. They found no morbidity and concluded that CT guidance improves the precision in needle placement thus increases the safety. In 1991 Mayzlik et al. [13] performed chemical lumbar sympathectomy in 22 patients after surgical exploration with 7.5% phenol in glycerin and noted no intra/post-operative complications with significant long term benefit in relieving pain and promoting ulcer healing. Alexander performed fluoroscopic guided chemical neurolysis in 544 patients (with phenol in 489) and found improvement in signs and symptoms of limb ischemia in 72% of the patients [14]. Significant changes in cutaneous temperature as a clinical predictor of success of LSGB in patients with sympathetically maintained pain states has been studied and observed rise in temperature up to 3 degrees C [15]. Bhattarai et al. performed fluoroscopy- guided chemical sympatholysis with 3ml of 70% alcohol at two level L2 & L3 each and found satisfactory results in terms of pain relief and healing of ulcers in patients with ischaemic lower limb ulcers [16]. Gliem et al. observed improvement in claudication and increase in the walking distance in thirty patients with proven PVD who were treated with lumbar neurolytic sympathetic blockade using 95% ethanol [17].

3. History of Radiofrequency (RF) ablation of LSG

The use of RF ablation for sympathetic nerves has been reported by Pernak J who first presented this technique of RF electro coagulation of sympathetic nerves. The first presentation of this technique took place at the 1st International Symposium ‘The Pain Clinic (Delft, 1984). In which 210 patients with obvious sympathetic hyperactivity was one of the criteria, percutaneous RF was performed and the results were described in the Proceedings of symposium (Pernak and V.D. Berg, 1985) [18]. Percutaneous RF ablation of sympathetic ganglion is an alternative method of sympathectomy for longer duration that is currently recommended technique of choice in the treatment of ischemic limbs to improve circulation for healing of ulcers and pain relief. It is less associated with neuroma formation and complications like neuralgias [19]. The technique evolved in three phases over period of fifteen years, to reduce the early and late failures. Wilkinson performed 148 unilateral and bilateral RF in 110 patients suffering from hyperhidrosis, Raynaud's disease, vascular occlusions, reflex sympathetic dystrophies [20]. In clinical practice although needle position is confirmed on fluoroscopy injection of contrast in psoas muscle is observed frequently and can cause genito-femoral neuralgia following chemical or RF ablation of LSG [21].

4. Surgical Sympathectomy

Based on the fact that sympathetic overactivity is responsible for vasoconstriction proximal to the occluded vessels in thromboangiitis obliterans (TAO) and arterio- sclerotic PVDs, where the trauma from the damaged or occluded wall of vessel is responsible for the vascular spasm. Sympathectomy eliminates the vasoconstriction proximal to the occluded vessel and permits maximal dilation of the collateral vessels. C Thomas in1959 published report of 138 surgical sympathectomies in 100 patients of PVDs performed at University of Mishigan Hospital from 1953-1956.A prior aortography /arteriogram and diagnostic lumbar sympathetic ganglion block was performed with local anaethetic drug. The patients had presented with gangrene of toes, intermittent claudication, rest pain, cold feet, atrophic changed in the feet, absent dorsalis pedis and/or popliteal pulsations and associated diabetes. Following surgical sympathectomy 52% patients had good and 17% patients had fair results in terms of wound healing and control of pain [22]. Becquemin etal. compared surgical lumbar sympathectomy of L2-5 ganglion with scanner guided phenolization with 6.7% phenol at L 3 &L4 level in 428 patients having severe ischemia and occlusion of leg arteries where bypass surgery was not feasible. They concluded that phenolization has similar results as that of surgical resection but with less morbidity and shorter hospital stay. However results in terms of limb conservation were disappointing as compared to distal bypass surgery [23]. Similar study by Holiday et al. where in 76 interventions done in 70 patients with surgical and chemical sympathectomy. The long term success rate were not significantly different, 47% for surgical and 45% for chemical lumbar sympathectomy and the complications were minor in both the groups. The study concluded that surgical treatment has limited role in the treatment of limb ischemia in patients without the option of vascular reconstruction [24]. Despite sympathetic discharge ischemia and exercise produces local metabolites that causes maximal vasodilatation. Hence there is no basis to use lumbar sympathectomy in patients with intermittent claudication but can be of help in the presence of ischemic ulcers. The toe temperature response following peripheral nerve block, transcutaneous oximetry (TcPO2) or ankle-brachial pressure index(ABPI) correlates best with effect of lumbar sympathecomy. However subsequent amputation may not be exempted as vasomotor tone normalizes in 2-6 weeks after operation. Reconstructive surgery may be the ultimate option in selected cases [25]. The magnitude of effects on blood flow and sympathetic activity after surgical and chemical sympathectomy are similar [26] with the advent of laparoscopic lumbar sympathectomy with omental transposition has been evolved later with interest [26-28].

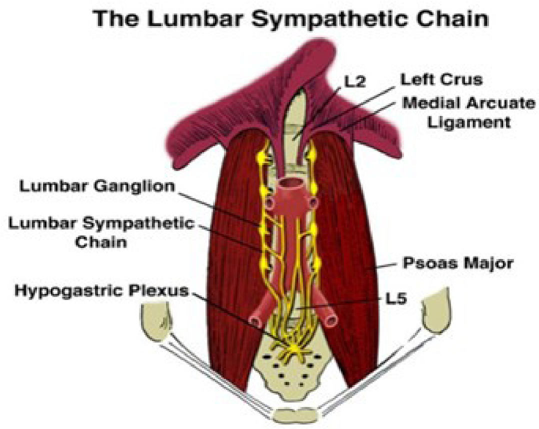

Figure 1: Anatomy of lumbar sympathetic chain

Lumbar sympathetic chain is located on the anterolateral surface of the L1to L4 vertebral bodies and medial to psoas muscles. Inferior vena cava lies just anterior to the right and aorta to the left of lumbar sympathetic chain of ganglion. There are four ganglions of size 3-5mm wide and 10-15mm in length. Occasionally there is fifth ganglion with the fusion of T12 and L1 ganglia. The chain consists of preganglionic axons and postganglionic neurons which pass through the L2 -L3 ganglia and joins all the major nerves of lumbar and lumbosacral plexus supplying the lower extremities.

5. Methods

1) Classical multiple needle technique described by Mandl & Kappis at L2/3/4 level [1] In prone position three needles are placed 5-8 cm lateral to spinous process of at L2, L3, L4. The 22G 12-15cm needle inserted at an angle of 70-80 degrees advanced until it hits the transverse process at a depth of 4-6cm,repositioned to slip off the transverse process for 2-3cm to lie on anterolateral border of vertebral body which is confirmed by dye study on fluoroscopy. In lateral Reid's approach needles are placed at 10-15cm from the spinous processes of L2, L3,L4 level,useful for neurolytic block for deposition of less quantity of solution and reduce neuralgic complications.

2) Double needle described by Boas et al,Rauk, and Reid et al.[1,2,9] Figure -2A shows anatomical correlation of technique of LSGB. Similar to above but at the distance of 7cm needles are inserted at L2 & L3 level. Under fluoroscopic guidance and dye study chemical

neurolysis with 3-5 ml of 95% alcohol or phenol (6-8%)is performed at each level.

3) Single needle Technique of Lumbar Sympathetic Ganglion Block (LSGB): Currently most popular method of choice of many pain interventionists. Fluroscopic guidance is used for neurolysis to confirm the needle position in AP and LAT view. In 1975 Brown et al. reported successful use of single needle technique [29] further supported by many others [9, 30, 31]. A significant complication of LSGB is interference with the function of genitofemoral (GFN) and lateral femoral cutaneous nerve (LFCN). A cadaveric study by Feigl et al. on two hundred and thirteen sides for nerve topography and distances of GFN and LCN from the L2/3,L3/4,L4/5 were measured and concluded that there is high chance of affection of these nerves at L3/4,L4/5 level than at L2/3 level [32].

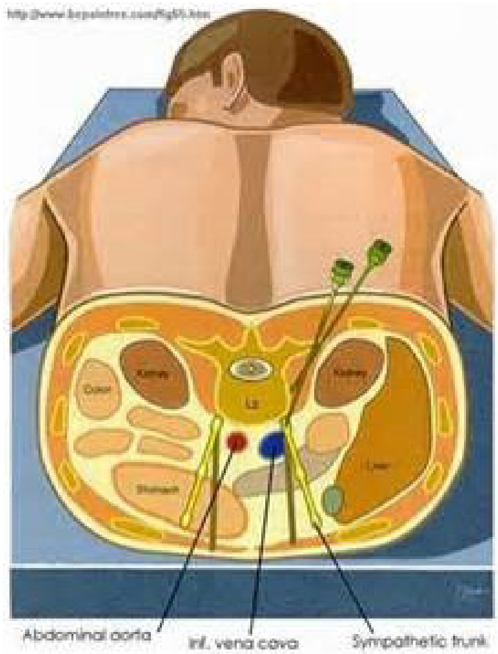

Figure 2: Anatomical correlation of Lumbar Sympathetic Ganglion Block (LSGB)

5.1. Method of radiofrequency of Lumbar sympathetic ganglion

Under fluoroscopic guidance 15mm RF cannula having 10mm active tip is introduced at L2,L3,L4 or L3,L4,L5 levels. At L2 level cannula is inserted along the middle and lower third of the vertebral body, at level of L3 at middle and upper third of vertebra and at L4 cannula is lined at the middle of vertebral body which corresponds to the position of lumbar sympathetic chain. The needle tip should lie upon the lateral aspect of vertebral body in fluroscopic AP view and confirmed in lateral view .After negative aspiration test the needles position again confirmed with 1ml of nonionic contrast and it's spread noted under fluoroscopy. Sensory and motor testing attempted with the active RF electrode by stimulation with 50HZ and 2 HZ with 0.5 v and 1v respectively to check the sensory and motor response. If no response to this initial stimulation, then the injection of test dose 2ml of LA lignocaine at each point. There should be rise of temperature of 1-2 degrees C within five minutes in the affected limb to confirm the block effect. Later RF ablation is done at 80-90 degrees C for 90-180 sec. Three such lesions are carried out by advancement of the tip for 2-5 mm at each point [33].

5.2. Assessment methods

The effectiveness of the lumbar sympathetic block is assessed by subjective and objective tests. Subjective tests include amount of pain relief (reduction in VAS score) and sense of warmth in the limb, increase in the walking distance and sings of healing like change in colour of the limb, appearance of demarcation and reduction in size of the wound/ulcer/gangrene when compared between pre and post block [15-17]. Objective tests includes measurement of skin temperature before and after sympathetic block, blood flow measurement with Doppler flow meter and pressure records of ankle/brachial (ABI) and toe/brachial index (TBI). Sympathetic skin response (SSR) is a reflex to different stimuli that evoke hypothalamic activation and increased sweating and electrical conductivity which is measured as an SSR in response to application of a sensory stimulation using EMG machine. Thus provocative tests like sweat chloride tests, SSR test and vibratory perception threshold over affected toes and external malleolus of both sides are methods of objective assessment [34-36]. Infrared thermographic imaging and transcutaneous oxygen tension (TcPO2).Each test has specific utility and can be used in combination to obtain information about functional severity of PVD in patients with claudication [37-39]. Rooke et al. evaluated influence of sympathetic activity on TcPO2 in ischemic limb. They measured dorsal foot TcPO2 by oxygen-sensing electrodes with surface temperatures of 42 degree C and 45 degrees C. The vasodilatation Index TcPO2 at 42 degrees C /TcPO2 at 45 degrees C as an index of vasomotor tone was measured in normal, ischemic limb and after cooling the limb and concluded that TcOP2 can be used to assess the degree of vasomotor tone in the skin that increases as ischemia worsens. Warmth improves the cutaneous circulation in ischemic limbs [39]. Angiography has been used but difficult to predict the response. Doppler ultrasound can determine the pressure in the thigh and ankle. Ankle systolic pressure above 60mmHg and ABI >0.3 and patency of superficial femoral artery found to be successful predictive test. High correlation is observed between ABI and TcPO2. Transmetatarsal TcPO2 <30mmHg may result in amputation [26]. A study by Modesti et al. to evaluate TcPO2 as compared to strain guage plethysmography and with Doppler in assessment of initial PVDs in asymptomatic diabetics and in normal individuals. Significant correlation was seen between strain guage plethysmography and TcPO2, where as correlation with data from Doppler was lacking [40].

5.3. Our study

We conducted study on 150 patients of PVDs of lower limbs who underwent chemical LSGB (Group CH, n=50),RF ablation of LSG (Group RF, n=50) and RF + chemical LSGB (Group RF+CH, n=50) at our Institution over the period of last ten years.The inclusion criteria's were Buerger's disease with claudication /gangrene of toes, non-healing ulcers, atherosclerotic PVD, diabetic non healing ulcer or gangrene, chronic post thrombo-embolic vascular obstruction in lower limbs, scleroderma with gangrene of toes and patients with post amputation CRPS. To assess the circulation in the lower limb all were subjected to arterio-venous Doppler study or CT angiography of the lower limbs. Pre and post block visual analog score (VAS), walking distance (WD) in meters noted. Presence of arterial pulsations in femoral/popliteal/posterior tibial and dorsalispedis noted. Temperature of affected the limb and non affected or contra lateral limb measured. Informed consent for the procedure should be obtained following proper counseling of the patient and nil by mouth period of 6-8 hours was observed. Intravenous access for IV fluids and for anxiolysis midazolam 0.5-2mg with fentanyl 50 mcg was given . Monitoring for the vitals like pulse, NIBP, ECG, SPO2 started. Procedure is performed usually in prone position and a pillow is placed below the abdomen to obliterate the lardosis. As described by Reid and coworkers [9] we followed the single needle technique of LSGB atL2 or L3 vertebral level in prone position for four successive days with 10-15ml of LA Bupivacaine 0.25% **Figure 3A & Figure 3B**. For chemical neurolysis as described by Rauk, we used double needle method at L2 and L3 vertebral level. [2] On fifth day following injection of test dose of LA either 5 ml of 8% phenol or 95% alcohol was used for chemical neurolysis (n=50) at two levels L2 & L3.Half ml of air injected before removal of the needles and prone position maintained for half an hour to prevent posterior spread of solution and then patient made supine. Based on different Studies regarding use of RF for sympatholysis, it's comparison with chemical neurolysis and superior results with lesser complications, we aimed to study the efficacy of RF and of combined techniques i.e. RF with chemical LSGB using 8% phenol [18-21,41,42]. Thus next patients (n=50) underwent RF ablation of LSG with two needle technique at L2,L3 level using 22G 15cm RF Insulated needles having 10mm active tip. **Figure 4** Under fluoroscopy two RF needles were placed at the anterolateral border of L 2,L3 vertebra. After negative aspiration test 1ml of nonionic contrast and its spread noted under fluoroscopy. **Figure 5A and 5B**. Sensory and motor testing attempted followed by the injection of test dose 2ml of LA lignocaine at each point. Rise of temperature of 1-2 degrees C within 2-3 minutes in the affected limb measured to confirm the block effect. RF ablation at L2 and L3 level was done at 80-90 degrees C for 90-180 sec. Three such lesions were carried out by advancement of the tip for 2-5 mm. In other Group of RF+CH (n=50) after initial RF treatment at L2-L3 level chemical neurolysis of LSG with 5ml 8% phenol was carried out at each level. Later half ml of air injected before removal of the needles and prone position maintained for half an hour. Post block sensory and motor functions were checked after each block in all the patients of LSGB. IV fluids 10-20ml/kg of ringers lactate, antibiotic and analgesic like IV paracetamol 1 gm, fentanyl 50-100mcg were supplemented as necessary. Post block pentoxyphylline 400mg TID, Cilastozol 100mg BID, nifedipine 10mg OD and ecosprin 75 OD were continued and NSAIDs were given for 5-7 days. Complications like neuralgias were treated with oral analgesics, steroids and gabapentinoids. The incidence of immediate and late complications noted.

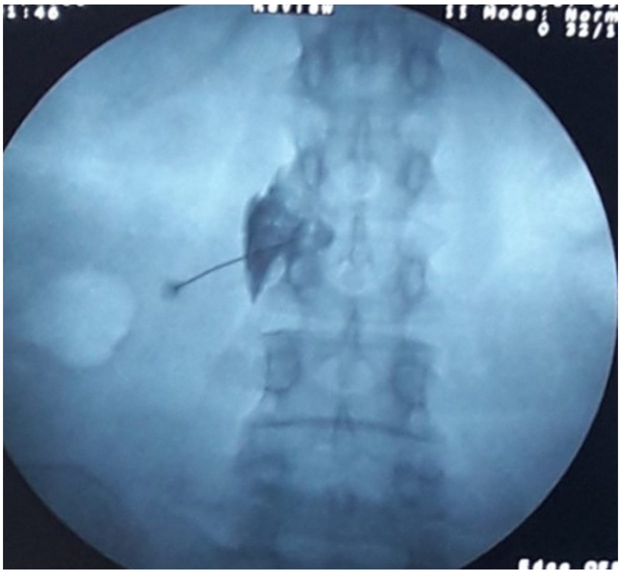

Figure 3A: Single needle LSGB-AP view

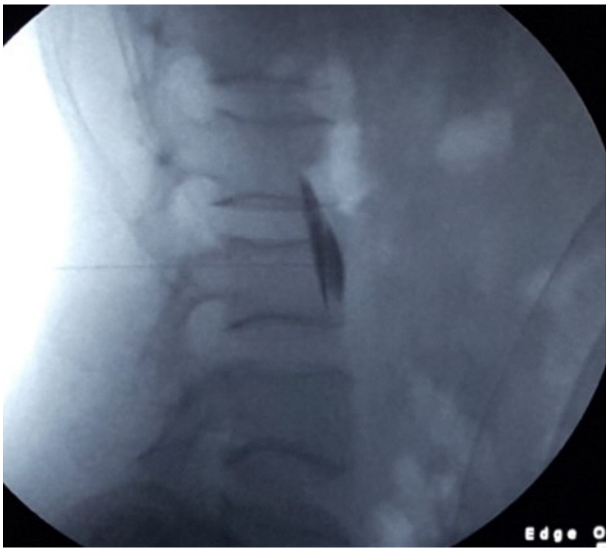

Figure 3B: Single needle LSGB LAT view

Figure 4: Fluoroscopy guided RF ablation of LSG

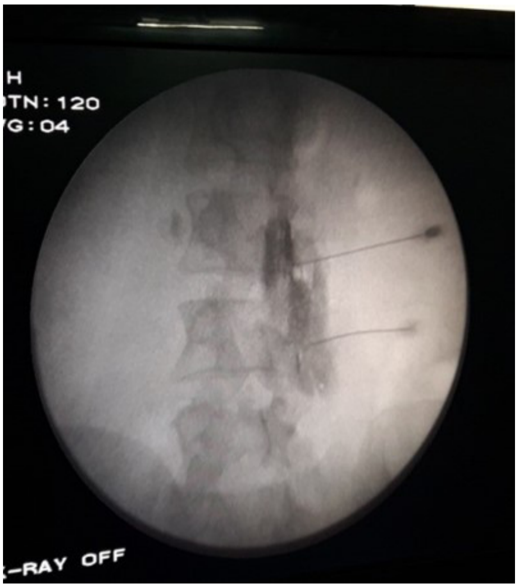

Figure 5A: RF ablation of LSG with two needle technique AP view

Figure 5B: RF ablation of LSG with two needle technique LAT view

5.4. Side effects and Complications of LSGB

The side effects are hypotension due to autonomic blockade usually responds to fluids and vasopressors. Bradycardia may be associated that can be managed with anticholinergics. Fever, chills, increased pain. Immediate complications like breathing difficulty, weakness in the limbs may be due to accidental spinal or epidural spread, so patients should be monitored closely, intravascular injection of the neurolytic solution and cardiac manifestations ,paralysis can be a rare complication. Headache may be due to inadvertent dural puncture. Bleeding due to major organ or vascular injury. Backache, neuralgia of genitofemoral or lateral femoral cutaneous nerve usually self limiting and responds to analgesics, gabapentinoids that recovers over 6-8 weeks period .Failure of ejaculation, necrosis of psoas muscle or sloughing of ureter are some of the rare complications [33]. Hence all patients should be closely monitored for the vitals and neurological examination should be carried out to rule out motor or sensory deficits. If discharged on the same day they are instructed not to drive and contact doctor if there is headache, fever chills, breathing difficulty or any other. Strict advice to stop further tobacco chewing and smoking needs to be given.

6. Discussion

Buerger's disease is an inflammatory disorder affecting medium sized vessels and adjacent nerves where smoking plays key role for the disease process leading to peripheral ischaemia. Chemical neurolysis of sympathetic ganglion using alcohol or phenol is a well-established method for prolonged effects especially in patients with limb ulcers. [5-10] It is also indicated in patients with diabetic lower limb ischemia's where the circulating norepinephrine concentration is higher in painful diabetic neuropathy as well as microvascular dysfunction due to hyperglycemia, dyslipidemia and currently LSGB has also been studied for pain due to lumbar disc diseases [26, 43-45]. RF ablation of sympathetic ganglion is considered to be safe and effective option but have concerns of availability and high cost of treatment. Hence chemical neurolysis is still a popular method in most of the pain management centers [10-17, 26,43,46]. RF therapy has two modes pulsed RF and thermocoagulation which targets nerve tissue by increasing temperature where unmylinated C nerve fibers get dissolved and become necrotic resulting in vasodilatation in lower extremities and long term pain relief improves numbness of neuropathies. However accuracy of targeted structure is extremely difficult and range of ablation is limited [42,47]. Manjunath et al. conducted a pilot study on 20 patients of CRPS type-I to compare the chemical neurolysis with 7% phenol and RF lumbar sympathectomy. Significant pain relief was present in both the groups without significant difference in mean pain scores between the groups [43]. Singh et al. conducted fluroscopic guided lumbar chemical sympathectomy using 8% phenol 8ml at L3 and L4 level following six successive blocks with LA in fifteen patients suffering from Buerger's disease with gangrene of toes. Significant improvement in VAS scores, WD and healing of toes observed in all the patients with each successive block .Thus he concluded that lumbar sympathetic block is very cost effective , safe and least invasive method for painful ischemic leg ulcers [48]. As the Buerger's disease progresses it results in amputation of gangrenous toes or limbs eventually leading to persistent post amputation pain and disability. Fifty such patients were studied by Usmani et al with chemical lumbar sympathectomy(n=25) and found significant reduction in development of phantom limb pain, VAS score ,quality of life compared to control group(n=25).[49] Recently combined chemical neurolysis and RF ablation of lumbar sympathetic ganglion is also studied in PVDs with diabetic peripheral neuropathy [41,42]. Chemical lumbar sympathectomy has been used for control of severe pain due to CRPS of lower limbs [49,50]. Different adjuvants like triamcenalone or botulium toxin are used for control of pain due to diabetic neuropathy and CRPS [15,49]. Both chemical neurolysis and RF sympathectomy are established techniques but there are limited studies to establish significant advantage of prolonged effects with RF over chemical neurolysis [19,43.] Hence combined methods are studied as by Dhafir A et al. who used pulsed RF with phenol at three levels (L2,L3,L4) for lumbar sympathectomy in a case of CRPS and found satisfactory result [41]. Yuanyuan Ding et al. conducted comparative study with CT guided chemical Vs RF Vs RF with chemical (anhydrous ethanol) lumbar sympathectomy at L2 &L3, for 30 patients in each group in patients with diabetic peripheral neuropathy and found it safe effective with better results in terms pain relief and duration and patients satisfaction in combined treatment group (RF+chemical) [42] In our study who underwent chemical LSGB (Group CH, n=50),RF ablation of LSG (Group RF, n=50) and RF + chemical LSGB (Group RF+CH, n=50) we too observed improvement in VAS scores, WD and temperature rise in the affected limb at one week in all the groups when compared with values before LSGB. There was good response to the treatment in all the groups but more satisfactory in combined LSGB group of patients when observed for the course of wound healing following LSGB [51]. The patients suffering from CRPS who are refractory to conventional treatment or chemical/ RF ablation, spinal cord stimulation is recommended to improve pain and dysfunction [52]. Different approaches of insertion of needle are experimented for minimizing the vascular and organ injury, one of them is extraforaminal paradiscal two needle technique where initial target point for needle entry is lateral most tip of the transverse process advanced to so that needle tip lies just posterior to the anterior border of the vertebral body. Another transdiscal technique is described to avoid complications of paramedian approach but chances of discitis, nerve root injury disc herniation or rupture increases [53,54]With the introduction of ultrasound(USG) indications have been expanding for the interventions to the deeper structures.USG provides many benefits like avoidance of radiation that occurs with fluoroscopy , prevention of vascular injection by visualizing the spread of injectate with real time US scan thus reducing the procedure time. This method may be of help for diagnostic use of LSGB on outpatient basis. The celiac plexus block and superior hypogastric plexus block have also been tried with ultrasound guidance [55,56]. Ryu et al conducted USG Vs fluoroscopy guided LSGB in fifty patients of PVDs with sympathetically mediated pain .Procedure time and success rate were not significantly different in two groups although procedural time was longer with USG technique but onset time was faster [57]. Punj et al performed USG guided with out of plane approach, using insulated 15cm 22G stimulation needle to visualize contractions of quadripceps and psoas muscle contractions on USG. [58] The newer modalities like spinal cord stimulation or surgical revascularization are claimed to have better outcomes but at present very costly and beyond reach of many centers [59,60].

Conflict of Interest: The authors declare that there is no conflict of interest regarding the publication.

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