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A Study of the Bone Scintigraphy of the Beta ray Nuclide for the Treatment

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INTRODUCTION

Cause of death in Japan is the first cancer. Recently, the survival span was lengthened in the advance on treatment methods. Therefore, patient quality of life became the importance. Patient about 70% of the last stage cancer tendency to complain of pain. As a result, patient quality of life is remarkably lowered.

Bone metastasis cancers of mammary cancer and prostatic cancer are accompanied by pain. The therapy using Beta ray of Strontium-89 is operated to alleviate the pain of osseous metastasis. But, we cannot measure from outside whether short-range Beta ray Strontium-89 accumulate at tumor area or not.

We paid attention to an occurrence of bremsstrahlung on coaction with material of a Beta ray. A Beta ray source used Phosphorus-32 and tried imaging of bremsstrahlung with gamma camera.

MATERIALS AND METHODS

A Beta ray source used Phosphorus-32 and tried imaging of bremsstrahlung with gamma camera. Then to decide measured subjects matching energy distribution of the bremsstrahlung. We measured the bremsstrahlung spectrum with semiconductor detector (GMX-25190-S SEIKO EG&G ORTEC) and NaI (Tl) scintillation pulse-height analyzer (GMX-20190-S SEIKO EG&G ORTEC).

The measurement of the spectrum did 1 channel 0.5keV, detector surface and 3 cm distances between samples, measuring time in 1000 seconds. This sample was used polyethylene vial which packed the calcium phosphate ($Ca_3(PO_4)_2$) in Phoshous-32 .

Next, the bremsstrahlung radiation image was imaged using the phantom by the gamma camera (ZLC-7500 SIEMENS). The phantom has the shape shown in figure 1. Calcium phosphate and Phosphorus-32 of 3.7 MBq radioactivity were enclosed in the phantom.

We instructed some energy level and picked up images. This energy level were

50,70,90 keV and acquisition energy window is ± 100%. And, we examined the optimum collimator by non- collimator, pinhole collimator and high sensitivity parallel type collimator.

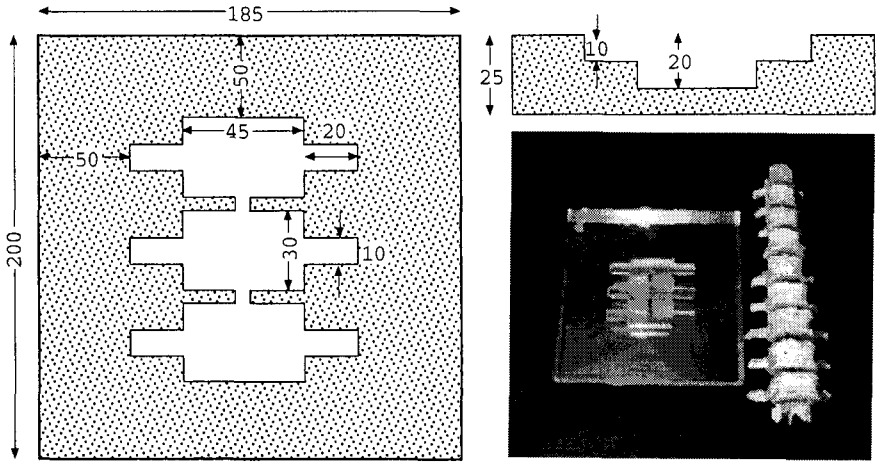


FIGURE 1. Scheme of the lumbar Vertebra phantom. Configuration of a vertebra is body of 30 mm × 45 mm, processes transverses and lingua of 10 mm × 20 mm. The lumbar vertebra with acrylic placed of thickness 25 mm. Images of the lumbar vertebra phantom and human of the lumbar vertebra.

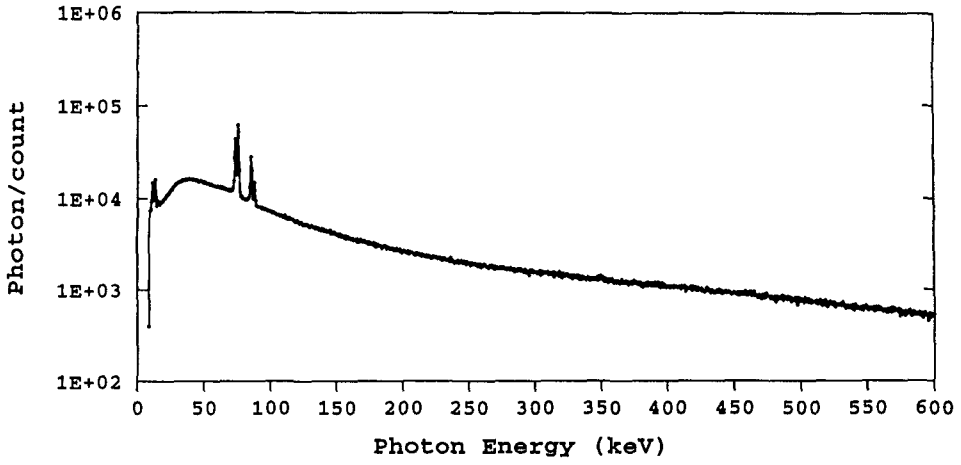
RESULTS

Bremsstrahlung energy spectra

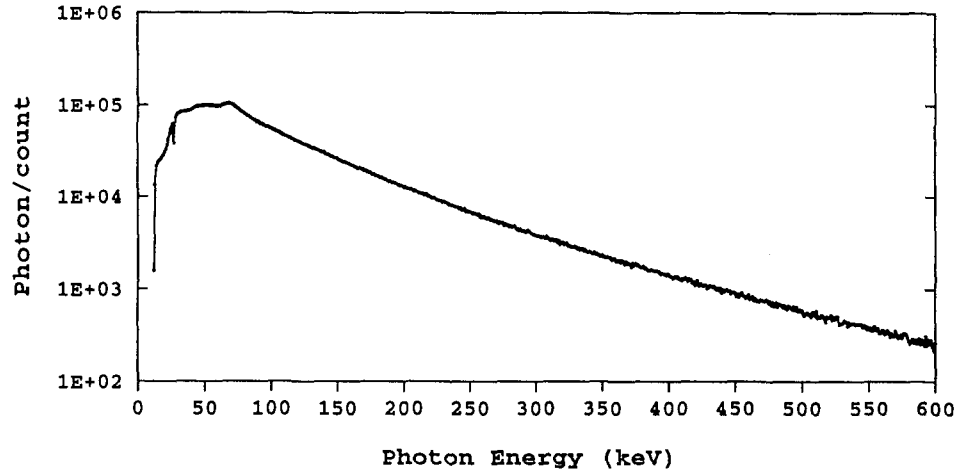
The measurement of the bremsstrahlung radiation spectrum by semiconductor detector and NaI (Tl) scintillation pulse-height analyzer showed the continuous spectrum near 70 with the peak (Fig.2). And, the characteristic X-rays (75,85 keV) of the lead is confirmed in semiconductor detector.

Bremsstrahlung radiation image

We succeed imaging of the bremsstrahlung. Peak energy 70 keV, window width 100% the collection condition was best. And high sensitivity parallel type collimator was best for the collimator (Fig.3).



Semiconductor detector (GMX-25190-S SEIKO EG&G ORTEC)



NaI(Tl) scintillation spectrometer (GMX-20190 SEIKO EG&G ORTEC)

FIGURE 2. The bremsstrahlung energy spectra for the source of Phosphorus-32 in calcium phosphate with semiconductor detector (GMX-25190-S SEIKO EG&G ORTEC) and NaI(Tl) scintillation spectrometer (GMX-20190 SEIKO EG&G ORTEC) . 1 channel hit determination condition of semiconductor detector and was 1000 seconds between data acquisition time by distance 3 cm of the surface and preparation of detection device with 0.5keV. 1 channel hit determination condition of NaI(Tl) scintillation spectrometer and was 1000 seconds between data acquisition time by distance 1 cm of the surface and preparation of detection device with 1keV. 70keV nearby energy peak were confirmed with semiconductor detector and NaI(Tl) scintillation spectrometer.

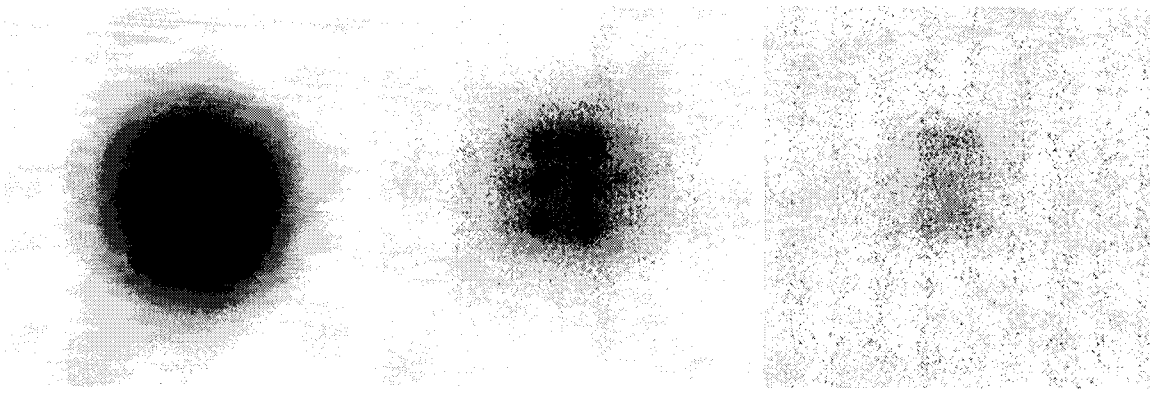


FIGURE 3. The left image is bremsstrahlung ray image at the no collimator. As for this image, a lot of scattered radiation was indistinct. The center image is bremsstrahlung ray image at the high sensitivity collimator. This image was the image which resolution was superior, and was good. The right image is bremsstrahlung ray image at the pinhole collimator. This image was indistinct with low count.

CONCLUSIONS

It was possible that this imaging method caught the distribution of the beta nuclide. It is thought that it is useful for the decision of internal radiation therapy effect using the beta ray.

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