Microspheres spatial distribution influence during yttrium-90 activity determination for liver radioembolization

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PURPOSE

The measurement of a radionuclide activity with a dose calibrator (DC) has always been a key point of several international recommendations. When the isotope presents a significant beta- emission, this can be a crucial issue. The shape of the container and the surrounding materials inside the DC, constitute a significant cause of error, leading to the necessity of individual geometric corrections. In the case of a vial containing resin-microspheres, an additional source of error can be noticed if the microspheres are in suspension or if they are at the bottom of the vial. Hence, two different calibration factors (#1 and #2) are necessary. The purpose of this work was to characterize this geometric effect which, if neglected, can lead to an increased error of the measured activity.

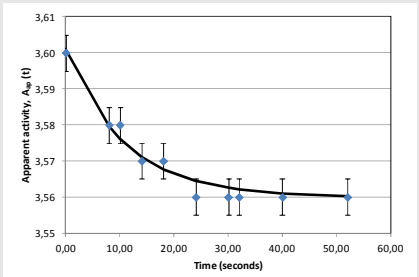
METHODS

A Capintec CRC-15R DC was used. A reception vial of resin-microspheres was placed inside the DC with the microspheres uniformly distributed inside the volume and the measured activity was recorded as a function of time until stabilization. The same procedure was performed for different volumes and activities. The difference between the initial and final activity was determined. The correspondent calibration factors were determined for both cases.

Reception vial (with arbitrary volume)

Dose Calibrator

Apparent activity as function of time: $A_P(t)$

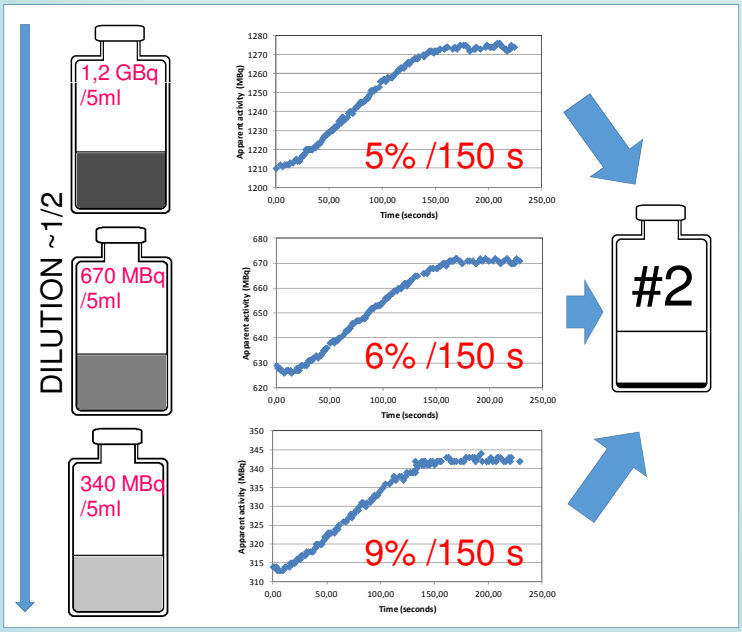


Apparent activity as function of time, $A_P(t)$ measured with the vial as arrived from manufacture (5 ml): maximum concentration of spheres and maximum activity available (1.1% decrease after 30 seconds)

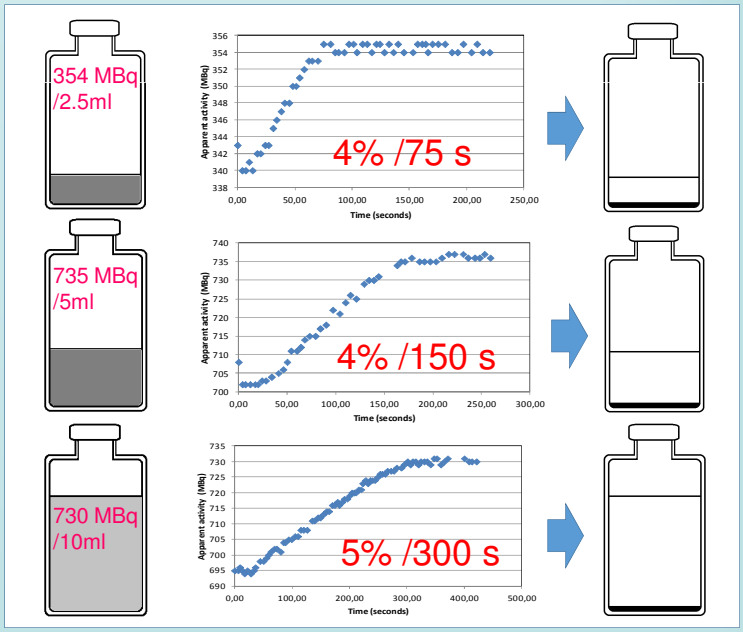
RESULTS

It was found that, depending on volume and activity, the microspheres deposition time can be on the order of 3-4 minutes, resulting in an activity difference ut to 10%. Since the dose partition must be performed with the microspheres in suspension (#1), this implies that calibration factors should be determined with a calibrated source with the microspheres in suspension and microspheres on the bottom of the vial.

VIAL RECEPTION DAY



AFTER 53 h DECAY TIME (HALF-LIFE = 64 h)



CONCLUSIONS

Measuring the vial activity with the microspheres in suspension (#1) and with the microspheres resting on the bottom of the vial (#2), we can notice a significant variation on the measured activity. This procedure should be taken into account in the calibration protocol. These findings, if not taken into account, can imply the possibility of easily reaching higher error values than the internationally suggested 5% uncertainty in activity measurement for therapeutic purposes.