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Condensed from
30 Years Ago

Technetium-99m-Pertechnetate for Brain Scanning

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Element No. 43, the metal technetium, "the artificial one," was discovered by Segré in 1937. This element was so named because it does not exist in nature. All of its nuclides are radioactive. Together with manganese and rhenium, it forms group VII A of the periodic table of elements, and its chemical behavior is similar to rhenium. Similarities have been noted in the biological behavior between pertechnetate ions and the halogens, which form group VII B of the periodic table. Concentration of pertechnetate in the thyroid of animals was demonstrated by Baumann. In 1963, the gamma emissions of the nuclide ^{99m}Tc were first used clinically for visualization of the liver by scintillation scanning, following administration and hepatic localization of the parent nuclide ^{99}Mo. Harper et al. first administered ^{99m}Tc parenterally for scintillation scanning of the thyroid gland and later for localization of brain tumors. Since January 1964, we have used this material routinely for brain scanning because of its ideal physical characteristics. The short physical half-life of 6 hr, the absence of beta emission and the gamma emission of 140 keV permitted the administration of large amounts of radioactivity (1 to 10 mCi) without excessive irradiation of the patient. Because of the higher counting rates obtained, the statistical variations in count rate were minimized, and the technique of brain scanning was much improved compared with older agents such as ^{131}I-serum albumin and ^{203}Hg or ^{197}Hg-chlormerodrin.

We discuss the applicability of ^{99m}Tc-pertechnetate as an agent for brain scanning, its tissue distribution in animals and man, and the relative merits of oral versus intravenous modes of administration.

In a series of 133 patients, ^{99m}Tc-pertechnetate produced significantly better brain scans technically than the older agents ^{131}I-albumin or ^{203}Hg-chlormerodrin. Although clinical experience with this agent is still limited, it would appear that certain tumors frequently missed with older agents, such as low-grade astrocytomas and supracellular cysts, also may be missed with pertechnetate. The concentrations of this material in transplantable gliomas and normal brain tissues of mice were similar in magnitude to those obtained with the older agents.

The superiority of labeled pertechnetate appeared to be due entirely to its physical characteristics, i.e., essentially monoenergetic gamma emissions of 140 keV, absence of beta emission and short physical half-life of 6 hr. These characteristics permitted the administration of relatively large doses of 10 mCi and a significant reduction in the procedure time; yet the radiation doses were kept below the levels obtained with other agents.

The radioactive preparation is easily obtained on a daily basis from a commercially available ^{99}Mo-^{99m}Tc generator. In this laboratory, the intravenous mode of administration is preferred over the oral, although both methods of administration have been tried. The intravenous method produces more consistent results, somewhat higher count rates with the same amount of radioactivity administered, and slightly lower fractions of the administered radioactivity are excreted in the feces. The oral route, however, may be preferred at other institutions when immediate sterilization of the radioactive material cannot be carried out conveniently. By the oral route, satisfactory gastrointestinal absorption can be obtained in approximately 90% of all patients. Furthermore, with oral administration, pyrogen-free reagents need not be used, and the volume of the eluate is not critical.

It is hoped that the use of this radionuclide in the near future can be further simplified by the development of an automatically timed elutor-titrator.

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