due to hydrolysis of the pyrophosphate in the blood as well as in the kidneys. The total activity at 2 hours after injection was decreased to less than half of the initial counts, suggesting the possibility of the scanning in short time after injection.

Sequential bone images with $^{99m}$Tc-pyrophosphate were done to find optimal time for scanning. All images from the gamma camera were collected onto the cassette tape through the newly devised systems and the change of the bone to soft-tissue ratio and lesion to normal bone ratio with time were studied. Bone to soft-tissue ratio increased as that of $^{85}$Sr bone scan. $^{99m}$Tc-pyrophosphate appears to be an excellent agent for bone scanning considering ideal physical characteristics of $^{99m}$Tc, rapidly with time till 2 hours after injection and then no significant increase was not found. Lesion to normal bone ratio gradually increased till one hour later and then stayed at the same level. The rapid increase of target to nontarget ratio could make possible to take very good skeletal images at any time beyond 2 hours after injection and there might not be much difference in image quality among these scans.

The exact mechanism of the localization of $^{99m}$Tc-pyrophosphate in the bone is not fully understood, however, the pathologic basis of $^{99m}$Tc-pyrophosphate bone scan seems to be same case of preparation, good chemical quality and rapid blood clearance.

Bone Tumor Imaging with $^{169}$Yb-citrate

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Tumor affinity of the Lanthanide series was first reported by Hisada et al. and one of the nuclides, $^{169}$Yb-citrate was proposed to be the most suitable tumor imaging agent. $^{169}$Yb-citrate also accumulated highly in some tissues other than tumors, i.e. bones, salivary glands and others, and when tumors were overlapped with skeletal system, the images sometimes became difficult to read to be positive tumor accumulation. So we intended to use $^{169}$Yb-citrate as a bone imaging agent rather than tumor imaging agent. Incidentally we had one autopsy case who died 19 days after $^{169}$Yb-citrate tumor scanning was done, and we confirmed that $^{169}$Yb-citrate accumulated chiefly in the bones (500–600 times of blood activity). From these results, we used $^{169}$Yb-citrate in detecting the location of malignant bone lesions on purpose of radiation therapy of these lesions.

Bone imaging was taken 2–5 days after injection of 150–200 $\mu$Ci of $^{169}$Yb-citrate intravenously.

Normal skeletal system, especially vertebral column, skull, pelvis, long bones and joints, was clearly delineated. The accumulation of $^{169}$Yb-citrate appeared to be slightly decreasing with age.

Forty-five bone images were obtained from 20 patients and nineteen lesions were detected by X-ray photo (X-p) and/or $^{169}$Yb-citrate (RI) imaging. These 19 lesions were confirmed by biopsy, operation, autopsy and/or clinical findings. Seventeen of these 19 lesions were detected by RI imaging (89.5%); of these 17, 15 (88.2%) revealed abnormal RI accumulation and 2 (11.8...
revealed abnormal RI defect. Fifteen lesions (79.0%) were detected by X-p and thirteen (68.4 %) by both X-p and RI imaging. To compare X-p with RI imaging in detecting these lesions, 8 (42.1%) were equally detected by each methods and in 8 (42.1%) RI imaging exceeded X-p and in 3 (15.8%) X-p exceeded RI imaging. $^{169}$Yb-citrate imaging seemed to detect more accurately osteolytic changes than osteoplastic changes, and in a case of almost complete osteolytic change, it revealed the lesion as RI defect. After radiation therapy, RI accumulation decreased.

Because of its little accumulation on liver and no disturbance by activity in urinary tract like $^{87}$Sr, $^{99m}$Tc-pyrophosphate and $^{99m}$Tc-polYPHOSphate, $^{169}$Yb-citrate is suitable for imaging in lumbar vertebral and pelvic region. Unfortunately, it highly accumulates in salivary glands and nasal cavity, it is difficult to image the lesion of head and neck region.

From our experience, it must be remembered that some cases will reveal the lesion as RI defect and that sternum and thoracic vertebra confuses in frontal view, then lateral view sometimes reveals useful.

$^{169}$Yb is non-beta emitter and has suitable gamma-ray energy for imaging, and has a long shelf life (physical half life; 32 days).

From a standpoint of radiation dose to skeletal system, large dose cannot be administered but selection of cases makes the nuclide to be relatively low-cost and useful bone seeking agent.

The Clinical Evaluation of $^{18}$F Imaging for Neoplastic Skeletal Diseases
—A comparative study with $^{87}$Sr and $^{99m}$Tc phosphorous compounds—

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The purpose of this study is to evaluate the usefulness of $^{18}$F as a bone tumor scanning agent.

Routine bone scanning has been carried out with $^{99m}$Tc phosphorous compounds and conventional rectilinear scanner now in our department. Comparative studies between $^{18}$F and $^{87}$Sr and $^{99m}$Tc phosphorous compounds were performed in thirty seven cases, including thirteen cases of primary skeletal neoplasms, twenty one cases of metastatic skeletal neoplasmes and three cases of skeletal inflammations.

In case of $^{87}$Sr scans it takes longer time for radioactivity to clear from the blood and soft tissues compared with $^{18}$F cases. So in general, the body background activity is much higher in $^{87}$Sr scan.

In all cases, scan were positive both with $^{18}$F and $^{87}$Sr and $^{99m}$Tc. In conclusion we feel that $^{18}$F scanning appears to be a very sensitive indicator in detecting bone tumor.