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MEASUREMENT OF BETA EMITTING RADIONUCLIDES IN DOSE CALIBRATORS ROUTINELY USED IN NUCLEAR MEDICINE DEPARTMENTS

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INTRODUCTION

Diagnostic radionuclides which emit gamma rays and therapeutic radionuclides which emit both beta and gamma rays are measured by commercially available dose calibrators in nuclear medicine. Pure beta emitting radionuclides are also used in therapy because of their favorable physical half-life and energetic pure beta emission. However, it is often necessary to use standardized sources to establish a dose calibrator dial setting for accurate calibration of clinical doses [1]. The type of container material, like glass or plastic, may seriously affect radioactivity measurements due to attenuation [2].

In 1994, a National Regulatory Comission (NRC) licensee reported 14 potential misadministrations. Due to the failure to calibrate the dose calibrator for the differences in geometry between the vials and syringes and the differences in materials between glass and plastic; the wrong dose calibrator settings had been used [2].

The importance of accurately measuring the activity of pure beta emitters is a potential problem for all nuclear pharmacy laboratories , because of the introduction of new therapeutic products containing pure beta emitters like Phosphorus-32, Strontium-89, Yttrium-90.
Y-90 is a pure beta emitting radionuclide with physical half-life of 64.0 hours, beta energy of 2.3 MeV and 99,984 % abundance. It decays to non-radioactive Zr-90.

MATERIAL METHODS

In this study, two types of commercially available dose calibrators were calibrated. One of them is CAPINTEC CRC-12, the other one is BIODEX ATOMLAB-100 available in the deparment. The Standard Y-90 source activity was 1.82 GBq by supplier's calibration, with calibration time 26.3.2004 : 12.00, PARIS and volume of 1.03 ml [3].

Procedure

1. The reference radioactivity on the standard source was corrected according to time and recorded.
2. Volume of activity for the patient dose (1480 MBq) was calculated.
3. The required volume was withdrawn using a 1 ml syringe.
4. It is placed in the dose calibrator and the " calibration number " was changed to equal a 1480 MBq read out.
5. The calibration number for 1 ml syringe was recorded.
6. The activity was transferred from 1 ml syringe to 10 ml vial immediately. The residual activity in the syringe was assayed.
7. The activity added to the reaction vial was determined.
8. Normal saline was added to the 10 ml reaction vial q.s and the vial was placed in the dose calibrator. The "calibration number" was changed to read the activity read in step 7
9. The calibration number for 10 ml vial was recorded.
10. The necessary volume was withdrawn into a 10 ml syringe based on the activity in step 7
11. The calibration number for 10 ml syringe was recorded [3].

These calibration settings were used in the Y-90 measurements made in the department since the day these measurements started.

RESULTS

Different material (glass-plastic) and different geometry (vial-syringe) were used for calibration of dose calibrators.

Table 1. Calibration values for dose calibrators

	CAPINTEC CRC-12	BIODEX ATOMLAB 100
1 ml SYRINGE	57,6 x 10	325
10 ml VIAL	32,2 x 10	463
10 ml SYRINGE	55 x 10	357

As a result of this calibration, differences in material and geometry, calibration number values were :

Table 2. Differences in material and geometry

	CAPINTEC CRC-12	BIODEX ATOMLAB 100
Between 1 ml syringe and 10 ml vial	+ 78.8. %	- 29.8 %
Between 10 ml syringe and 10 ml vial	+ 70.80 %	- 22.89 %

The type of container material may seriously affect radioactivity measurements due to attenuation, since it is crucial to give the exact amount of radioactivity to the patient for therapy purposes.

DISCUSSION

The container material and geometry may affect the measurements seriously. Therefore it is very important to use exactly the same brand and type of syringes, needles and vials in order not to cause any variation of measurements made at different times. In this study the glass vials of

the supplier and the syringe and needles regularly used in nuclear medicine departments were evaluated. These points were taken into consideration dealt with in this study.

CONCLUSION

Dedicated dose calibrators which are specially manufactured for the measurement of pure beta emitting radionuclides are commercially available but these measuring systems are not widely used in nuclear medicine centers where therapy is applied to the patient. It is a known fact that dose calibrators routinely used in nuclear medicine departments can be calibrated for vials and syringes using standart sources of the same radioisotope. The method of calibration of Y-90 measurement for two commercial dose calibrators available in the institute were summarized in this study.

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COMBINATION OF THE PROMPT NEUTRON CAPTURE METHOD WITH OTHER NEUTRON METHODS FOR SUBSTANCE ELEMENTAL CONTENT ANALYSIS

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Neutron analysis method of determining element composition has found wide range of applications in industry due to different types of interaction of neutron with substances /1/. With the aim of widening the circle of problems to be solved, on the basis of the device /2/ for determining the elemental content of substance, possibilities of combining the method based on the use of neutron capture gamma-ray spectrometry with other neutron methods; in particular neutron activation analysis and neutron absorption analysis were studied.

Developed laboratory of model experimental device based on the Cf^{252}radionuclide – neutron source with yield of 1,5 x 10^7 neutron/sec. By means of using neutron capture gamma - radiation spectrometry the possibilities of determining some elements (H, B, N, S etc.), which are not determined by widely used activation analysis method.

Fig.1 shows design of laboratory model of the experimental device. Measurement of geometry and the construction materials of experimental device allows maximal flux of thermal neutrons on the investigated samples with minimal amount of fast neutrons and disperse gamma-rays.