Experimental Study of Combined Coaxial Irradiation by High-peaked Puls Wave Form CO\textsubscript{2} and Nd:YAG Laser on the Brain

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The CO\textsubscript{2} laser is optimal for cutting and vaporization but not for the coagulation and hemostasis. To the contrary, YAG laser is effective for coagulation and hemostasis but not for cutting. The purpose of this study is to examine the effect of the radiation of combined, co-axial CO\textsubscript{2} and YAG laser on the animal brain to supplement the advantages and drawbacks each other.

To compare these results, non-combined puls wave form CO\textsubscript{2} or YAG lasers was irradiated separately.

(MATERIALS AND METHODS) The lasers in this study were puls wave form CO\textsubscript{2} and YAG lasers, irradiating separately or simultaneously using 130 YZ of NIHON INFRARED INDUSTRIES COMPANY. Japanese white rabbits were anesthetized with pentobarbital. Fronto-parietal burr holes were made, dura was removed and then Evans blue solution was injected intravenously. The lasers were irradiated on the area without the great vessels on the brain through a micromanipulator which was attached to an operating microscope with a distance of 30 cm. The spot size was 0.7 mm for CO\textsubscript{2} laser and 1.2 mm for YAG laser.

First experiment was to see the effect of simultaneous coaxial CO\textsubscript{2} of 2, 4 and 8 watts and YAG lasers of 10, 20 and 40 watts, 1sec on the brain, which constituted 9 subgroups.

In the second experiment also in the combination of two lasers, the radiation time of YAG laser was elongated 1 or 3 seconds into 2 or 4 seconds and the arrangement of powers was the same as that of the first experiment, constituting 18 subgroups.

To compare these results, the third experiment was performed, in which CO\textsubscript{2} and YAG laser was irradiated independently with the laser power of comparative value in the first and second experiment. 15 minutes after the radiation, the brain was prepared for the histological examination.

(RESULTS) The diameter of the laser incision (crater) ranged 1500-3000 micron, which is 2-4 times greater than the spot size.
of the laser beam. The size of crater and carbonization were not affected by the wattage of CO2 laser. To the contrary, the crater and the Evans blue stained area increased in size with the rise of YAG laser energy. The non-combined YAG laser did not produce a crater when the energy was low. The size of Evans blue stained area increased remarkably with the rise of YAG laser energy, but not of CO2 laser.

The HE preparation showed the lesions by the radiation of YAG laser were all characteristically ellipsoidal. When the energy of radiation was raised, the lesion increased in size especially in the deep portion but not in the superficial area. There was an increase of surrounding edematous layer, which extended to 800 micron. The lesion of combined radiation was sharply pointed, wedge-shaped and the necrotic zone was clearly demarcated, in contrast to that of non-combined YAG radiation. In addition, necrotic layer was thicker but the edematous layer thinner. And when the power of CO2 laser was increased into twice value but that of YAG remained the same, the depth of the lesion increased about twice but diameter was not affected. When the energy of YAG laser was increased into twice value, the necrotic zone was increased also twice in thickness.

The frequency of the hemostasis in the radiation of YAG laser alone was 86%, that in combined CO2 and YAG(40, 20 and 10 watts) lasers were 59%, 51% and 47% respectively and that in CO2 laser alone was 18%.

((CONCLUSION))
1. The efficacy for hemostasis by laser radiation was as follows: Nd:YAG laser alone > combined CO2 and YAG lasers > CO2 laser alone.
2. In the combination of CO2 and YAG lasers, the more the power of YAG laser was increased, the more the frequency of hemorrhage was decreased.
3. The lesion size by the combined laser radiation was greater than that of CO2 or YAG laser alone. Nd:YAG laser contributed to the increase of the lesion diameter, and the CO2 laser, the depth of the lesion.
4. As the time of radiation of YAG laser was increased, the microcyst was observed more often. From these results, the longer radiation of YAG laser (which may be over 2 seconds) on the same spot should be avoided.