

## Observation of Microcirculatory Change in the Great Occipital Nerve

Shobu SHIBATA and Masashichi KAWANO

*Second Department of Surgery*

*Nagasaki University School of Medicine, Nagasaki, Japan*

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One-third of the patients with chronic post-traumatic headache have tenderness of the occipital nerves and, in lesser degree, of the trigeminal nerve. Various factors may contribute to this neuralgic reaction of these nerves which produce headach of extracranial pathology which we have been studying clinically and experimentally.

In this paper we report of the observation of changes in microcirculation of the great occipital nerve following occipital cooling and compression. To reverse the impaired microcirculation we adovocate early ambulation and active exercise. Intramuscular injection of adrenaline is expected to produce similar effect on microcirculation which was observed under the perspective microscope.

### MATERIALS AND METHOD

To observe the effect of occipital compression the great occipital nerve of the rabbit was ligated in two places 3cm apart. The ligature was released 40 minutes later and microcirculation was observed during and after ligation. In some cases division of the nerve was added.

In the second series of experiment the occiput of the rabbit was cooled with ice bag at 5 degree C. and microcirculation of the nerve was studied for 6 hours. In the third series of experiment 0.013mg/kg of adrenaline was injected intramuscularly and observed to see the behavior of microcirculation during physical activity represented by increased pulse rate, blood flow and blood pressure.

### RESULTS

1. Effect of Compression: In the normal control the erythrocytes fill all lumens of the arteriole and the capillaries along the great occipital

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\*柴田尚武, 川野正七

nerve and flow as a homogeneous blood stream to one direction (Fig. 1). After 30 minutes of compression stasis in the venule appears showing nearly suspended blood flow with partial sludge phenomenon of the blood cells (Fig. 2). Due to marked stasis the capillaries are distinctly visible in contrast to the control presenting sludge phenomenon and extravasation of the erythrocytes. Figure 3 shows the control, and Figure 4 shows microcirculation after 30 minutes of nerve compression. Stasis and sludge phenomenon are visible in the arteriole and the venule. When the great occipital nerve was divided distally, the arteriole and the venule show strangulation associated with stasis and extravasation (Fig.5).

2. Effect of Cooling: The occipital region of the head was cooled with ice on 8 rabbits, and change in microcirculation of the nerve was studied one, three and six hours after initiation. Subdermal temperature drop to 5° to 10°C. in 5 or 10 minutes and was maintained around 5°C (Fig. 6). In contrast to the control (Fig. 7) movement of the vascular wall becomes active after one hour of cooling (Fig. 8), showing irregularity of the diameter. Stasis and partial sludge phenomenon are reversed to the normal state, if cooling be stopped at this stage. After 3 hours of cooling the vessels are dilated and sludge phenomenon are common accompanied by interruption of capillary blood flow (Fig. 9). Return to the normal blood flow of the capillary is not always possible at this stage, even if cooling was stopped. After 6 hours or longer cooling sludge phenomenon appear everywhere and rupture of the venules accompanied by extravasation is found (Fig.10). Edema of the nerve is diffuse in this stage and all changes are irreversible.

3. Effect of Adrenaline: Adrenaline was injected intramuscularly, 0.013 mg per kilogram body weight, on rabbits to create the physical conditions similar to those in active exercise. Cardiac contraction markedly increased in one minutes accompanied by increased pulse rate (plus 20) and blood pressure (plus 60mmHg.) In contrast to the control (Fig.11) marked increase of blood flow is found one minute after injection of adrenaline (Fig.12).

## DISCUSSION

These findings in the first and second series of experiments suggest that continuous compression of the occipital region with pillow and cooling with ice pillow customarily ill-advised and practised after head injury regardless of the grade of trauma, may give untoward effect on microcirculation of the vasa nervosum of the great occipital nerve leading to prolonged hypoxia, increased irritability of the nerve and lowered pain threshold of the nerve manifested as neuralgic occipital headache. And ambulation and active exercise will improve microcirculation of the nerve and contribute to healing of headache.

We are going to study the effect of therapeutic agents on microcirculation of the nerve as a part of investigation of pathogenesis and treatment of chronic post-traumatic headache.

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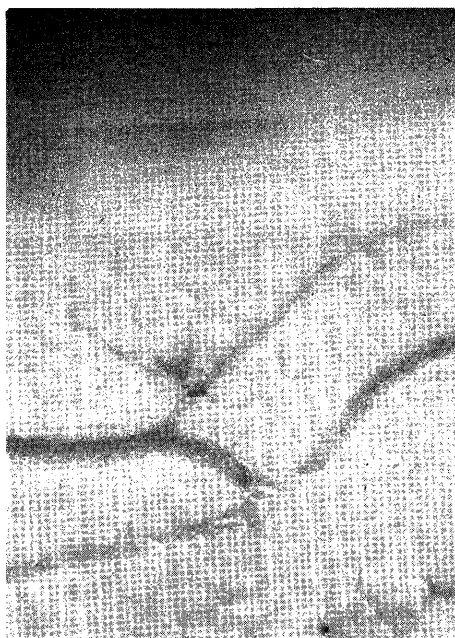


Fig. 1. Microcirculation of the great occipital nerve in rabbit (control).

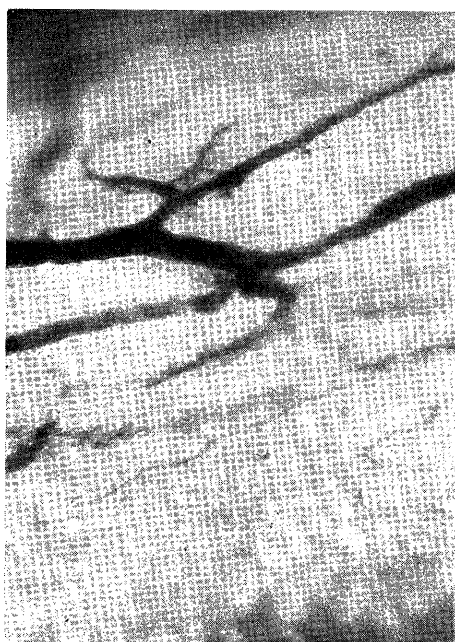


Fig. 2. 30 minutes after compression of the great occipital nerve.



Fig. 3. Control.



Fig. 4. 30 minutes after compression of the great occipital nerve.



Fig. 5. Amputation.

Room temperature 24~26°C

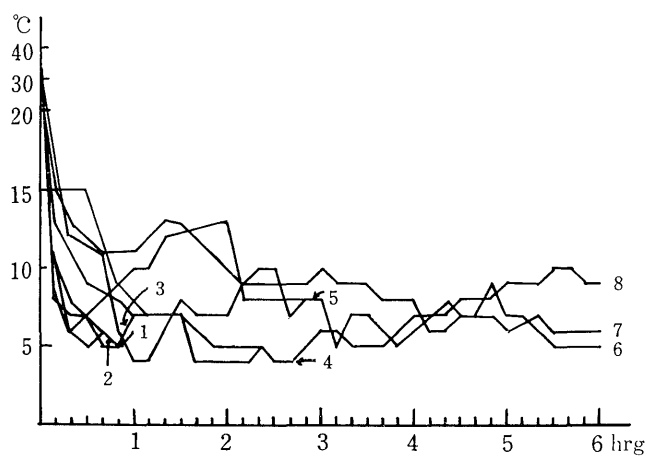


Fig. 6. Subdermal temperature of the occiput following cooling with ice.



Fig. 7. Control.

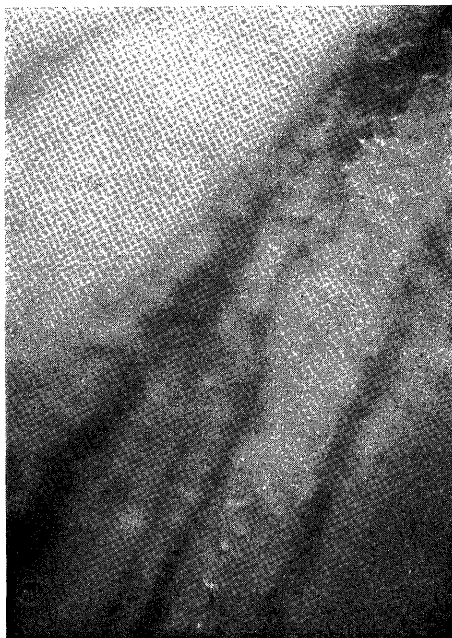


Fig. 8. After one hour of cooling.

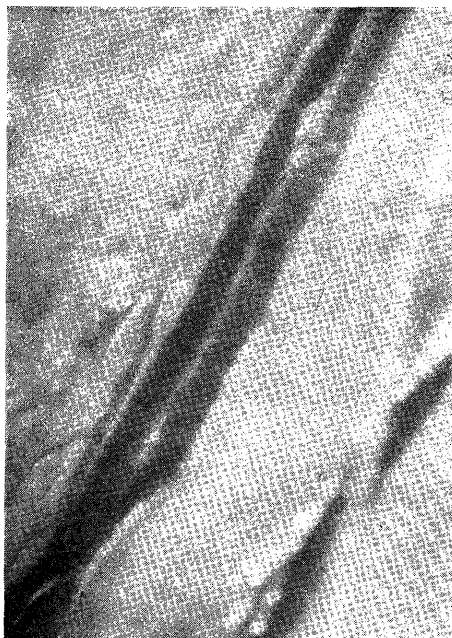


Fig. 9. After three hours of cooling.



Fig. 10. After six hours of cooling.





Fig. 11. Control.

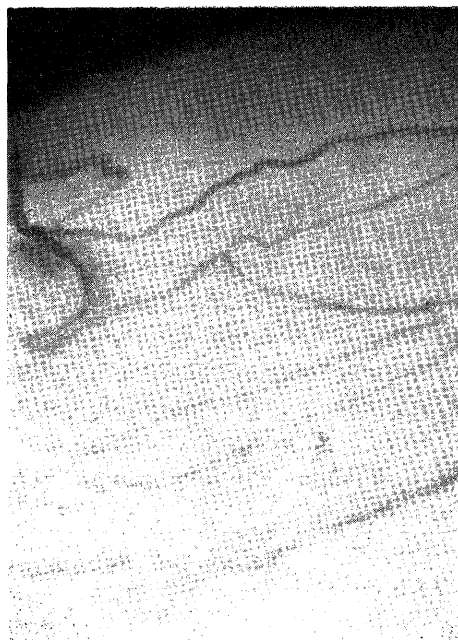


Fig. 12. One minute after injection of adrenaline.