Observational Study

Medicine

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Comparison of lidocaine and ropivacaine stellate ganglion blockade in treating upper limb postherpetic neuralgia

Zhouhong Fan[a], Xin Zheng[b], Dongbai Li[b], Haopeng Chen[b], Lingchao Li[b,*]

Abstract

To provide a basis for treating postherpetic neuralgia (PHN), we compared the efficacy of lidocaine and ropivacaine stellate ganglion block (SGB) in PHN treatment in the upper limbs.

Data from 252 patients with upper-limb PHN were retrospectively analyzed. The lidocaine group (n = 118) was treated with oral pregabalin capsules 75 mg twice a day, tramadol hydrochloride sustained release tablets 100 mg twice a day, and amitriptyline 25 mg once at night combined with ultrasound-guided lidocaine SGB; the ropivacaine group (n = 134) was orally administered the same medicines combined with ultrasound-guided ropivacaine SGB. The visual analog scale (VAS), self-rating anxiety scale (SAS), and adverse reactions were compared between the groups before treatment and at 1 week, 1 month, and 3 months after treatment.

There were no significant differences between the lidocaine and ropivacaine groups in terms of sex, age, height, weight, and pain duration ($P > .05$). There was no significant difference between the groups in VAS and SAS scores before treatment ($P > .05$). At 1 week, 1 month, and 3 months after ultrasound-guided SGB treatment, the VAS and SAS scores were significantly lower in the ropivacaine group than in the lidocaine group ($P < .05$). There were no significant differences between the groups in terms of adverse reactions ($P > .05$).

For ultrasound-guided SGB treatment of upper limb PHN, ropivacaine is superior to lidocaine. Ultrasound-guided ropivacaine SGB is safe and effective for the treatment of upper limb PHN.

Abbreviations: NE = norepinephrine, NGF = nerve growth factor, PHN = postherpetic neuralgia, SAS = self-rating anxiety scale, SGB = stellate ganglion block, VAS = visual analog scale.

Keywords: lidocaine, postherpetic neuralgia, ropivacaine, stellate ganglion

1. Introduction

Postherpetic neuralgia (PHN) is the pain caused by herpes zoster that recurs or persists for more than 1 month after the characteristic rash resolves.[1] The incidence of herpes zoster worldwide is approximately 3% to 5% per year;[2] the incidence of PHN is 9% to 34% in herpes zoster patients, and 25% to 50% in herpes zoster patients over 50.[3] Herpes zoster is common in the elderly, and its most common complication is PHN. PHN often occurs in the unilateral chest, accounting for approximately 50% of cases, and rarely in the upper limbs (<1%).[4] Treatment of upper limb PHN is challenging because of the motor function involved.

There are many treatments for PHN, including medications, nerve block, radiofrequency, and electrical nerve stimulation [5]; however, some patients experience inadequate therapeutic effects. These patients suffer from PHN for long periods and lose the ability to work, severely affecting their quality of life. Suicidal ideation has been reported to cause considerable burden on families and society.[6] Currently, the outcomes of PHN are not optimistic, and the prevention and treatment of PHN

The ethics committee of the Second Hospital of Dalian Medical University approved the study (No. 2021039).

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The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

[a] *Department of Pain, Yichun People's Hospital, Yichun, Jiangxi Province, PR China,* [b] *Department of Pain, The Second Hospital of Dalian Medical University, Dalian, PR China.*

[*] *Correspondence: Lingchao Li, Department of Pain, The Second Hospital of Dalian Medical University, No. 467 Zhongshan Road, Shahekou District, Dalian 116000, PR China (e-mail: lilingchaottk@163.com).*

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are generally inadequate. However, ultrasound-guided stellate ganglion block (SGB) has been used to treat PHN of the head, face, neck, and upper limbs and has achieved good results.[7]

Lidocaine and ropivacaine are amide local anesthetics used in a variety of nerve block treatments. Ropivacaine is a long-acting local anesthetic, and its action time is longer than that of lidocaine.[8] At present, there are no reports comparing the efficacy of lidocaine and ropivacaine SGB in the treatment of upper limb PHN. Therefore, we compared the efficacy of these local anesthetics and adverse reactions for SGB in treating upper extremity PHN using a retrospective analysis to provide a basis for treatment.

2. Methods

2.1. General information

We retrospectively analyzed the clinical data of 252 patients with upper extremity PHN (from November 2017 to August 2021) seen in the outpatient and inpatient pain departments of the Second Hospital of Dalian Medical University. The group included 123 men and 129 women, aged 52–83 years (mean 67 ± 5.1 years). The pain duration ranged from 1 to 3 months (mean 1.91 ± 0.32 months), and all patients had unilateral upper limb disease ($P > .05$) (Table 1). The patients were divided into a lidocaine group (n = 118) and a ropivacaine group (n = 134). The diagnoses were based on the diagnostic criteria, PHN, defined as pain persisting more than 1 month after the onset of the rash in the same affected area.[1] The ethics committee of the Second Hospital of Dalian Medical University approved the study (No. 2021039).

2.2. Selection criteria

The inclusion criteria were as follows: the pain duration was 1 to 3 months; the skin lesion had subsided while neuropathic pain remained; the visual analog score (VAS) was 7 to 10 (severe pain), and Self-Rating Anxiety Scale (SAS) was no less than 50 (patients with anxiety). The exclusion criteria were as follows: puncture site infection at systemic infection, allergy to lidocaine or ropivacaine, presence of malignant tumors or other chronic pain diseases, and mental disorders.

2.3. Treatment methods

Patients in both groups were treated with ultrasound-guided SGB based on oral pregabalin capsules (Chongqing Saiwei Pharmaceutical Co., Ltd, China) 75 mg twice a day, tramadol hydrochloride sustained release tablets (Mengdi Pharmaceutical Co., Ltd, China), 100 mg twice a day, and amitriptyline (Hunan Dongting Pharmaceutical Co., Ltd, China) 25 mg once at night.

The course of treatment was ultrasound-guided SGB once daily for 10 days. The patients were placed in the supine position, with their head leaning to the healthy side. The operating area was disinfected and covered with a sterile sheet. A high-frequency ultrasound probe (Philips, model: sparq) was coated with a coupling agent, placed in a medical sterile protective cover, and then moved from the clavicle to the head end. When the ultrasound revealed the "sofa sign," the strong echo at the highest point was the posterior nodule of the C7 transverse process (the C7 transverse process has no anterior nodule). Ultrasound-guided needle insertion was performed in-plane in real time, and the needle tip reached the lateral inferior common carotid artery on the surface of the longus colli muscle at the C7 level. The study has shown that the success rates of 4 mL volume for sympathetic blockade were similar to 6 mL volume and 8 mL volume, while the incidence of side effects increased with the increase in drug solution volume; therefore, we chose 4 mL of drug solution was slowly injected when no blood was drawn back.[9] Ultrasound image showed that the injected local anesthetics locally remained and did not spread to the brachial plexus due to the small volume of local anesthetics and accurate injection under ultrasound guidance. If Horner's syndrome occurred and skin temperature increased in the hand on the treated side following SGB, the SGB was deemed successful. The lidocaine group was injected with 1% lidocaine [9] (Hubei Tiansheng Pharmaceutical Co., Ltd, China), and the ropivacaine group was injected with 0.2% ropivacaine [10] (Jiangsu Hengrui Pharmaceutical Co., Ltd, China). The other operations were the same. All treatments were performed by the same physician (Fig. 1).

2.4. Observation indicators

According to the follow-up data, pain score, anxiety scale, and adverse reactions were evaluated before treatment and at 1 week, 1 month, and 3 months after treatment. We used the VAS: a vernier marked with 0 to 10 points were used for assessment. 0 points indicated painless, 1 to 3 indicated mild pain, 4 to 6 indicated moderate pain, 7 to 10 indicated severe pain and 10 points indicated the most severe pain that was unbearable. Ask patients to draw a mark on the vernier according to their feeling to indicate the degree of pain. Higher scores indicated higher degree of pain. Zung developed the SAS in 1971.[11] SAS scores less than 50 are considered normal, 50 to 59 as mild anxiety, 60 to 69 as moderate anxiety, and 70 or higher as severe anxiety. Adverse reactions included hoarseness, dysphagia, dizziness, and pain at the puncture point.

2.5. Statistical methods

IBM SPSS (version 26.0; SPSS, Inc., Chicago, IL) was used for all statistical analyses. Measurement data are expressed as the mean ± standard deviation ($\bar{x} \pm s$). Repeated measures analysis of variance was used to compare time points before and after treatment in the same group. The *t*-test was used to compare groups, and the Chi-Squared test was used to compare the count

Table 1

Demographic information.

Group	Cases	Gender (male/female)	Age (years, $\bar{x} \pm s$)	Height (cm, $\bar{x} \pm s$)	Weight (kg, $\bar{x} \pm s$)	Pain duration (months, $\bar{x} \pm s$)	Affected side (left, right)
Lidocaine	24	11/13	65.75 ± 7.43	165.8 ± 17.24	63.23 ± 8.83	3.25 ± 0.95	13/11
Ropivacaine	28	12/16	66.13 ± 7.51	166.2 ± 16.98	62.84 ± 9.29	3.38 ± 0.86	15/13

The lidocaine group compared with the ropivacaine group, $P > .05$.

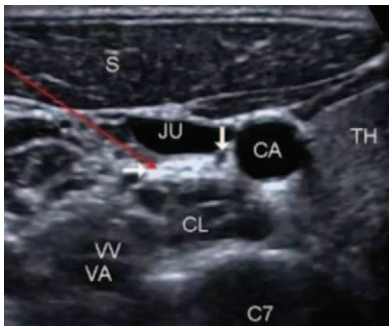

Figure 1. Ultrasound-guided stellate ganglion block. The red arrow: the puncture path; the white arrows: the stellate ganglion; S = Sternocleidomastoid muscle, JU = jugular vein, CA = common carotid artery, TH = thyroid, CL = longus cervicis muscle, VA = vertebral artery, VV = Vertebral vein, C7 = The seventh cervical vertebra.

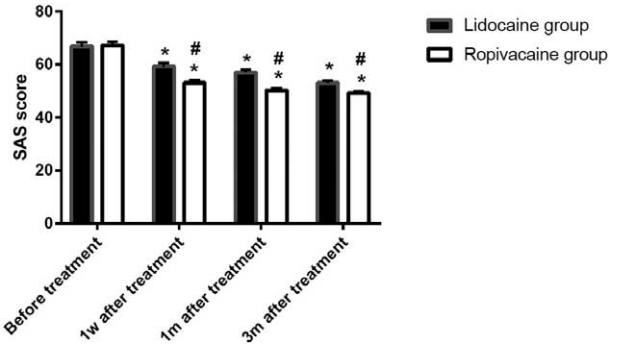

Figure 3. *Comparison of SAS scores between the lidocaine and ropivacaine groups before and after treatment. *Compared with before and after treatment in the same group, $P < .05$; #compared with corresponding time points between the lidocaine and ropivacaine groups, $P < .05$.

data. Chi-Squared test was used to compare the gender, affected side and adverse reactions of the 2 groups. The age, height, weight, pain duration, VAS and SAS of the 2 groups were compared by *t*-test. Statistical significance was set at $P < .05$.

3. Results

3.1. Demographic information

Chi-Squared test was used to compare the gender and affected side of the 2 groups, $P > .05$. The age, height, weight and pain duration were compared by *t*-test, $P > .05$. There were no significant differences between the groups in terms of sex, age, height, weight, pain duration and affected side. Therefore, the demographic information of the 2 groups is comparable. (Table 1).

3.2. Comparison of VAS scores between the two groups before and after treatment

VAS of the 2 groups was compared by *t*-test. There was no significant difference between the groups in VAS scores before treatment ($P > .05$). At 1 week, 1 month, and 3 months after treatment, the VAS scores were significantly lower in the ropivacaine group than in the lidocaine group ($P < .05$) (Fig. 2).

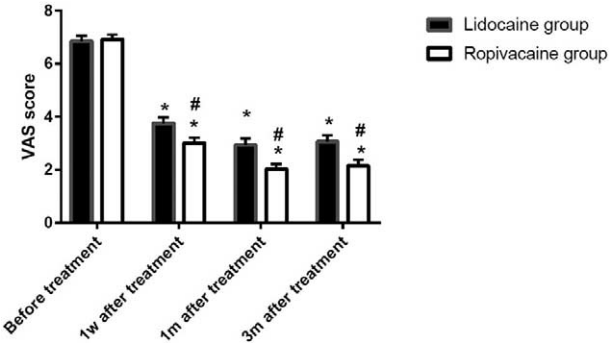

Figure 2. Comparison of VAS scores between the lidocaine and ropivacaine groups before and after treatment. *Compared with before and after treatment in the same group, $P < .05$. #compared with corresponding time points between the lidocaine and ropivacaine groups, $P < .05$.

3.3. Comparison of SAS scores between the groups before and after treatment

SAS of the 2 groups was compared by *t*-test. Before treatment, there was no significant difference between the groups in SAS scores ($P > .05$). The SAS scores of the ropivacaine group at 1 week, 1 month, and 3 months after surgery were significantly lower than those of the lidocaine group ($P < .05$) (Fig. 3).

3.4. Comparison of adverse reactions between the two groups

There were no severe complications during treatment and follow-up in either group, and all adverse reactions resolved after a short rest without specific treatment. Ultrasound-guided SGB was administered once a day for 10 days as a course of treatment, a total of 1180 times in the lidocaine group and 1340 times in the ropivacaine group. Chi-Squared test was used to compare the adverse reactions of the 2 groups, $P > .05$. There were no significant differences between the groups in terms of adverse reactions (Table 2).

4. Discussion

The pathogenesis of PHN is complicated and is not completely clear. Possible mechanisms include central sensitization, peripheral sensitization, inflammatory response, deafferent phenomena, and the involvement of sympathetic nerves. [12] Severe neuritis stimulates the sympathetic nerves, leading to decreased blood flow in the nerves, nerve ischemia, and damage. The stellate ganglion is one such sympathetic ganglion. SGB blocks the sympathetic nerves of the head, face, neck, upper limbs, and upper chest and inhibits abnormal excitement of the sympathetic nerves innervating these areas. [13] SGB also dilates blood vessels, improving blood circulation in the head, face, neck, upper limbs, and upper chest. [14] It increases the blood supply to nerves, prevents nerve ischemia and damage, blocks the vicious cycle of pain, and relieves neuropathic pain. [13] Studies showed that serum levels of inflammatory factors IL-6 and substance P in PHN patients are significantly elevated, [15] suggesting that immune function is impaired. SGB improves local blood circulation, clears the inflammatory mediator IL-6, reduces substance P, cortisol, 5-hydroxytryptamine, and angiotensin II, and promotes nerve repair. [16]

Table 2

Comparison of adverse reactions between the lidocaine and ropivacaine groups.

Group	Treatment (times)	Hoarseness (times)	Dysphagia (times)	Dizziness (times)	Puncture point pain (times)
Lidocaine	1180	11	3	5	5
Ropivacaine	1340	10	2	4	6

The lidocaine group compared with the ropivacaine group, $P > .05$.

SGB relieves PHN in the head, neck, and upper limbs C7 level puncture is closer to sympathetic nerves innervating the upper limbs than C6 puncture, and it is superior for sympathetic nerve block innervating the upper limbs [17] However, the stellate ganglion is close to many important blood vessels, nerves, and organs, especially at the level of C7, close to the vertebral arteries, veins, and inferior thyroid arteries. SGB may lead to complications such as epidural block, total spinal anesthesia, esophageal injury, nerve injury, pneumothorax, and hematoma formation. [18] Ultrasound images reveal blood vessels, nerve roots, organs, puncture needles, diffusion processes of injected medications, and puncture path. Under real-time guidance using Doppler ultrasound, the puncture needle can accurately reach the "target point" and avoid injuring nerves, blood vessels, and surrounding organs. [10] If blood vessels and nerves are found in the puncture path, the puncture direction and path can be adjusted to avoid secondary injuries. In the present study, no severe complications were observed.

Chronic pain is associated with anxiety and depression. The incidence of anxiety in patients with chronic pain is 24.4% to 57.4%. [19] Because of the interaction between anxiety and pain, a vicious circle can occur. Therefore, anti-anxiety and depression treatments are necessary to treat pain. Tricyclic antidepressants can inhibit the reuptake of 5-hydroxytryptamine and norepinephrine in the presynaptic membrane, block α-adrenoceptors, and sodium ion voltage-gated channels, and regulate the descending inhibitory system of pain and numb pain. [20] Amitriptyline is a commonly used antidepressant in patients with PHN.[21] In the present study, the patients took amitriptyline 25 mg orally once a night, which helped treat anxiety and complementary analgesia. Combined with SGB treatment, the SAS scores of lidocaine and ropivacaine groups were significantly lower than before treatment ($P < .05$), suggesting that antidepressants combined with SGB relieve anxiety in patients with upper limb PHN. Concentrations of nerve growth factor (NGF) are known to increase with chronic stress. The NGF increase leads to retrograde transport from the intracerebral site to the stellate ganglion and eventually causes sprouting (new nerve growth) at the nerve terminals. Although there may be several reasons for elevated norepinephrine (NE) levels, an increased level of NE could contribute to anxiety symptoms. Local anesthetic injection next to a sympathetic ganglion leads to the reduction of NGF, and the reversal of NGF increases its "downstream" effects. After SGB, the concentration of NGF decreased, leading to a reduction in NE and deactivation of the intracerebral pathologic states. [22] It may be the principle of SGB in alleviating anxiety.

Ropivacaine is a long-acting amide local anesthetic used in various nerve blocks. It has a prolonged action time and low cardiac and neurotoxicity. It has higher blocking efficacy on pain-conducting Aδ and C nerve fibers than Aβ nerve fibers, and at lower concentrations, it produces sensory and motor blocks, which are unique pharmacological characteristics.[23] It has been reported that the analgesic effect of lidocaine administered by subcutaneous infiltration does not exceed 2 hours, whereas that of ropivacaine reaches 12 hours. [24] Another study found that ropivacaine was superior to lidocaine in terms of nerve block efficacy and postoperative analgesia duration. [25] In the present study, the blocking time of the lidocaine group lasted approximately 1.5 to 2 hours, while ropivacaine group lasted 5 to 6 hours, so ropivacaine produced longer-term inhibition of sympathetic nerve, and reduced longer-lasting sympathetic nerve excitability. We observed that the treatment efficiency of the ropivacaine group was significantly higher than that of the lidocaine group. The longer duration of anesthesia with ropivacaine is related to the high affinity to the nerves and their lipid solubility. Lidocaine induces local vasodilation and low lipid solubility compared with ropivacaine, resulting in a shorter duration. Ropivacaine was superior to lidocaine in the present study, and 2 explanations seem plausible. The first is that ropivacaine provides prolonged pain relief. The second explanation is that ropivacaine helps break the "pain–inflammation" loop and thus better controls secondary hyperalgesia.

Lack of long-term follow-up for >3 months is a limitation of this study. We hope to collect more long-term follow-up data to validate our findings.

5. Conclusion

Our findings suggest that ultrasound-guided ropivacaine SGB is more effective than lidocaine in treating upper limb PHN. It is safe, effective, and worthy of promotion.

Author contributions

Conceptualization: Lingchao Li
Data analysis: Dongbai Li
Data collection: Xin Zheng
Data curation: Xin Zheng
Drafting the manuscript: Zhouhong Fan
Related articles search: Haopeng Chen
Software: Haopeng Chen
Supervision: Lingchao Li
Writing – original draft: Zhouhong Fan
Writing – review & editing: Dongbai Li

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