Investigating a dopant for mitigating the natural degradation of Fricke Xylenol Gel dosimeters

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Introduction

Despite its excellent properties, such as tissue equivalence, which make the Fricke Xylenol Gel (FXG) dosimeter highly attractive for medical dosimetry, it has a limitation in terms of irradiation time compared to other dosimeters due to the oxidation of iron ions by external influences other than radiation. One possible solution to address this limitation of the FXG is the addition of a dopant that minimizes external oxidation. This study aimed to evaluate the feasibility of adding formaldehyde as a stabilizer and compare its long-term effects on the dosimeters.

Methods

Dosimeters were produced with different concentrations of a pre-prepared dopant solution and irradiated in groups with various doses. Spectrophotometric analysis was performed to calculate the average absorbance of dosimeters irradiated with the same dose and to analyze the spectra. Additionally, an analysis of absorbance over time was conducted in the Fe^{+3} region for both the irradiated dosimeters and a non-irradiated group.

Results

The results demonstrate formaldehyde as a promising dopant when used in intermediate quantities for mitigating the natural oxidation of the Fricke Xylenol Gel dosimeter.

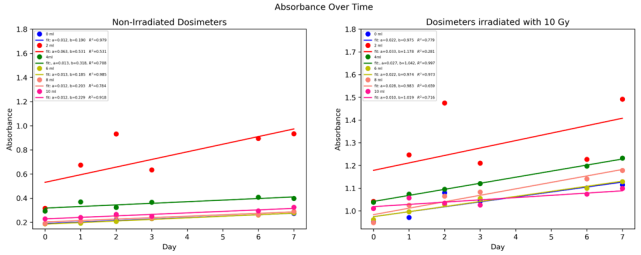

Figure 1: Average absorbance over time for different dopant quantities in irradiated and non-irradiated dosimeters.

Conclusions

It was found that irradiated dosimeters undergo accelerated degradation, which can be mitigated by adding an intermediate dose of a dopant. Adding small amounts does not yield significant differences compared to dopant-free dosimeters, while high amounts lead to a loss of sensitivity.

Personalized dosimetry in ^{177}Lu-DOTATATE/DOTATOC treatment with a single measurement to the patient after 4 days. Theoretical-practical analysis of the proposal of Hänscheid et al. with patients at La Fe hospital in Valencia, Spain

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Introduction

Activity in patients is usually measured several times after administration of the radiopharmaceutical to estimate its effective half-time (T_{eff}) in organs and lesions, thus evaluating the dose. Hänscheid et al. propose a single measurement after 96 h. This work analyses its validity with patients at La Fe hospital, Valencia, Spain.

Methods

Dose can be estimated (assuming monoexponential decay) as where t_i is the time from injection to measurement of activity A and S is a conversion factor from activity to dose rate.

It is not possible to know T_{eff} by performing a measurement, the approximation is proposed so that the dose can be estimated as , making it unnecessary to know the value of T_{eff}. If measurements are made at 96 h, this approximation is valid up to 10% difference for the range of values T_{eff} = [38, 128] h. Range of radiopharmaceutical T_{eff} in kidney and lesion measured are equivalent for the 13 patients at La Fe hospital (24 kidneys and 17 lesions) and for the 29 patients by Hänscheid et al (54 kidneys and 30 lesions). T_{eff} for each patient fits within the range of [38, 128] h.

Results

Theorical relative differences in dose calculation when using the approximation and measuring at 96 h are as follows in La Fe patients: 9 kidneys and 5 lesions have less than 5% difference. 14 kidneys and 11 lesions have between 5% and 10% difference. 1 kidney and 1 lesion have a 13% difference.

Conclusions

An alternative method for performing dosimetry supported by theory is presented, and its validity should be checked with experimental measurements.

The absorbed doses in different organs and lesions could be estimated with reasonable added uncertainty (~10%) by performing a single measurement 4 days after administration of the radiopharmaceutical.

This method drastically decreases the workload and machine time employed. It does not reduce patient visits to the hospital.