Cardiovascular Response of Radiofrequency Therapy of Gasserian Ganglion with Lidocaine Local Anesthesia during the Treatment of Trigeminal Neuralgia: A Retrospective Single-blind Case-Control Study

Dingliang Zhao
Nanjing Drum Tower Hospital, the Affiliated Hospital of Nanjing University Medical School
Jing Li
Nanjing Drum Tower Hospital, the Affiliated Hospital of Nanjing University Medical School
Chao Ma
Nanjing Drum Tower Hospital, the Affiliated Hospital of Nanjing University Medical School
Ying Huang
Nanjing Drum Tower Hospital, the Affiliated Hospital of Nanjing University Medical School
Gaojian Tao (dreamout@njglyy.com)
Nanjing Drum Tower Hospital, the Affiliated Hospital of Nanjing University Medical School

Research Article

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Abstract

Objective

Radiofrequency thermocoagulation of Gasserian ganglion has a difficult problem how to provide perfect acesodyne for patients to make the treatment more smoothly and comfortably. In our study, we used moderate lidocaine local anesthesia to assess its safety and efficacy in the treatment of trigeminal neuralgia.

Methods

From January 2017 to December 2020, 80 patients suffering from trigeminal neuralgia were treated with radiofrequency thermocoagulation through oval foramen in our institution. They were entirely enrolled and randomly divided into the study group and the control group . In the study group moderate lidocaine was given outside and inside of the oval foramen after puncturing in place,while in the control group the same dose of normal saline was given in the same way. The mean arterial pressure (MAP), heart rate(HR) and visual analogue scale (VAS) were recorded respectively at different treatment temperatures.

Results

he fluctuation of mean arterial pressure and heart rate in the experimental group were lower than those in the control group, and the difference was statistically significant. The two groups showed a significant difference in MAP, HR and VAS at different treatment temperatures. Meanwhile, the fluctuation of blood pressure and heart rate in the study group were lower than those in the control group.

Conclusion

Reasonable lidocaine local anesthesia can obviously depress the fluctuation of blood pressure and heart rate during the Gasserian ganglion radiofrequency thermocoagulation in treatment trigeminal neuralgia. This simple anesthesia method can effectively reduce pain and the occurrence of cardiovascular adverse events.

Introduction

Trigeminal neuralgia (TN) is a common paroxysmal severe facial pain in the distribution area of one or several trigeminal branch nerves. A great quantity of elderly over 50 years old suffer from the most common type of cerebral neuralgia, seriously infuencing sleep, diet, and social communication[1-3]. Recent research shows that the incidence rate of TN is about 50/1 million, gradually increasing with age[4-6]. Although drugs including carbamazepine and oxcarbazepine are the prior choice in treating TN, there are still a great number of patients whose pain cannot be well controlled or cannot tolerate the side effects of drugs[7-8]. These medically intractable individuals require invasive treatments including

microvascular decompression, balloon compression, gamma knife radiosurgery and other interventional therapies[9-12].

Radiofrequency thermocoagulation (RFT) is a common method for the treatment of TN, which has the advantages of small trauma, fast recovery, widely use, simple operation[13-15]. Conventional radiofrequency therapy of Gasserian ganglion through the oval foramen is the most widely used approach. However, the fluctuation of heart rate and blood pressure during cannulation and RFT treatment increases the difficulty of treatment and the risk of cardiovascular events. Sedatives and analgesics are widely used in order to reduce the risk of RFT treatment and ensure the cooperation of patients. Intravenous anesthesia with spontaneous breathing is preferred in the RFT treatment[16-17]. However, this method often needs to be equipped with an excellent anesthesiologist, and cannot completely reduce the fluctuation of blood pressure and heart rate (HR), which has higher labor cost and certain anesthesia risk.

We tried to apply reasonable local anesthesia to suppress the vagal reflex during puncture and the great increase of blood pressure and heart rate caused by pain during radiofrequency therapy. This simple local anesthesia may allow surgeons to perform the operation independently. This research aimed to observe the cardiovascular response of local anesthesia with lidocaine to RFT of Gasserian ganglion during the treatment of trigeminal neuralgia.

Materials And Methods

Ethical approval

This study was approved by the Nanjing Drumtower Hospital Ethics Committee (2021-434-01), and all patients signed the informed consent. All patients read the informed consent form and agreed to the therapeutic protocol. This trial was registered with chictr.org.cn in 2021/03/12 (number ChiCTR2100044223).

Patients

A total of 80 cases suffering from trigeminal neuralgia admitted to the Department of pain, Nanjing Drumtower Hospital from July 2017 to July 2020 were randomly divided into the study group and control group, 40 cases in each group. There were 21 males and 19 females in the study group, aging 43-85 years old, with an average age of 65.4 years old. On the other hand, there were 18 males and 22 females in the control group, aging 43-85 years old, with an average age of 69.3 years. There were no significant differences showing in age, gender, lesion segment, location, preoperative mean arterial pressure (MAP), basal heart rate (HR) and visual analogue scale(VAS) between the two groups(Table 1).

Surgical procedure

The patients in the two groups were fasting for 8 hours before operation. The peripheral vein was opened before operation, blood pressure, blood oxygen, heart rate, flat position was taken, CT guided local anesthesia was used to puncture the oval foramen on the affected side. When approaching the target position, the patients were tested for motor stimulation and sensory stimulation by radiofrequency therapeutic apparatus. When the needle tip were confirmed reaching the target position, the study group was given 1-1.5 ml 1% lidocaine outside the oval foramen. After entering the oval foramen and seeing cerebrospinal fluid, 0.2-0.4ml 2% lidocaine was injected before radiofrequency treatment. The control group was given 1-1.5ml normal saline at the outer orifice of oval foramen, and then 0.2-0.4ml normal saline was given when seeing cerebrospinal fluid. The temperature of radiofrequency thermocoagulation was gradually increased from 60℃ to the maximum of patients' tolerable temperature, and the increasing temperature was about 5℃ by each 120s, and the maximum temperature was not more than 75℃.

Evaluation indexes, data collection and management

The MAP, HR and VAS of the two groups were recorded at the beginning and end of puncture and during the radiofrequency treatment when the temperature were 60℃, 65℃, 70℃ and 75℃ respectively. The fluctuation amplitude of MAP and HR during the treatment was also recorded, and the occurrence of adverse reactions such as hypertension, bradycardia, agitation, headache, nausea and vomiting during the operation were observed.

Statistical analysis

We took the use of SPSS, version 23.0 (SPSS, Inc., Chicago, IL, USA) for analysis, and count data expressed by [*n (%)*] were applied chi square test for statistical analysis; measurement data expressed by [$\bar{x} \pm s$] were used *t*-test for statistical analysis. The level of significance was 5%.

Results

The MAP in the study group was lower than that of the control group, and when radiofrequency treatment was set at 70℃ and 75℃, the difference was statistically significant ($P<0.05$)(Table 2). During radiofrequency treatment, the HR and VAS scores of the study group at each treatment temperature were lower than those of the control group, and the differences were statistically significant ($P<0.05$) (Table 3 and Table 4). The fluctuation range of MAP and HR in the study group were lower than those in the control group, and the difference was statistically significant ($P<0.05$) (Table 5). The cases of restlessness, bradycardia and hypertension in the study group were lower than those in the control group, and the difference was statistically significant. There was no significant difference in postoperative nausea, vomiting and headache between the two groups ($p>0.05$) (Table 5).

Discussion

Trigeminal neuralgia has a high incidence rate in the elderly, who often accompanied by chronic underlying diseases such as hypertension, cerebral infarction, diabetes. The treatment of trigeminal

neuralgia includes surgical operation and minimally invasive treatment, and RFT is a conventional method in treating trigeminal neuralgia. However, in the procedure of radiofrequency treatment of trigeminal ganglion, puncture through oval foramen could activate vagus nerve baroreflex, and then cause the HR decreasing significantly. During the treatment, pain caused by gradually rising temperature increases blood pressure and HR through sympathetic reflex, which increases the difficulty of treatment and the risk of cardiovascular events in the whole treatment process[18-21]. Meng *et al*[22] did the study of 48 patients with primary trigeminal neuralgia treated by radiofrequency, and observed that 6 patients developed bradycardia during puncture, 42 patients developed tachycardia during radiofrequency treatment, and all patients had obvious blood pressure rise.

Previous studies used intravenous anesthesia and keep spontaneous breathing to ensure the safety and smooth of radiofrequency treatment, but this method often need be equipped with professional anesthesiologists and has higher requirements for anesthesia. A large number of intravenous anesthetics are not easy to maintain the stability of hemodynamics, and trigeminal neuralgia are mainly middle-aged and elderly patients who have great possibility of chronic respiratory diseases hard to maintain respiratory stability[23-25]. Sweet *et al*[26] found that large doses of intravenous analgesics could not completely block the nociceptive nerve endings in the dura mater of oval foramen. However, it has been confirmed that a small amount of lidocaine injection before entering the oval foramen can prevent hypertension and tachycardia during balloon compression surgery for trigeminal neuralgia. Therefore, we hope that different concentrations of lidocaine can respectively be injected out of the oval foramen (to reduce vagal pressure reflex) and into the oval foramen (to inhibit sympathetic reflex) during the puncture process and before radiofrequency therapy through simple local anesthesia, so as to reduce the pain as much as possible and reduce the huge fluctuation of blood pressure and HR during the treatment process.

Our study confirmed that the reasonable use of lidocaine local anesthesia in the process of radiofrequency treatment of trigeminal ganglion can effectively reduce the decrease of HR caused by puncture, and reduce the increase of blood pressure and heart rate caused by pain during radiofrequency treatment. Our data showed that 5 patients respectively in the control group could not tolerate the treatment temperature of 70℃ and 75℃, while only 3 patients in the study group could not tolerate the treatment temperature of 75℃. In addition, due to the positive local analgesic effect, the risk of intraoperative agitation and hypertension in the experimental group was significantly lower than that in the control group, and there was no significant difference in postoperative nausea, vomiting and headache between the two groups. Our study suggests that there is no significant difference in the incidence of bradycardia between the two groups, which may be related to the timing and dose of lidocaine in inhibiting vagal reflex, and further study is needed.

Conclusions

Lidocaine local anesthesia shows great potential in enhancing the safety and effectiveness in the Gasserian ganglion RFT. This anesthesia method is simple and safe, can effectively maintain the

hemodynamic stability, which is suitable for clinical application. Meanwhile, prospective clinical studies are needed on a larger number of samples to further confirm our results.

Declarations

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Authors' Contributions

Dingliang Zhao and Jingli are equally contributed to this work. Dingliang Zhao and Jing Li were responsible for study conception and design. Dingliang Zhao was involved in data acquisition and drafted the article. All authors were involved in data interpretation and manuscript review and revisions. All authors reviewed and approved the final manuscript for submission.

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Availability of data and materials

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Nanjing Drumtower Hospital Ethics Committee (2021-434-01). This trial was registered with chictr.org.cn (number ChiCTR2100044223). All patients signed the informed consent. All patients read the informed consent form and agreed to the therapeutic protocol. All methods were performed in accordance with the relevant guidelines and regulations.

Consent for publication

Not applicable.

Declarations

The authors declare that there are no competing interests. The authors state that all methods were performed in accordance with the relevant guidelines and regulations.

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Tables

Table 1: Study and control groups were paired in their general characteristics(*n*=80)

	Study group	Control group	p^a
Gender	21men;52.5%	18men;45.0%	0.502
Mean age	65.4±1.7years old	69.3±1.5years old	0.096
Location	20 left side;50.0%	21 left side 52.5%	0.823
Trigeminal branch affected	V2:10(25.0%)	V2:9(22.5%)	0.965
	V2/V3:3(7.5%)	V2/3:3(7.5%)	
	V3:27(67.5%)	V3:28(70.0%)	
Basal mean arterial pressure	101.1±1.3mmHg	100.3±1.3mmHg	0.662
Basal mean heart rate	67.6±1.4	66.4±0.8	0.464
Preoperative visual analogue scale	5.8±0.1	5.6±0.1	0.286

[a]Pearson's χ 2 test to compare general characteristics between the groups

Table 2: Means of MAP of patients were higher in the control than the study group

	Study group	Control group	p^a
Preoperative MAP	100.1±1.0	99.0±1.1	0.461
The end of puncture MAP	108.0±1.2[a]	100.6±0.9	<0.001
Radiofrequency treatment at 60°CMAP	108.9±1.7	105.9±1.2	0.280
Radiofrequency treatment at 65°CMAP	113.2±1.2	115.3±5.1	0.197
Radiofrequency treatment at 70°CMAP	114.8±1.3[a]	118.8±1.1	0.021
Radiofrequency treatment at 75°CMAP	113.8±0.9[a]	121.7±1.5	<0.001
Postoperative MAP	103.7±1.2	101.2±1.0	0.114

[a]student's *t*-test, there was a statistical difference between the groups at the evaluation during puncture and radiofrequency treatment

Table 3: Means of HR of patients were higher in the control than the study group

	Study group	Control group	p^a
Preoperative	66.9±1.1	68.9±0.1	0.385
The end of puncture HR	70.2±1.6	69.7±1.0	0.790
Radiofrequency treatment at 60°CHR	69.0±1.3[a]	73.2±1.2	0.017
Radiofrequency treatment at 65°CHR	67.6±1.2[a]	77.5±1.2	<0.001
Radiofrequency treatment at 70°CHR	68.7±1.3[a]	81.0±1.3	<0.001
Radiofrequency treatment at 75°CHR	68.3±1.1[a]	81.9±1.5	<0.001
Postoperative HR	69.3±1.1	71.3±1.0	0.186

[a]student's *t*-test, there was a statistical difference between the groups at the evaluation during puncture and radiofrequency treatment

Table 4: Means of VAS of patients were higher in the control than the study group

	Study group	Control group	p^a
Preoperative	5.8±0.1	5.6±0.1	0.286
The end of puncture HR	2.5±0.1 [a]	4.0±0.1	<0.001
Radiofrequency treatment at 60°CHR	2.8±0.1 [a]	5.0±0.1	<0.001
Radiofrequency treatment at 65°CHR	2.9±0.2 [a]	5.8±0.1	<0.001
Radiofrequency treatment at 70°CHR	3.3±0.2 [a]	6.2±0.1	<0.001
Radiofrequency treatment at 75°CHR	2.8±0.1 [a]	6.0±0.2	<0.001
Postoperative HR	1.2±0.1 [a]	2.4±0.1	<0.001

[a]student's *t*-test, there was a statistical difference between the groups at the evaluation during puncture and radiofrequency treatment

Table 5: Study and control groups were paired in their Intraoperative and postoperative adverse reactions

	Study group	Control group	p^a
MAP variation range	18.1±0.7 [a]	27.3±0.8	<0.001
HR variation range	12.0±1.3 [a]	16.2±0.8	0.006
Intraoperative hypertension	4(10%) [a]	15(37.5%)	0.004
Intraoperative Bradycardia	18(45%)	19(47.5%)	0.823
Intraoperative agitation	1(2.5%) [a]	6(15%)	0.048
Postoperative nausea and vomiting	3(7.5%)	2(5%)	0.644
Postoperative headache	0(0%)	2(5%)	0.152

[a]Pearson's χ 2 test to compare general characteristics between the groups