medicine in future analogously to a microscope. Contributions of utilization of radioisotopes to developments of biological and medical researches are surprisingly great. New knowledges, which would seem impossible if radioisotopes had been unable to use, have became not only our common knowledge in practical medicine, but also a basis of further developing of medical sciences.

Such phenomena are prevailing in every field of medicine and never previleged to any branches of medicine already specialized. This means that a concept of "nuclear medicine" involves all fields of medicine in which energy of radioisotopes are applied. The application of radioisotopes in medicine can be mainly classified into three major fields. 1) tracer experiments, 2) diagnostic procedures and 3) treatments.

Recently, an utilization of radioisotopes in medicine has so rapidly expanded that some one says it seems to be convenient to use the word "nuclear medicine" restrictedly to a methodology of medicine, in which radioactivity of radioisotopes are put to use regardless their metabolic natures. It is my feeling that an utility value of radioisotopes in medicine is splendidly emphasized in the concept of "nuclear medicine" and that a possibility of hazardous effects of radioisotopes on human body is apt to be left disregarded. However, it must be seriously taken into consideration to avoid conceivable injuries, be use at present time it is difficult to say definitely safe even when a minimal dose of radioisotope is given. Further developments of nuclear medicine need completely secured facilities and highly trained techniques in order to minimize the radiation injuries.

It is noteworthy that "nuclear medicine" particularly needs intimate cooperation with other fields of sciences, such as physics, engineering, electronics et al.

Nuclear Medicine as Considered from the Viewpoint of Internal Medicine

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Radioisotopes are now widely used in clinical medicine. In the field of internal medicine, the fundamental principles in the use of radioactive tracers may be divided into three categories: isotope dilution studies, diffusion and flow studies and metabolic studies. Some of these studies are performed mainly for the purpose of clinical investigations, but a large number of tracer studies have already been introduced into clinical medicine as routine procedure, and are now being used not only for the diagnosis of various diseases but also for the function test of various organs.

Furthermore, the advancement of radioisotope scanning technique has made it possible to determine the localization, shape, size and function of various organs such as the thyroid gland, brain, lung, heart, liver, spleen, pancreas, kidney and placenta and to detect space occupying lesions in these organs. Radioisotopes are also used for irradiation therapy, as external and implanted radioactive sources, or as sources of internal irradiation.

As mentioned above, recent advances in nuclear medicine are rapid and striking, and we can forsee enormous progress in the near future. The application of radioisotopes to the field of internal medicine may be further enhanced, if the following requirements are fulfilled.

1) Preparation of suitable radioisotopes for clinical use.

The introduction of radioisotopes with short half lives, little β and weak γ rays is desirable to reduce the radiation effect to the minimum and to increase the efficiency of radioactivity measurement. In this respect, the ineroduction of ^{99m}Tc seems to be useful for scanning of various organs because of its physical properties which satisfy the above-montioned requirements. The preparations of various radiopharmaceuticals labeled with suitable radioisotopes is important for the progress of diagnostic procedures and metabolic studies.

2) Development of instrumentation for radioactivity measurement.

Automation aids in radioactivity measurement and data analysis, and development of new instruments such as γ-ray scintillation camera, positron scintillation camera and autofluoscope will increase the usefulness of radioisotopes in clinical medicine and make it possible to visualize and analyze the rapid movement of labeled substances in various organs. This kind of information will be of great value for dynamic analysis of organ functions.

3) Application of whole-body counter to clinical medicine.

The whole-body counter will be useful for the measurement of minute amount of radioactive substance present in human subjects such as ^{40}K and ^{837}Cs, and for metabolic studies and diagnostic procedures using radioisotopes at levels greatly below the maximum permissible dose, for example kinetic studies of iron metabolism using ^{59}Fe, absorption test of Vitamin B_{12} using ^{60}Co-B_{12}, studies of sodium metabolism using ^{22}Na, diagnosis of bone diseases using ^{85}Sr and ^{45}Ca, and studies of protein metabolism using ^{131}I-human serum albumin.

4) Use of activation analysis for clinical medicine.

As the research reactors become available for biology and medicine, activation analysis will be used more widely inclinical medicine. The indication of activation analysis will be as follows: (1) automatic analysis of a large number of samples of a few elements, (2) Special analyses requiring high sensitivity, and (3) analyses of enriched stable isotopic tracers. By using the technique of activation analysis, it will become possible to perform some tracer studies without giving radioisotopes to the subject, for example studies of iron metabolism have become possible using enriched stable isotope ^{58}Fe and activation analysis. This will prevent the subject from the danger of exposure to radiation.

Radioisotopes will be more and more used in the field of internal medicine, but in order to accelerate further development of the application of radioisotopes to clinical medicine, the cooperation of many scientists of various fields will be required for the introduction of new radionuclides, preparation of new compounds labeled with suitable radioisotopes and improvement and device of instruments for sensitive and accurate radioactivity measurement. At the same time, safe handling and storing of radioisotopes, prevention of radiation hazards both of the patient and the investigators, and careful consideration in the disposal of radioactive waste and training of research workers should not be neglected. For this purpose, the establishment of central radioisotope laboratories will be helpful.

Necessity of Establishing the Teaching System of Nuclear Medicine

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There has not been a separate department of nuclear medicine in any medical school in Japan yet, although there are many in U.S.A. already.

Establishment of the teaching system, either large department or small section, is an urgent requisite for promoting the spread of nuclear medicine as well as clinical services.

It is very important to know the present state of actual teaching of nuclear medicine in Japan.

The method of approach took the form of a questionnaire, posing only eight questions, quickly answered and requiring no troublesome review of curricula. This form was sent to deans of 46 medical schools. Of those, 39 replies (84.8%) were received.

Question 1:

Do you give undergraduate teaching in the theory and applications of radioisotopes?

Answer: Yes 38/39 (97.4%)
No 1/39 (2.6%)