NEW TECHNIQUE FOR INTERSTITIAL IRRADIATION OF BRAIN TUMORS

JAMES W. CORRELL, M.D., NORMAN E. CHASE, M.D., AND HAROLD L. ATKINS, M.D.

Services of Neurological Surgery and Radiology, the Neurological Institute,
Presbyterian Hospital, New York, New York

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There is increasing evidence that radiation therapy is of value in the treatment of intracranial neoplasms. Reports from several different institutions have indicated that the life of patients with glioblastoma multiforme is prolonged by the addition of roentgen-ray therapy to treatment by surgical resection of tumor. Sachs, in 1954, drawing on his accumulated experiences in the treatment of patients with glioblastoma multiforme, concluded that benefit resulted from an increase in the amount of radiation delivered to residual tumor remaining after surgical excision. He implanted gold radon seeds for interstitial irradiation of the area of tumor, pointing out that the great advantages of this method were that it was possible to give larger quantities of radiation than with roentgen ray, and the radiation was concentrated in the region of the tumor avoiding an effect on the rest of the brain. It was indicated that the placement of these seeds was difficult. Gaps in the intensity of radiation could occur easily and allow regrowth of tumor. In addition, the short half-life and other physical properties of radon made its use cumbersome.

In the treatment of some malignant tumors elsewhere in the body, particularly carcinoma of the tongue and the advanced stage of cervical carcinoma when surgical resection is not possible, it generally has been accepted that interstitial irradiation by the implantation of radium needles is the most satisfactory method of treatment. However, radium needles, like radon seeds, are heavy and migrate when placed in brain tissue making adequate implantation difficult.

The development of artificial radioactive isotopes has made it possible to devise methods for interstitial irradiation free from many of the disadvantages of older materials. Henschke concluded that iridium-192 (Ir\textsuperscript{192}) was most satisfactory. This material has the advantage over cobalt-60 (Co\textsuperscript{60}) of emitting much softer gamma rays which to a larger extent are absorbed locally by tumor tissue. The half-life (74.37 days) of Ir\textsuperscript{192} is much shorter than Co\textsuperscript{60} or radium which decreases hazard in case of accidental loss, but it is long enough in contrast to radon or gold-198 (Au\textsuperscript{198}) to permit storage for over 2 months. Iridium-192 can be produced in much smaller sizes than radon or Au\textsuperscript{198} sources. In addition, Ir\textsuperscript{192} presents a much smaller risk to hospital personnel than radon or Co\textsuperscript{60} since it has a gamma radiation that is much more easily shielded by lead. Henschke showed that satisfactory and effective implantations of greater volume could easily be made under circumstances previously not feasible by using Ir\textsuperscript{192} prepared as seeds and placed at fixed intervals in fine, flexible, nylon-ribbon carriers. The seeds were made by encasing Ir\textsuperscript{192} in stainless steel which absorbs the emitted beta particles. It seemed that this method of interstitial irradiation possessed properties that should be of value in the treatment of intracranial neoplasms.

The method of Henschke has been modified, adapting it for intracranial use, and a clinical trial has begun with some encouraging results.

TECHNIQUE

Iridium is prepared by the manufacturer en while the manufacturer en- cased in stainless steel cylinders (seeds) measuring
approximately 3 mm. in length and 0.5 mm. in diameter and fixed in nylon ribbon spaced 1 cm. apart on center. The nylon ribbons were modified by attaching a 00 silk suture to one end and each ribbon was cut to a length of 8 cm., and contained 8 seeds (Fig. 1). Needle guides and other equipment used for extracranial implantations were found to be unnecessary.

The procedure is carried out under direct vision at the time of craniotomy, either immediately or soon after adequate decompression of the brain. The precise area and extent to be implanted are estimated utilizing all available clinical and radiological information, as well as that obtained at the time of operation. The free end of each ribbon is inserted into the tumor-bearing portion of the brain, having been cut to length depending on the depth of irradiation desired, so that the end of the ribbon with the suture attached approximates the cortical surface of the brain. The ribbons are inserted in a parallel fashion at a distance as near to 1 cm. from each other as possible, to provide all portions of the implanted area with the full calculated dose of irradiation. The sutures attached to the cortical ends of the ribbons are collected and buried at a convenient site beneath the scalp where they can be easily retrieved at the end of the time calculated to give the necessary dosage. At that time, the sutures are exposed by a small incision in the scalp, under local anesthesia, and the ribbons are withdrawn easily by gentle traction.

The plan of the implant follows a Paterson-Parker* distribution for radium as closely as possible. A tissue dose of 5000–6000 r usually is achieved in 4–7 days with seeds having an initial activity equivalent to 0.3 to 0.5 mg. of radium. The exact rate of dosage is calculated from the Paterson-Parker tables for interstitial radium implantation* after measurements are obtained from the post-implantation roentgenograms.

During the implantation and removal no special instruments, other than long forceps, are necessary.

COMMENT

It has been demonstrated that Ir$^{192}$ can be used for interstitial irradiation of brain tumors. Fig. 2 shows the implantation of Ir$^{192}$ in a patient with glioblastoma multiforme. Decrease in vascularity of a recurrent hemangioblastoma of the cerebellum shown by vertebral arteriography, after interstitial irradiation by implantation of Ir$^{192}$, is demonstrated in Fig. 3. It is evident that this technique has resulted in a favorable effect on the tumor in the area of implantation, with clinical improvement. However, as shown by the patient described in Fig. 3, the full extent of the tumor must be implanted to prevent recurrence.

The materials used are easy to handle, and the procedure has a high probability of obtaining adequate effective irradiation of all parts of the volume of tissue implanted while sparing surrounding normal parenchyma. In addition, there is minimal hazard to all persons in the operating room. During recent operations using the above technique, the surgeon has received less than 21 milliroentgens, the radiologist assisting the surgeon even less, and others have shown no evidence of exposure. These figures are well below the allowable maximum per week, and with experience it is probable that this can be reduced.

It is believed that this method of irradiation deserves further evaluation and will prove a valuable adjunct in the treatment of intracranial neoplasms when complete surgical resection is not possible.

SUMMARY

A method for the interstitial irradiation of intracranial neoplasms by the implantation