

Usefulness of perfusion index in evaluation of stellate ganglion block

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Abstract

Clinical conditions such as Horner's syndrome and conjunctival injection have conventionally been used post-treatment to evaluate stellate ganglion block (SGB). Recently, there have been occasional reports of using a perfusion index (PI) obtained using a pulse oximeter to evaluate improved peripheral blood flow. In this study, we investigated whether the PI value from the blocked side is useful in evaluating the effects of SGB following treatment. A pulse oximeter sensor was placed on the fingertip of a patient diagnosed with glossalgia, and after measuring the PI value to use as the control value, SGB was performed 10 times. PI values before and after the procedure were compared, and while the PI value fell significantly immediately following the procedure, it then rose significantly between 2 and 20 minutes after treatment, peaking at about the 5-minute

mark. In the post-SGB evaluation, conditions such as Horner's syndrome and conjunctival injection were acknowledged on the blocked side. SGB blocks the sympathetic nerves and increases the volume of blood flow in the head and neck, face, and extremities thoracica of the affected side, improving peripheral circulation. Accordingly, the PI value, which is said to correlate with peripheral blood flow, can be considered useful in evaluating the effects of SGB. In this case, the PI value in the fingertips on the blocked side rose following the SGB, peaking at approximately the 5-minute mark, clearly indicating increased peripheral blood flow from the initial phase after the SGB. The PI value was therefore considered useful in evaluating the effects of SGB.

Key words: stellate ganglion block, pulse oximeter, perfusion index

Introduction

Stellate ganglion block (SGB) is a therapeutic technique commonly used in pain clinics. The existence of clinical conditions such as Horner's syndrome, conjunctival injection and elevated skin temperature, which generally occur post-treatment, have been used to evaluate the effects of SGB¹; however, in recent times, a number of studies have used a perfusion index (PI value) obtained from a pulse oximeter to evaluate increased peripheral blood flow.²⁻⁴ We investigated this by performing multiple blocks on the same patient to see whether or a PI value taken

following SGB from the blocked side would be useful in evaluating the treatment.

Materials and Methods

The subject was a 59-year-old woman with taste disturbance and pain on the right side of her tongue for about 3 months, who had been diagnosed by a dentist as having no particular perceivable abnormality; however, because the taste disturbance and tongue pain had continued, she had consulted an anesthetist at this hospital, where she was diagnosed with glossalgia. It was decided to use SGB to treat the

condition, and following a verbal explanation, the patient consented to the use of a PI value from a pulse oximeter to evaluate the effects of SGB. Prior to the procedure, a pulse oximeter sensor (Masimo Corporation) was positioned on the tip of the second finger of the right hand, and blood pressure, pulse rate and PI were measured as control values. Next, SGB was performed 10 times using 7 ml of 1% lidocaine at the right transverse process of the sixth cervical vertebra, and the blood pressure and pulse rate were measured again 20 minutes after treatment. The PI and clinical conditions such as Horner's Syndrome were observed over a 20-minute period to evaluate the effects of SGB.

Statistical analysis was performed using Student's paired t-test, and $P < 0.05$ was considered significant.

Results

Blood pressure and pulse rate measurements from before and after SGB treatment are shown in Table 1. A rise in systolic blood pressure was observed following treatment, which caused no change in diastolic blood pressure or pulse rate. Prior to SGB, the PI value was 5.0 ± 1.3 (mean \pm SD), and while this fell significantly immediately following treatment, it then rose significantly from 2 minutes after treatment to reach 7.4 ± 1.2 at the 5-minute mark, measuring 6.4 ± 1.1 20 minutes after SGB. The PI peaked 5.1 ± 1.4 minutes after treatment (Figure 1). Horner's syndrome, conjunctival injection and a raised skin temperature were observed 20 minutes after the procedure (Table 2).

Table 1 Changed in blood pressure and pulse rate.

Time	Before	After
	SBP/DBP/Pulse rate	SBP/DBP/Pulse rate
1	128 / 82 / 51	136 / 90 / 58
2	129 / 77 / 55	135 / 79 / 53
3	127 / 79 / 52	138 / 78 / 50
4	136 / 82 / 51	141 / 84 / 53
5	131 / 77 / 58	146 / 81 / 54
6	124 / 77 / 54	133 / 80 / 51
7	129 / 76 / 53	147 / 80 / 52
8	120 / 75 / 58	146 / 82 / 57
9	126 / 79 / 55	137 / 85 / 55
10	114 / 75 / 58	129 / 72 / 53

Before: before SGB treatment After: 20 minutes after SGB treatment

SBP: systolic blood pressure DBP: diastolic blood pressure

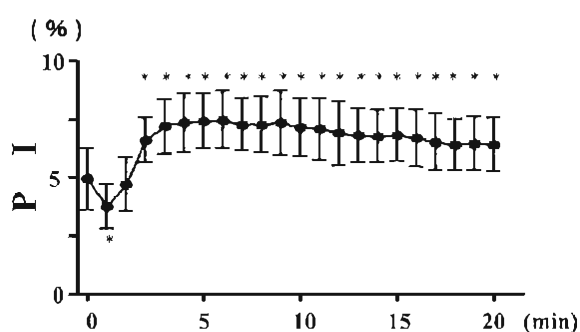


Fig. 1 Changes in PI value after SGB treatment. PI value increased significantly from 2 to 20 minutes after treatment. Number is ten. Values are expressed as the mean \pm standard deviations (SD). * : $P < 0.05$ vs before.

Table 2 Evaluation of SGB treatment.

Time	Ptosis	Miosis	Conjunctival injection	Raised skin temperature	Anhidrosis	Nasal stuffiness
1	+	+	+	+	-	+
2	+	+	+	+	-	+
3	-	+	+	+	-	-
4	-	+	+	-	-	-
5	+	+	+	+	-	+
6	+	+	+	+	-	+
7	+	+	+	+	-	+
8	+	+	-	-	-	+
9	+	+	+	+	-	+
10	+	+	+	+	-	+

+ : effect - : no effect

Discussion

SGB is a widely used nerve block in pain clinics. Sympathetic block resulting from SGB expands blood vessels in the head and neck area, face and extremities thoracica and increases blood flow on the blocked side, thus improving peripheral circulation. SGB affects circulation by acting directly on the peripheral vasculature and indirectly on cardiac function by blocking cardiac sympathetic nerves.⁵ With regard to the effects of SGB on cardiac function, while some reports indicate no change in blood pressure or heart rate,^{2,6} and virtually no change in cardiac index or cardiac output,⁶ others suggest that right SGB results in a reduced heart rate while left SGB causes systolic arterial pressure to rise.^{7,8} In this study, when SGB was administered 10 times on the right side, the systolic arterial pressure rose, while no changes were observed in diastolic blood pressure or pulse rate. The results of this study differ from those of past reports in that they suggest that SGB affects systolic arterial pressure for some reason.

In the past, clinical conditions such as Horner's syndrome (ptosis, constricted pupils), conjunctival injection, raised skin temperature, anhidrosis and nasal stuffiness have been used to evaluate the effects of SGB.¹ In addition to these clinical conditions, highly objective measurement methods have also been used to evaluate the effects of SGB, such as the pulse wave,⁹ skin temperature,^{9,10} ultrasonic Doppler flowmeter^{5,6} and thermography,^{1,11} but such methods have not been widely adopted due to issues such as large measurement errors, the cumbersome nature of the testing method, and the cost of the relevant equipment. SGB causes blood vessels to expand and blood flow to increase, and therefore confirmation of increased blood flow is considered useful in evaluating SGB, and so a PI value indicated by a pulse oximeter could also be considered useful for evaluation as it involves none of the abovementioned issues.²⁻⁴ The pulse oximeter provides a plethysmograph (a plethysmographic waveform), and the ratio of apulsatile to pulsatile components can be used to obtain a PI value ($PI \% = \text{apulsatile components} / \text{pulsatile components} \times 100\%$). The PI value is said to correlate with the peripheral blood flow,¹² and while there is no normal value, a level of 3% to 8% is considered to indicate that peripheral circulation is being maintained. In this study,

SGB was performed on the same patient 10 times by the same clinician, and each time there was a significant increase in the PI recorded from the fingertip on the side of the block following the procedure, peaking at about the 5-minute mark, with increased peripheral blood flow in the initial phase following the block that continued for a 20-minute period.

With SGB, the puncture site and amount of local anesthetic vary among patients, while the patient's muscular or fascial arrangement will also affect the area affected by the sympathetic block¹³; therefore, even with the same clinician administering SGB to the same patient, the procedure must be objectively evaluated each time. Results will vary, regardless of whether a single clinician performs SGBs on one patient, as in this study, or multiple clinicians perform the procedure on multiple patients,² so that a PI value, being simple and objective, was ascertained to be useful in evaluating the effects of SGB, in addition to the use of clinical conditions.

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