$^{99m}$Tc-Labeled Monofluorophosphate as a Skeletal Imaging Agent: a Comparison with Pyrophosphate and Diphosphonate

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Fluoride ions, a trace amount of bone crystal, have been shown to have a strong affinity for the hydroxyapatite crystal of bone. A sodium monofluorophosphate stannous fluoride preparation was developed at the Radiochemical Center (Amersham, England). Combination of high affinity for bone of fluorine and phosphate with the convenience of $^{99m}$Tc is attractive. We have compared its performance with those of $^{99m}$Tc-pyrophosphate and $^{99m}$Tc-diphosphonate in rabbits. Studies included chromatographic quality control, measurements of blood clearance, tissue distribution, urinary excretion, skeletal imaging and measurements of the serum calcium. The percentage labeling for $^{99m}$Tc-monofluorophosphate was 98% on paperchromatography and 85% on thin layer chromatography. A large fraction of the activity of three labels cleared very rapidly from the bloodstream, however, slow components of the curves represented the highest level for $^{99m}$Tc-monofluoro-

phosphate and lowest for $^{99m}$Tc-diphosphonate. Three hours after injection 20.0% of the dose of $^{99m}$Tc-monofluorophosphate was taken up by bone. The corresponding values with $^{99m}$Tc-pyrophosphate and $^{99m}$Tc-diphosphonate were 29.1% and 40.0% respectively. The concentration in the bone to that in other major organs was highest in $^{99m}$Tc-diphosphonate. The ratios were comparable for both $^{99m}$Tc-monofluorophosphate and $^{99m}$Tc-pyrophosphate and much lower than those with $^{99m}$Tc-diphosphonate. Visual comparison of the scans obtained with three labels confirmed the results of radioassay. All the labels were excellent skeletal imaging agents, however, $^{99m}$Tc-diphosphonate appeared superior to other two labels, because the contrast between bone and background was better. With 50 mg of monofluorophosphate and 1 mg of stannous fluoride, no hypocalcemia was noted.