Improved internal dose estimation with whole-body counter by considering biokinetics of radionuclide

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Body of Abstract: Background and purpose:
The internal dose can be estimated by the body burden which is measured by the whole-body counter (WBC). In measuring the body burden, the geometric efficiency is one of the big discussion points. The most adopted assumption is that the geometric efficiency is same over the whole-body, wherever the radionuclide is located. The radionuclide is located only in the stomach right after ingestion reasonably. This would make a big difference of dose estimation. In this study, we investigated the precise internal dose estimation method with WBC by taking into account the biokinetics of radionuclide as the important factor.

Experiment:
The WBC at the University of Tokyo is consisted of 20cm thick iron shield room with 8 inch x 4 inch NaI(Tl) scintillator. We used the block phantom and the anthropometric phantom. The anthropometric phantom has several organs: stomach, intestine, lung, thyroid gland. The geometric efficiencies were measured at 5 locations over the body.

Estimation of biokinetics:
The biokinetics of radionuclide is calculated by the Lunge-Kutta method according to the ICRP compartment model.

Result:
It is turned out that almost radionuclides can be measured more precisely above the abdomen within 5 hours after ingestion. As for inhalation, the measurement above the head (nose) is the best for the screening purpose and the measurement above the lung is suitable for the dose estimation of radionuclides of type S.

Conclusion:
Several whole-body measurements are done at the end of daily work in which the intake of radionuclide might be expected. In such case, the radionuclide remains at the lung (in inhalation) or stomach (in ingestion). The more precise measurement would be accomplished by arranging the geometry and time of measurement.