Evaluation of ^{99m}Tc-sodium tripolyphosphate as a bone seeking agent

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We have performed bone scans with ^{99m}Tc-sodium tripolyphosphate (STPP).

The preparation of ^{99m}Tc-STPP is based on Subramanian's method with slight modification. The method is as follows. We prepare ^{99m}Tc-STPP by "Kit system". All reagents are sterilized and loaded in the vials. (1) Add about 5 ml of pertechnetate to the first vial containing 1 ml of stannous chloride in 1 NHcl ($Sncl_2 \cdot 2H_2O$) and stir the mixture well. Wait for five minutes. (2) Add 1 ml of sodium tripolyphosphate (20 mg/ml) in the first syringe to the first vial and stir the mixture well. Wait for five minutes. (3) Add 1.4 ml of $NaHco_3$ in the second syringe to the first vial. PH is adjusted to 6.5–7.5. If all procedures are performed aseptically, there is no need to sterilize the compound.

The organ distribution of ^{99m}Tc-STPP is studied in rats. It is estimated that 43.5% of administered dose is localized in the skeleton one hour after injection. The ratio of the concentration in the skeleton to that in the other organ is high enough to delineate the skeletal system using scintiscanner or gamma camera. The bone/blood, bone/liver and bone/muscle ratio are 6.2, 21.5 and 33.7 respectively, Radioactivity of the liver is little compared to that of bone. The liver uptake of ----Tc-STPP is about 1.0% injected dose. When the final PH is adjusted above 7.5, there occurs colloid formation and the liver uptake is increased. The urinary excretion of ^{99m}Tc-STPP is 25.4% of the administered dose one hour after injection.

Animal studies performed shows that it is possible to use ^{99m}Tc-STPP as a bone seeking agent. Various bone diseases are delineated by rectilinear scanning. Administered dose are 3 to 10 mCi. A blood pool background is high when a scan starts two to four hours after injection. An injection to scan interval of about 6 hours seems satisfactory in many sites. It is possible to delineate skeletal system 24 hours after injection.

Studies of Sn-compounds as the Bone Scanning Agents

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^{85}Sr, ^{87m}Sr, and ^{18}F have been used in clinical scanning of bone. But these nuclides have disadvantages in their half lives or energies. So, in order to investigate the nuclide having suitable half life and energy for clinical bone scanning, this experiment was undertaken.

In our experiment already performed, strong affinity of Sn-compounds for the bone were observed. So, affinity for the bone and the other organs of ^{113}Sn-compounds was examined by using rats. ^{113}Sn-citrate and ^{85}Sr-chloride were injected intravenously to each group of rats and these rats were sacrificed 1 hour, 3 hours and 24 hours after injection. The radioactivities of blood,

muscle, liver, kidney, spleen and bone were measured by a well-type scintillation counter, and the retention value in each tissue was calculated and expressed as a percent dose per gram-tissue weight. In order to determine the biological half time of ^{113}Sn-citrate in rats, the rats to which ^{113}Sn-citrate were injected intravenously were measured by the animal whole body counter for sixteen days.

The retention values of ^{113}Sn-citrate in bone were 2.0%/g at 1 hour, 1.9%/g at 3 hours and 2.0%/g at 24 hours. And bone-muscle concentration ratios were 77 at 1 hour, 212 at 3 hours and 389 at 24 hours, bone-blood concentration ratios were 24 at 1 hour, 110 at 3 hours and 715 at 24 hours, bone-liver concentration ratios were 31 at 1 hour, 33 at 3 hours, 46 at 24 hours. In bone-organs concentration ratios, ^{113}Sn was superior to ^{85}Sr at 1 hour, but ^{113}Sn was inferior to ^{85}Sr at 24 hours after injection. Retention curve of ^{113}Sn-citrate in rats showed rapid phase and slow phase and half time of rapid phase was 18 minutes and half time of slow phase was 30 days.

As a suitable nuclide for clinical bone scanning, the production of ^{117m}Sn by atomic reactor is being under investigation.

On Preparation of ^{99m}Tc-Sulfur Colloid for Improved Bone Marrow Imaging

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$^{99m}Tc_2S_7$ colloids (Tc-C) have been accepted as one of the best available RE imaging agents, especially that of liver. Critical reviews clarify most of their preparations are not necessarily appropriate enough for marrow delineation. Especially in dynamic assessment of marrow RE function, uniform colloidal particles of relatively smaller size are mandatory. Our efforts on development of Tc-C just suitable for this purpose was reported here.

Various modifications of the two major methods of sulfurization with $Na_2S_2O_3$ and H_2S gas were compared in respect to blood clearance T-1/2 of of radiocolloids, organ distribution, assay for free $^{99m}TcO_4^-$ by paper chromatography, and clinical and experimental marrow scintigraphy.

$Na_2S_2O_7$ method: Hepatic uptake of Tc-C ranged between 70 and 85% given dose, that of spleen between 0.3 and 3.8 respectively, and marrow uptake was assumably between 6.6 and 10%.

H_2S gas method: The longest reaction time of 50 min resulted in a greater uptake by liver and lungs, and less marrow deposition when volume ratio of gas to $^{99m}TcCO_4^-$ was kept constant at 4: 1. Tc-C from 1: 1 of gas volume ratio revealed higher blood retention. Its distribution pattern, however, was not significantly different from those of 2: 1 and 4: 1. Satisfactory marrow scintigrams were obtained of rabbits and patients alike with Tc-C prepared with the H_2S gas volume ratio to $^{99m}TcCO_4^-$ of 2: 1 or greater, and the reaction time of 20 min or longer.

In interpreting marrow scintigrams, it should be taken into account that marrow RE uptake of radiocolloids may greatly be affected by different colloidal preparations.