ISOTOPE SCANNING FOR TUMOR LOCALIZATION

Study of the distribution of a radioisotope administered to the body has become increasingly important in medical diagnosis and research, for the distribution can indicate the condition of the tissue which takes up the isotope. If the distribution can be studied visually - as is done in radioisotope scanning - the existence or location of a tumor or any other space-occupying lesion can often be detected with a degree of accuracy that is hard to obtain with the conventional methods of investigation.

The principle of obtaining diagnostic information from a visual image of isotope distribution is based on the fact that the uptake of an isotope by abnormal tissue often differs from that by normal, healthy tissue. Sometimes it is more, in some other cases less. If the isotope administered is radioactive, a picture formed by the radiations emitted would show the differences in concentration; a visual image on a screen or a photograph would enable an expert to locate a tumor from this study in contrast.

Several techniques of isotope scanning or "seeing into the body" have passed from the stage of experiment to that of established medical practice. While the instrumental approach varies, the basic problems are common. Present techniques offer a two-dimensional image, somewhat similar to the appearance of x-ray absorption as seen on an x-ray picture. The essential requirements are (1) detection of radiation with high sensitivity and high resolution (i. e. registering even very minute differences in concentration) and (2) presentation of this information in a form that can be readily interpreted.

Resolution of small differences is obtained by what is known as a collimator, and considerable improvements in collimating systems have recently been made. The problem of presentation is essentially that of producing a suitable visual image, a portrayal of the radiation distribution that would accurately reflect even the smallest differences in isotope content in an organ. If the differences were large, there would be marked contrasts and interpretation would be simple. But in many cases the differences are indeed very small and correct interpretation is difficult.

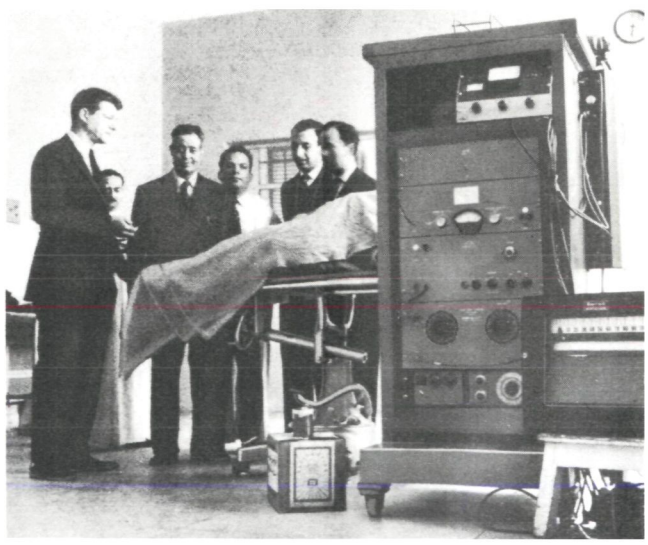
The technical problems of scanning as well as the major applications of scanning techniques were reviewed at an international scientific seminar in Vienna two-and-a-half years ago. Discussions at this meeting, which was organized jointly by the International Atomic Energy Agency and the World Health Organization, showed that isotope scanning had become an important diagnostic procedure at several advanced medical centers. It was also clear that interest in this new technique was becoming gradually more widespread.

Project in the UAR

Early this year, at the request of the Government of the United Arab Republic, the Agency provided the services of an expert for the establishment in the UAR of a tumor localization program using photoscanning techniques and appropriate radioactive tracers. Photoscanning is a recently developed technique whereby the differences in isotope concentrations are enhanced on the record, and this facilitates the interpretation of the record. It was decided that a radioisotope photoscanner would be constructed and selected personnel trained in the use of this instrument.

The expert chosen for this assignment was Dr. Merrill A. Bender, of the Roswell Park Memorial Institute, Buffalo, New York, USA, who had taken part in the Vienna seminar in 1959 and had presented two papers. An account of Dr. Bender's work is contained in a report which he has submitted to the Agency.

Dr. Bender arrived in the UAR in January this year and drew up, in co-operation with medical and technical specialists of the Republic, a program for the construction of a scanner. It was decided that a variety of important items of equipment would be obtained from the USA, while Dr. I. B. Hazza, Director of the Radioisotope Center at Dokki, Cairo, and Dr. Mahmoud Mahfouz, who acted as Dr. Bender's liaison officer, would get several pieces of electronic equipment from the isotope centers within the country. The major mechanical components of the instrument



A lecture demonstration by Dr. Bender (extreme left)

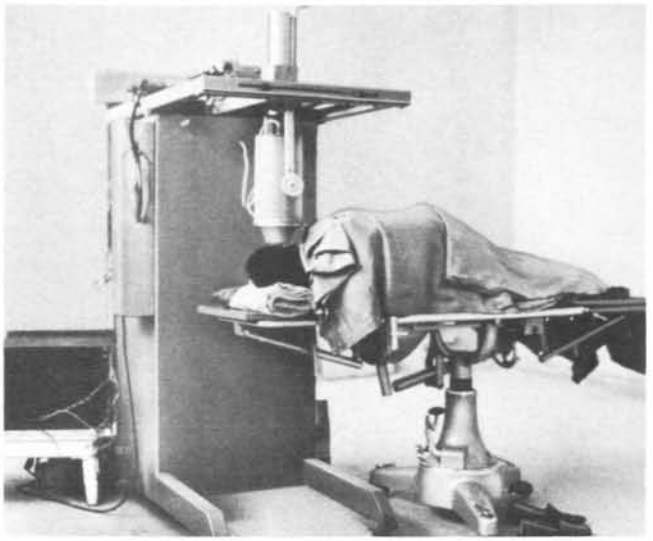
were to be constructed by Dr. M. M. Etman, an engineer attached to the UAR Atomic Energy Establishment.

The items obtained from the USA were shipped within two weeks by the Department of Nuclear Medicine of the Roswell Park Memorial Institute. At the same time Dr. Hazza and Dr. Mahfouz collected the necessary electronic equipment. These components were then assembled at the Radioisotope Center at Dokki. The carriage and housing for the scanner were constructed by Dr. Etman, who also provided the lead shield. This completed the construction of the unit, but at the same time Dr. Etman had begun construction of the mechanical components of three additional scanners of his own, and in the opinion of Dr. Bender, an improved design. With four complete scanners, there will be one for each of the four neurosurgical centers in the Republic.

Localization of Brain Tumors

At the beginning of April, the photoscanner constructed under the IAEA technical assistance project was moved from the Radioisotope Center to the Neurosurgical Unit at Kasr el Einy Hospital, and clinical trials were begun. A variety of brain tumors were located, using a suitable radioactive tracer (Hg^{203}-labeled Neohydrin) obtained from the USA. In some other investigations, processes in the kidney were scanned. Further, radioactive gold was used to demonstrate the normal and pathological spleen and liver and these tests showed various types of space-occupying lesions resulting from malignancy and the parasitic infections endemic to the area. "There was", says Dr. Bender in his report, "more than an ample supply of patients who would receive considerable benefit from these studies."

While the localization of brain tumors by scanning techniques is extremely useful, it does not always establish the precise extent of the tumor which should be known at the time of surgery. Dr. Bender, therefore, thought it advisable to instruct personnel in the use of what is known as an in-vivo needle scintillation probe - a technique for the investigation of



The photoscanner in operation

the isotope concentration in a particular tissue during operation. The necessary instrument was obtained for this purpose and demonstrations were given; one patient was examined in this way at the time of surgery at the University of Alexandria Hospital.

Before undertaking actual operational guidance, Dr. Bender gave a series of lectures on photoscanning techniques and tumor localization. The lectures, given at different centers, were attended by physicians, scientists and technical personnel. Besides, during the construction of the scanner and later during the clinical trials, a small number of scientists were given intensive training in the use of the instrument. "I am confident", says Dr. Bender, "that the majority of the professional personnel have a thorough understanding of the theory of operation, and to support this belief, a significant number of excellent scans were obtained by members of this group without assistance or advice from me." He adds: "I believe that the radioisotope scanning program has enough impetus and a sufficient nucleus of trained personnel to make it essentially self-sustaining from now on".