Laser Surgery
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Three kinds of apparatus of CO$_2$ laser, that is, Medilaser S, NIIC Lasery 60 and NIIC Lasery Model 60Z, are used in our institute. Two kinds of apparatus of Nd-YAG laser, that is, Molectron Model 8000 and Medilas are utilized also. We have used CO$_2$ lasers for removal of tumors in 75 brain tumor cases and 9 spinal cord tumor cases. CO$_2$ lasers were also used for hemostasis in the muscle layer and subcutaneous tissue in 31 neurosurgical cases. YAG lasers were utilized for removal of brain tumors in 20 cases and also hemostasis in the muscle and subcutaneous layers in various neurosurgical procedures in 24 cases. CO$_2$ lasers and Nd-YAG lasers have their respective characteristics. We believe the neurosurgical procedures will be performed more safely and quickly, should these equipments be used properly.

Clinical Materials: We have used CO$_2$ lasers for removal of brain tumors in 75 cases including 40 cases of meningiomas. Out of the 40 cases 19 were basal meningiomas and the remaining 21 were either convexity meningiomas or falx and parasagittal meningiomas. Out of 75 cases of the brain tumors 21 were gliomas and the remaining 14 cases were miscellaneous intracranial lesions consisting of 4 chordomas, 3 chemodectomas, 2 orbital tumors, 2 cholesteatomas, 1 pituitary adenoma, 1 dural AVM and 1 brain abscess.

YAG lasers were used for removal of brain tumors in 20 cases. They were 7 basal meningiomas, 2 convexity meningiomas, 2 cerebellar hemangioblastomas, 2 orbital tumors, 2 pineal tumors, 1 chordoma, 1 facial neurinoma, 1 CP angle glioma, 1 intraventricular glioma and 1 temporal osteosarcoma.

Results: For amputation of the tumors or vaporization of the tumor tissues, focused beams of CO$_2$ laser 60W in output power were very effectively used in 15 cases including chemodectomas, pineal tumors and gliomas. YAG laser beams 100W, 0.5 sec. at 0.5 cm distance were used for making small holes in tough cyst walls of the teratomas in the pineal region for draining of soft contents and internal decompression of the tumors. Thereafter these deeply seated tumors were able to be removed totally without causing any damage to the surrounding neural structures. Separation of the cyst walls of gliomas from the adjacent normal brain tissue$^1$ was performed easily in 3 cases using CO$_2$ laser with near-focused beams of 30W in output power.
Defocused beams were used more frequently than the focused beams for removal of brain tumors, especially for hemostasis on the exposed surface of the tumors such as meningiomas, chordomas and malignant tumors of the skull. We have used CO\textsubscript{2} laser beams of 40 - 60W in output power effectively in 25 cases of such tumors. YAG laser beams of 60 - 100W at 3 - 7 cm distance were used very effectively in 5 cases of tumors mentioned above. Coagulation of the attachment of the basal meningiomas\textsuperscript{1)} in order to control the feeding vessels and also prevent recurrence of the tumors has been performed very effectively by CO\textsubscript{2} laser beams in 19 cases and YAG laser beams in 17 cases. Chemodectomas and hemangioblastomas can be removed relatively easily after coagulating their exposed surface by either CO\textsubscript{2} laser beams or YAG laser beams. The defocused beams of CO\textsubscript{2} laser or YAG laser beams at a certain distance were extremely effective for removal of the glomus jugulare tumor\textsuperscript{1,2)} which was a typically densely vascular tumor at the base of the skull and had remarkable arteriovenous shunts not only in the tumor tissue, but on its surface. For this purpose we used defocused CO\textsubscript{2} laser beams of 40 - 60W in output power in 5 cases and YAG laser beams of 60 - 100W in output power at 3 - 5 cm distance in 2 cases.

For removal of spinal cord tumors we have used CO\textsubscript{2} lasers in 9 cases. Especially internal decompression of intramedullary lipomas was very effectively performed with high peak pulse CO\textsubscript{2} laser beams without causing any damage to the surrounding neural structure. In such occasions the output power was 5W per second with pulse width of 0.5 mm per second and repetition of 100 per second. By this set-up the maximal peak power is approximately 250W. Attachments of meningiomas with the spinal dura could be also very easily coagulated by either defocused CO\textsubscript{2} or YAG lasers. While removing the malignant tumors involving the vertebral body, bleedings could be very easily controlled by either CO\textsubscript{2} laser or YAG laser irradiation.

Serious complications caused by laser surgery in our cases were one cortical blindness following vaporization of the posterior parasagittal meningioma with CW CO\textsubscript{2} laser beams of 60W in output power, one optic nerve damage induced by repeated irradiations of YAG laser beams of 30 - 60W in output power, 0.5 sec. at 1 - 2 cm distance for controlling venous bleeding from the cavernous sinus during a trans-sphenoidal surgery and one oculomotor palsy and one trigeminal palsy occurring while coagulating the attachments of the basal tumors by repeated irradiations with YAG laser beams of 100W in output power, 0.5 sec. in duration of each pulse at 3 - 4 cm distance.
Discussion: Because the CO$_2$ laser does not have a good flexible beam guide like the one used with Nd-YAG laser, it is very difficult to use CO$_2$ laser at removal of deeply seated tumors. YAG laser appears to be more effectively used at such a situation. Recently invented high peak pulse (super pulse) CO$_2$ laser can give about 250W power instantly and vaporize very small area without causing any thermal effect to the adjacent neural structures. This special nature of the super pulse CO$_2$ laser beams can be useful for removal of small tumors such as microacoustic neurinomas, preserving facial and cochlear nerve function in the near future.

Reference