THE CLINICAL USE OF FLUORESCEIN IN NEUROSURGERY

THE LOCALIZATION OF BRAIN TUMORS*

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In an earlier paper it was indicated that fluorescein appeared to be helpful in the detection of malignancy, particularly in the recognition of brain tumors. This report concerns the clinical use of fluorescein as an aid in the localization and recognition of intracranial neoplasms. Fluorescein has been used for this purpose during the past year in this clinic and has proved to be of definite clinical value.

Although brain tumors can usually be localized by neurological examination and ventriculographic study, this is not always true. Cerebral edema, which is so frequently present in association with subcortical tumors, often renders precise preoperative determination of the size and location of tumor impossible. Unless some evidence of the tumor appears in or through the dura at the time of operation, there is doubt concerning the exact site at which the dura should be opened, for one should confine the dural opening to the smallest defect consistent with adequate exposure. In this clinic, as well as in many others, it has been customary to locate subcortical tumors with a brain needle before the dura is opened widely. In these cases an opening is made just large enough to pass freely a brain needle into the most probable site of the tumor. A needle biopsy is obtained by creating a vacuum in the syringe attached to the needle. This biopsy material may be sectioned to determine the presence and even the type of tumor. This procedure, however, is time-consuming and the presence of edema or necrosis often makes the sectioning and mounting of the minute pieces difficult. But with the method described in this report the surgeon or his assistant can determine the presence of tumor at once. The mere presence of tumor is the essential information desired, for regardless of the type, the tumor should be removed so that an internal decompression is obtained to make recovery from the operation more certain and more rapid. Since neoplastic tissue as well as edematous tissue adjacent to a neoplasm can be recognized by applying the fluorescein technique, the value of this procedure can readily be appreciated.

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TECHNIQUE

At present, the following technique is being used in this clinic. Immediately before or upon the completion of ventriculography, 5 cc. of a 20 per cent solution of sodium fluorescein (1 gm.) is injected very slowly intravenously. With this high concentration the patient may become nauseated and vomit if the dye is injected too rapidly, but the 20 per cent solution is still being used because the small containers in which it is bottled are conveniently sterilized, and when injected more slowly the frequency of disagreeable reactions encountered is low.

Another satisfactory method is to add the fluorescein to the first 500 cc. of intravenous fluid that is started immediately preoperatively. Children require relatively greater amounts of dye than adults. A convenient volume containing the equivalent of .35 to .5 gm. of the dye gives satisfactory results. It is most important that the dye be given early enough so that an interval of at least 1 hour or more intervenes between the time of injection and the examination of the tissue under suspicion. If the tissue is examined too soon after injecting the dye, the differential fluorescence of normal and neoplastic tissue is insufficient for diagnosis. On the other hand, if the interval is greater than 5 hours, the degree of fluorescence is diminished. The maximum tissue fluorescence is attained in about 2 hours.

At the time of operation, the material obtained by needle biopsy is collected on gauze squares and examined under ultraviolet light. A CH-4 Mercury Vapor Lamp with a Wood's filter has been found to be convenient and efficient for this purpose.

Since it is not necessary to darken the room in order to view the difference in fluorescence, the examination can be carried out in the operating room.

CLINICAL EXPERIENCE

In 46 patients operated upon because of a clinical diagnosis of a possible brain tumor, fluorescein has been injected intravenously before operation and 52 needle biopsies have been obtained and examined under ultraviolet light. In addition, the gross specimen was examined and the presence or absence of fluorescence recorded. The pathological examination of individual needle biopsies was done by one of us (W. W. Walker) and the final diagnoses are taken from the records of Dr. A. B. Baker, Division of Neuropathology. The results appear in Table 1.

Of the 46 patients subjected to the fluorescein technique the presence or absence of tumor tissue was correctly determined in 44 instances. In one case (#31), the correct diagnosis was suggested but not unequivocally.

In one instance (Case #15), a needle biopsy appeared to fluoresce even though no neoplastic cells were found by examination of multiple frozen sections. No reason for this discrepancy can be given. In another instance, (Case #17), six pieces of tumor tissue (angioblastoma) did not fluoresce when examined under the ultraviolet lamp. It is possible that in this case, the excessive amount of clotted blood present obscured such fluorescence as might have been present.

It is noteworthy that the fluid aspirated from cysts associated with brain tumors have invariably fluoresced a brilliant yellow. The specificity of this phenomenon is not known since no cysts have been explored that were not associated with tumor tissue. Fluid obtained from the ventricles does fluoresce faintly, but can easily be distinguished from cyst fluid.

After removal of infiltrating brain tumors, the residual cavity can be examined directly under the ultraviolet lamp. In several cases, additional small pieces of tumor tissue which had escaped notice when viewed with