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CHEMICAL BLOCKAGE OF CERVICAL SYMPATHETIC TRUNKS FOR FACIAL PALSY

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INDEXING WORDS

facial palsy; stellate ganglion block; common carotid arterial blood flow; tissue blood flow; improvement of microcirculation

SYNOPSIS

Impairment of microcirculation of the facial nerves is considered to play an important role in etiology of facial palsy, and the main emphasis of the conservative treatment is aimed at circulatory improvement. Therefore, at the pain clinic, improved blood flow to the facial nerve by chemical blockage of cervical sympathetic trunks (stellate ganglion block; SGB) is employed in treating patients with facial palsy. The circulatory effects of SGB were clinically determined in 20 patients with acute Bell's palsy, and the effects of chemical blockage of cervical sympathetic trunks on the tissue circulation of facial nerve were also experimentally evaluated in dogs. In the clinical study, the blood flow volume of the common carotid artery increased signifi-

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cantly in 5 minutes after SGB, and has reached its peak of 176.4% in 20 minutes. This significant increase continued up to 75 minutes. In the animal model experiments, the common carotid arterial blood flow volume increased immediately after performing experimental SGB with a peak rise of 143.5% in 15 minutes, and the significant increase continued up to 45 minutes. The blood flow volume in the facial nerve tissue also increased for 5 minutes with a peak rise of 115.2% in 20 minutes after SGB, and this significant increase persisted for up to 60 minutes. A marked increase was observed in the blood flow volume in the facial nerve tissue as well as through the common carotid artery. The circulatory improvement performed by SGB extended as far as the facial nerve itself. From the facts above mentioned, SGB is considered to be an extremely effective treatment for the Bell's palsy.

INTRODUCTION

Idiopathic peripheral facial palsy, known as Bell's palsy, accounts for about 70% of all peripheral facial palsies. Although the cause of Bell's palsy still has not been clarified, it is generally understood that localized edema due to impaired microcirculation of facial nerves in the temporal bone causes an increase in the pressure inside facial neural tubes and secondary ischemic changes in the nerves result in edema and compression, thus producing a vicious circle which is considered to cause the onset of the palsy[3). Since there is an extremely strong relationship between the pathophysiology of Bell's palsy and circulatory disorders of the nutrient blood vessels in the facial nerves, the main emphasis of the conservative treatment is aimed at circulatory improvement. On the other hand, at the pain clinic, improved blood flow to the facial nerve by chemical blockage of cervical sympathetic trunks (stellate ganglion block; SGB) is employed in treating patients with Bell's palsy. Its efficacy has already been adequately confirmed[7)]. The blood circulation improving treatment of Bell's palsy by SGB is thought to be brought about by a vascular dilatation due to the blocking effects on the sympathetic nerve. However, the detailed mechanism has not been adequately investigated. Therefore, we determined the effects of SGB on the common carotid arterial blood flow volume and the tissue blood flow volume in facial nerve tissue in patients at the acute stage of Bell's palsy and experimentally in animals. The circulatory effects of chemical blockage of cervical sympathetic trunks on the microcirculation of the facial nerve were studied.

SUBJECTS AND METHODS

Clinical study:

Among patients at the acute stage of Bell's palsy whose onset occurred within 1 week, 20 patients were subjected to this study. The main purpose and nature of the study were explained to all the patients to obtain the consent to participate in this study. There were 10 males and 10 females. The age ranged from 15 to 69 years with a mean of 47.1 $\pm$ 4.6 years. The affected nerve side was at the left side in 11 cases and at the right side in 9 cases. SGB was performed by the paratracheal approach using 5 ml of 1% mepivacaine. The success of SGB was confirmed by the Horner's sign, hyperemia of the ocular conjunctiva, sensation of warmth in the face and upper limbs, and the stopping of sweating.

The blood flow volume in the common carotid artery was measured using an ultrasonic blood flowmeter (Nihon Koden, FM-1100) before performing SGB and for 90 minutes after performing SGB. The ultrasonic blood flowmeter used in this study has been described and validated previously[8). The main characteristic of this apparatus is the rangegated time system of reception, which enables selection of the sample volume size and facilitates its movement across the vessel lumen. The diameter was determined according to the echographic equation from the ultrasonic beam. Mean and phasic cross-sectional blood flow velocities can be measured. Mean blood flow volume was calculated with the computer according to the formula.

Animal model experiments:

Fifteen mongrel dogs with a mean body weight of 11.5 $\pm$ 1.7 kg were used in the experiments. Intravenous anesthesia was achieved with 100 mg of pentobarbital and 4 mg of pancuronimun, and artificial respiration was performed by tracheal intubation under conditions of constant ventilation with room air so that PaCO2 was maintained at about 37 $\pm$ 2 mmHg. Skin incisions were made on the anterior cervical region to expose the common carotid artery , and an electromagnetic flowmeter (Nihon Koden, MFV-3200) was connected to measure continuously the common carotid arterial blood flow volume. Skin incisions were also made on the lateral cervical region, and at the ectopic region from the stylomastoid foramen the facial nerves were exposed. A probe for measurement of the tissue blood flow was implanted, connected with the laser Doppler tissue blood flowmeter (Advance, ALF2100), and the tissue blood flow volume in the facial nerves was continuously measured. The drug injection needle was implanted by directly puncturing the cervicothoracic ganglion corresponding to the stellate ganglion in humans. After attaching the measuring and chemical blockage devices, the stability of the blood flow value was confirmed. One ml of 1% mepivacaine was infused, thus making chemical blockage of cervical sympathetic trunks. The effects on the blood flow volume in the common carotid artery and the facial nerve tissue were recorded.

All of the data are expressed as mean ± SE. Statistical analysis was performed by comparison of baseline values using paired Student's T-test. Differences were considered significant at p values of less than 0.05.

RESULTS

Clinical study:

Prior to performing SGB, the blood flow volume in the common carotid artery was 403.7 ± 20.3 ml/min, but from 5 minutes after performing SGB it increased significantly to 530.4 ± 27.7 ml/min. (132.1 ± 4.2%), and 20 minutes after the blockade it was 706.3 ± 37.1 ml/min (176.4 ± 6.3%). Thereafter a gradual decline, but with still significant increases continued up to 75 minutes after. (Fig. 1)

The blood flow velocity in the common carotid artery increased markedly from 5 minutes after performing SGB and reached its peak of 142.9 ± 5.4% in 20 minutes . This was followed by a gradual decrease although a significant increase remained up to 60 minutes after the blockade. (Fig. 2)

The vascular diameter of the common carotid artery from the 5 minutes after conducting SGB showed a slight but significant enlargement, and in 20 minutes it reached its maximum of 112.6 ±

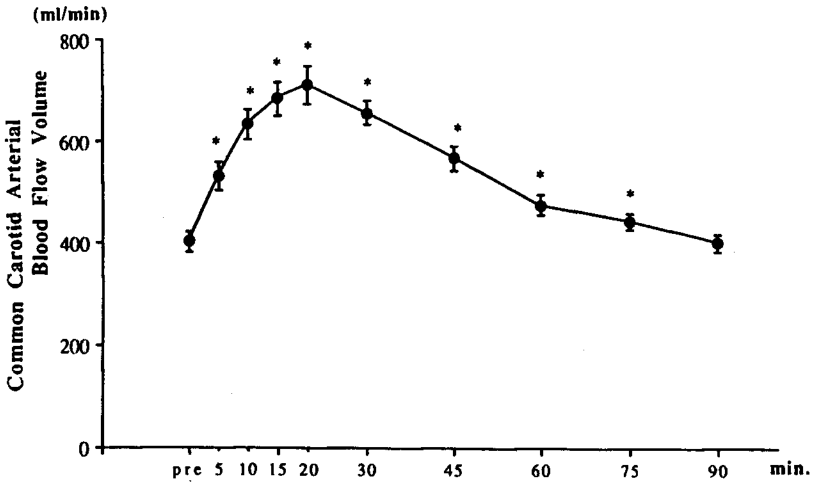

Fig. 1 Effects of Stellate ganglion block on the blood flow volume through the common carotid artery in patients with facial palsy.
*: p<0.05 vs. pre-blockage level

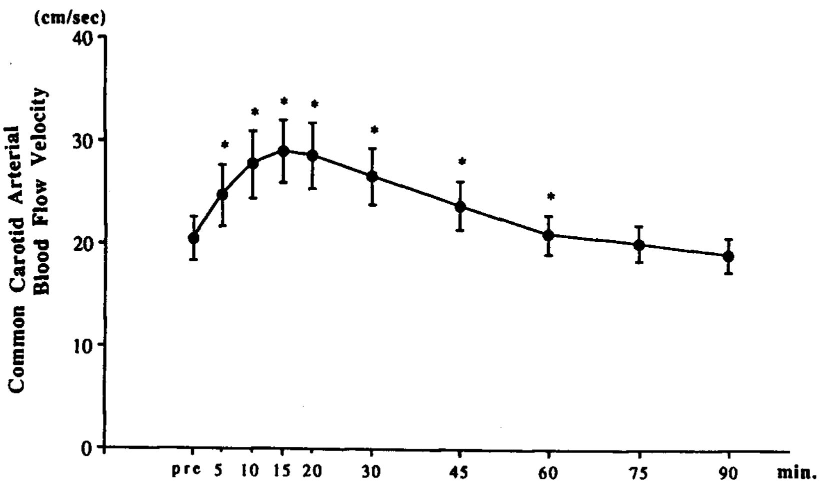

Fig. 2 Effects of stellate ganglion block on the blood flow velocity in the common carotid artery in patients with facial palsy.
*: p<0.05 vs. pre-blockage level

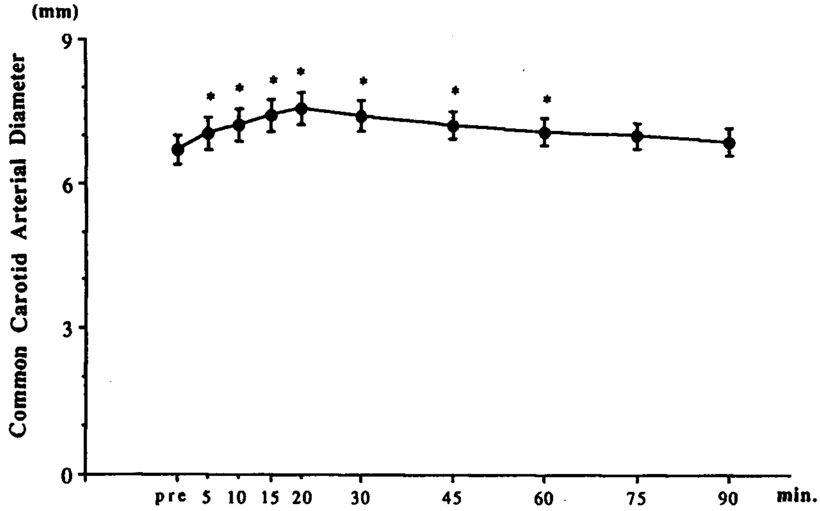

Fig. 3 Effects of stellate ganglion block on the vascular diameter of the common carotid artery in patients with facial palsy.
*: $p<0.05$ vs. pre-blockage level

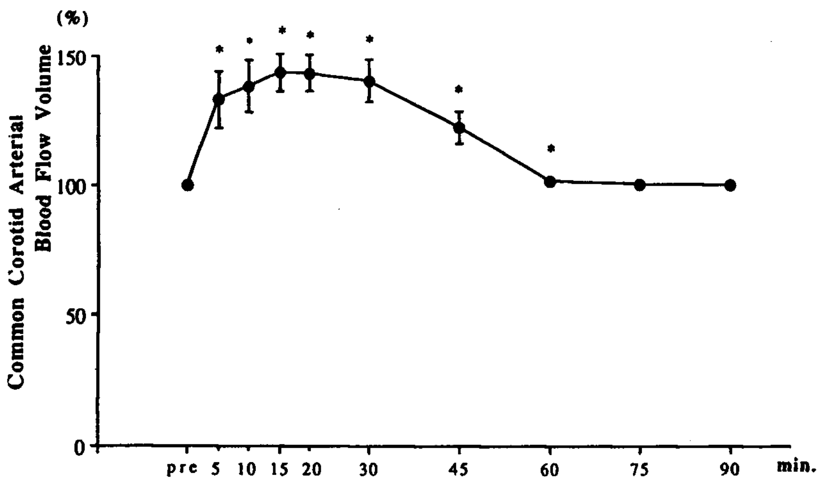

Fig. 4 Changes in the blood flow volume through the common carotid artery following chemical blockage of cervical sympathetic trunks in dogs.
*: $p<0.05$ vs. pre-blockage level

Table 1. Effects of Stellate Ganglion Block on Hemodynamic Parameters in Patients

TIME (min)	PRE	5	10	15	20	30	45	60	75	90
SYS. BP (mmHg)	119.4±6.7	120.2±8.7	120.6±7.3	120.1±6.5	119.8±6.8	116.9±5.9	119.3±7.1	121.6±5.4	122.0±6.5	120.8±5.0
DIA. BP (mmHg)	76.0±3.8	76.1±6.2	78.2±4.5	78.2±4.0	77.6±4.3	77.1±4.2	77.7±4.3	79.6±3.7	75.7±3.1	77.1±4.4
H.R. (beat/min)	74.9±2.9	73.5±3.4	74.2±3.8	74.7±3.7	74.2±3.9	72.9±4.1	72.6±4.3	70.6±4.7	70.2±4.4	71.2±4.1

Values are mean±SE, No statistical differences observed

PRE= pre-blockage, SYS. BP= systolic blood pressure, DIA. BP= diastolic blood pressure, H.R. = heart rate,

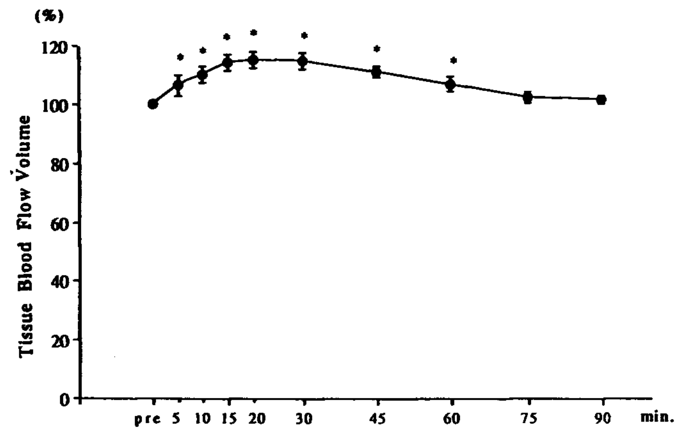

Fig. 5 Changes in the tissue blood flow volume of the facial nerves following chemical blockage of cervical sympathetic trunks in dogs.
*: $p<0.05$ vs. pre-blockage level

Table 2. Hemodynamic Effects of Chemical Blockage of Cervicothoracic Ganglion in Dogs

TIME (min)	PRE	5	10	15	20	30	45	60	75	90
Mean AP (%)	100	108.2±2.7	103.6±2.3	101.7±1.9	101.2±2.1	99.5±1.4	99.7±1.1	100.6±1.4	101.5±1.8	102.1±2.3
H.R. (%)	100	98.7±1.2	98.2±1.6	97.2±1.6	97.6±2.1	98.1±1.2	98.7±1.3	99.6±1.7	99.7±1.1	99.7±1.4

Values are mean±SE, No statistical differences observed

PRE= pre-blockage, Mean AP= mean arterial pressure, H.R. = heart rate, values: mean±SE

1.6%. This significant enlargement persisted up to 60 minutes. (Fig. 3)

Blood pressure and heart rate showed no significant changes even after the SGB. (Tab. 1)

Animal model experiments:

The blood flow volume in the common carotid artery increased markedly immediately after injection of drugs, and reached a peak of 143.5 ± 7.5% at 15 minutes. This was followed by a gradual decline although a significant increases persisted for up to 45 minutes, and the value then gradually returned to the pre-blockage level. (Fig. 4)

Also, the tissue blood flow volume of the facial nerves almost paralleled that in the common carotid artery. From 5 minutes after performing SGB it increased significantly, and reached peak values of 115.2 ± 2.8% at 20 minutes, followed by a gradual decrease. A significant increase persisted for up to 60 minutes after which the value returned to the prior level. (Fig. 5)

At the time of injection of the drug, arterial pressure and heart rate both showed transient increased, but thereafter displayed no marked changes. (Tab. 2)

DISCUSSION

The main pathophysiological conditions of Bell's palsy are thought to be due to impairment of microcirculations of the facial nerves inside the temporal bone, and edema and compression caused by ischemic changes in the nerves appear to be the mechanism for the development of palsy. Anatomically, the main nutrient blood vessels to the facial nerves inside the temporal bone are the external carotid artery system, and a close relationship between the onset of Bell's palsy and circulatory disorders in the external carotid artery system has been summarized. In clinical cases, it has been reported that facial palsy occurred due to circulatory disorders in the external carotid artery system associated with therapeutic procedures[1,2,9,13]. There have also been reports on facial palsy produced experimentally by means of circulatory disorders caused by artificial procedures[6,10]. It was strongly suggested in all these cases that ischemic facial palsy occurred due to circulatory impairment in the external carotid artery system.

On the other hand, when treatment is considered in accordance with circulatory disorder associated with the onset of facial palsy, attention is focused on the effects of blockage of cervical sympathetic trunks on circulation of the facial nerves. In the previous study in patients at the acute stage of Bell's palsy, SGB markedly increased the blood flow through the external carotid artery and the common carotid artery at 30 minutes after performing SGB due to the dilatation of peripheral blood vessels in the external carotid artery and in the nutrient blood vessels of the facial nerve. It became clear that blood flow volume almost doubled, and it was evident that SGB in treating Bell's palsy patients markedly increased the blood flow to the nutrient blood vessels of the facial nerve[11].

In this study, along together with examining the effects on blood flow volume through the common carotid artery due to SGB, we investigated changes in blood flow volume in the facial nerve in experimental animals using a laser Doppler tissue blood flowmeter. This method has been used in continuous measurements of microcirculation by analyzing cyclic count changes undergone when the laser beam disperses the erythrocytes inside the tissue[12), and was found useful for continuous evaluation of microcirculation locally in the brain[5) and in the cerebral cortex[4).

Our results indicate that in parallel with the increase of the blood flow volume through the common carotid artery due to SGB, the tissue blood flow volume in the facial nerve also clearly increased, confirming that SGB markedly increases blood flow in the nutrient blood vessels of the facial nerve. Since both the postganglionic fibers containing noradrenaline and those containing neuropeptide Y in the sympathetic perivascular nerves are blocked by the sympathetic blocking action based on the circulation improving effects of SGB, both arteries and veins are dilated[14). Therefore, the circulation improving effects of SGB are thought to be effective in treating not only neural damage of blood flow stoppage due to vascular constriction, but also, in the regeneration of nerve fibers that have already undergone Wallerian degeneration, and secondary disorders due to entrapment as well.

It was concluded from this study that chemical blockage of the cervical sympathetic trunks caused marked increases in blood flow volume through the common carotid artery and in the facial nerve tissue, which resulted in improvement of microcirculation of the facial nerve itself, SGB appears to be a very effective treatment method for Bell's palsy.

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