Painful Diabetic Peripheral Neuropathy: Evaluation of Combined Radiofrequency and Chemical Blockade of Multi-segmental Lumbar Sympathetic Ganglia

SCIENCE Clinical Research

Key Take-Away:

Radiofrequency thermocoagulation connected with anhydrous ethanol (AE) chemical blockade of the Multi-segmental Lumbar Sympathetic Ganglia was safe and effective. Nevertheless, the details underlying analgesic mechanisms still need to be investigated.

As the quality of life is improving, the incidence of diabetes is increasing. Epidemiologists have suggested that the global prevalence of diabetes will reach 552 million by 2030. The rise in the incidence of diabetes leads to an increase in the rate of its complications. Diabetic neuropathy is one of the most critical and common complications of diabetes that accounts for 50% of diabetic neuropathy, and the extent of painful diabetic peripheral neuropathy (PDPN) is 13%-26%. PDPN strictly affects the quality of life and is difficult to manage, so there is an urgent need for new cost-effective treatment methods. The various targets for management approaches of PDPN are 2-6 pairs of lumbar sympathetic ganglia (LSG). The inhibition of L2 and L3 LSG blocks the sympathetic fibres of the lower extremities and dilates blood vessels; L2 ganglia also plays an integral role in this process.

Moreover, the position of LSG also varies; the L2 sympathetic ganglia are mainly present in the lower one-third of the L2 vertebrae and upper one-third of the L3 vertebrae; thus a multi-segment treatment is required while targeting these regions. Traditional LSG blockades constitute surgical or chemical sympathectomy. Surgical sympathectomy can lead to trauma and tissue, whereas chemical sympathectomy can cause harm to the surrounding vital tissues and organs due to drug diffusion.

Radiofrequency therapy constitutes two methods: radiofrequency thermocoagulation and pulsed radiofrequency.

Radiofrequency thermocoagulation lumbar sympathectomy targets the nerve tissue by increasing the temperature and has been shown to be another effective treatment approach. The unmyelinated nerve fiber C-axis axons get dissolved and become necrotic due to local high temperature. It maintains a state of vasodilatation in lower extremities, increases peripheral blood flow, improves symptoms such as numbness induced by nerve injury of lower limbs, and generates long-term pain relief. However, the validity of punctured target selection is difficult, and the range of ablation is limited. PDPN treatment demands the use of comprehensive treatment. No studies are examining the combination of chemicals and radiofrequency for PDPN.

Rationale behind research

- The previous studies have indicated the use of single chemical or single radiofrequency treatment approaches for destroying LSG, but there is a lack of studies that examine the combination of chemicals and radiofrequency for PDPN. Therefore, this research has been conducted to determine the efficacy of a combination of radiofrequency thermocoagulation and anhydrous ethanol (AE) chemical blockade of LSG for the treatment of PDPN.
Objective

The present research investigated the efficacy of a combination of radiofrequency thermocoagulation and anhydrous ethanol (AE) chemical blockade of LSG for the treatment of PDPN, by comprehensively assessing their clinical effectiveness and safety.

Methods

• Study outcomes

○ Patient demographic characteristics were studied at baseline
○ Other outcomes studied were necessary preoperative conditions, visual analogue scale (VAS), the total remission rate (TRR), skin temperature (ST) and the improvement of numbness and hyperalgesia in the lower extremities, complications, and degree of satisfaction (DOS) before and after surgery
○ Time Points: 1M, 3M, 6M, and 1Y

Outcomes

i. Baseline: There were no significant differences observed at baseline
ii. Study outcomes:

○ There was a considerable decrease seen in postoperative VASs compared to preoperative VASs in all groups
○ There was an increase observed in VAS scores in group A after three months, in group B after six months when compared with VAS scores in other groups at three months (3M), six months (6M) and one year (1Y)
○ There were significant differences observed in TRR in group C as compared to groups A and B. TRR in group A, group B and group C at 1Y after an operation was 66.7%, 73.3% and 93.3%, respectively (Fig:2)
○ There were no significant differences observed in higher ST in the lower extremities after surgery in all the groups compared to peroration (P<0.05)
○ There was an improvement in the incidence of the numbness and hyperalgesia in all three groups after surgery compared to preoperational time. The numbness in group C was significantly higher as compared to groups A and B. No severe complications were observed.
○ The degree of satisfaction was higher in group C as compared to groups A and B at a period of 6M and 1Y after surgery.

Discussion

Conclusion

The results of the study found that pain symptoms repeatedly appeared in the AE group after 3M,
gradually becoming worse with the prolongation of time. These results were consistent with the studies reported by Jackson and Gaeta, and it might be related to the regeneration of nerves using the AE. The incidence of complications was significantly reduced under visual guidance, but the permanent damage of the genitofemoral nerve or lateral femoral cutaneous nerve can readily occur due to the fluidity of damage agent and variation of the neural pathway, leading to acute renal failure in severe conditions. In this study, four cases of genitofemoral nerve damage occurred, which got resolved after conservative treatment. The maintenance of pain relief for a short period and a higher incidence of complications restrict the use of CLS.

CT-guided radiofrequency thermocoagulation of LSG has various benefits like clear images, an accurate target position for puncture, scanning, and confirming the location of needlepoint position. It helps to avoid injury and sensory and motor neurological tests that can further stop the occurrence of complications. It can also be performed repeatedly. Although, there are high requirements for accuracy of nerve target the number and location of lumbar sympathetic ganglia mainly vary with the absent division of sympathetic stem and communicating branches. It can result in incomplete nerve ablation, where the degree of ablation is affected by temperature, location and action duration. So, there is no stability in the effect of simple radiofrequency ablation of LSG. In this study, the analgesic effect in the radiofrequency group in the early stage was found to be lower as compared to the AE group and the combination group. The combination group (group C) was better in achieving an analgesic effect for up to 1 year, and its 1-year total effective rate was also higher as compared to the other two groups (groups A and B). The remission rate of numbness symptoms in the late stage was also superior to the other two groups, with higher satisfaction and fewer complications than the AE group. There was no significant difference found in skin temperature between the three groups which indicates that symptom relief was not merely attributed to expansion of blood vessels to improve circulation in group C. Various studies have shown that disruption of lumbar sympathetic nerve cells can regulate the regeneration of cutaneous vascular cells due to inhibition of the proliferation of parietal cells and increased expression of angiopoietin-1. It can also reduce the inflammatory reaction in the sympathetic nerve denervation area, decrease the adrenergic release in the dorsal root ganglion, inhibit sympathetic activity by stimulating α2-adrenergic receptors and upregulating α2-adrenoceptors,31 inhibit spinal microglia activation and reduce the expression of inflammatory cytokines (IL-1β, IL-6, and TNF-α). Thus, the mechanisms of sympathetic nerve blockade inducing pain relief are complex, and there is a need for further analysis in this area. At last, it can be concluded that multi-segmental AE combined with radiofrequency thermocoagulation blockade of LSG can be precisely positioned, reduce complications and can be helpful in achieving long-term analgesic effects.

Diagnostic, Diabetic Neuropathy, Lower Limbs, Retrospective Comparative Study, Maintenance, Effi-cacy, Safety, VAS scale