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A Preliminary Evaluation of Fluorine-18-Labeled Tetrafluoroborate as a Scanning Agent for Intracranial Tumors

W. Entzian, S. Aronow, A.H. Soloway and W.H. Sweet

Massachusetts General Hospital, Boston, Massachusetts and Neurochirurgische Universitäts Klinik, Bonn, Germany

Radioisotopic localization of intracranial space-occupying lesions has become a standard diagnostic procedure in many neurosurgical centers, utilized routinely in patients with suspicion of tumor or other focal intracranial lesions.

Coincidence detection of the annihilation radiation from positron emission has distinct advantages in comparison with simple gamma-emitting isotopes for recording such lesions. Of those positron-emitting isotopes which have been evaluated in man, ^{72}As and ^{74}As as sodium arsenate have been the isotopes of choice from a localization standpoint. However, the long half-life of ^{74}As, 17.5 days, and the fact that it is cyclotron-produced are major disadvantages. Copper-64 chelates have been used to circumvent these two drawbacks of ^{74}As.

The work of Anbar et al. in producing and utilizing ^{18}F as a scanning agent is of great significance in this recent development. Fluorine-18 is a pure positron-emitter with a 112-min half-life. Large single doses may be administered for rapid localization of lesions and repeated tests performed within short time intervals.

The present work is a series of studies with animals and with human patients using potassium fluoroborate labeled with ^{18}F. It corroborates the excellent work of Askenasy et al. in the localization of intracranial lesions using the $B^{18}F_4$ anion.

While the number of scans performed, 10, is limited and allows no generalizations, we do confirm the results obtained by Askenasy et al. In all cases, except the benign intracranial hypertension in which there was no evidence of focal disease, the ^{18}F scan was checked against a scan with arsenic or copper, or both.

The glioblastomas were clearly localized. The fluorine scan was somewhat poorer than the copper, possibly due to the fact that the scan was begun 10 min after injection. This seems to be too short a time for good localization. In one case, an astrocytoma was clearly missed with both isotopes and was seen in another case. This is consistent with the analysis of arsenic scans—that astrocytomas are frequently not seen. In Patients F and I, there was some bony involvement of the neoplasms. In both patients, visualization with fluoroborate was better than with other isotopes. There is a possibility, which is being investigated further, that some fluorine may be split off biologically from the complex ion and appear as a fluoride ion going preferentially to such bone or that the $B^{18}F_4$ was contaminated with ^{18}F and a more rigorous purification of $B^{18}F_4$ is required. Metastatic melanoma in Patient G was missed with fluorine though seen with copper, and metastic carcinoma in Patient H was visualized with all isotopes, but the images were equally poor.

In summary, we think that labeled fluoroborate ion may prove to be a satisfactory scanning agent and should be explored further, as illistruated by these cases.

Although this series of scans reveals no unusual physiological advantages of $B^{18}F_4$ as a conventional scanning agent, its physical properties must be emphasized. Administration of 20 to 40 mCi, giving a whole-body dose of only 1 to 2 rads, would be permissible for routine scanning and even higher doses would be appropriate for patients with known focal lesions. While these higher doses per se do not guarantee better diagnostic accuracy, they would allow greatly refined resolution with currently used scanning times. Alternatively, the scanning time might be appreciably reduced. These improvements could open new avenues for scanning procedures such as transient studies.

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