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The measurement of radiation doses in brachytherapy using an alanine dosimeter

ช่วงเวลาดำเนินการ ปี พ.ศ. 2566

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รายละเอียดสรุป

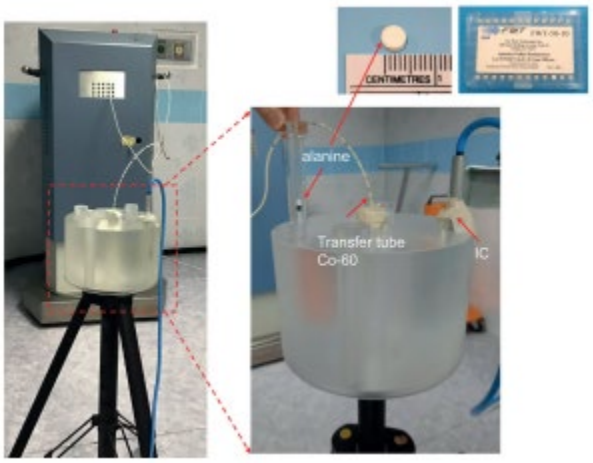
Background: Brachytherapy involves the use of high radiation doses to treat cancer patients, making it essential to have appropriate dosimeter properties to confirm the accuracy and precision of the dose delivered to the patient.

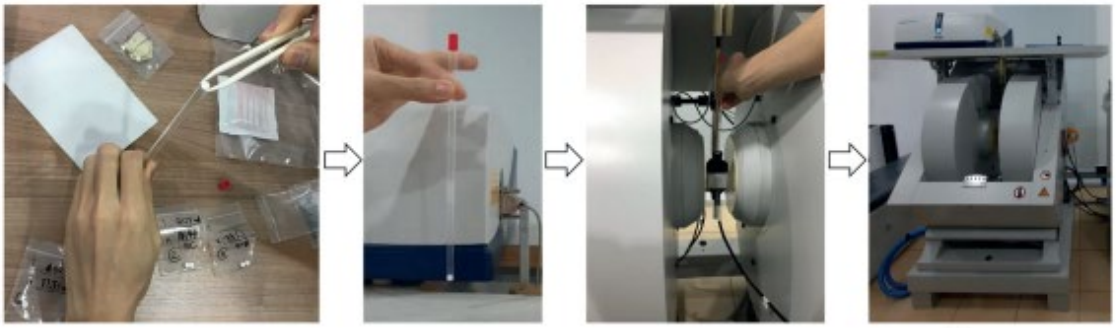
Objectives: This study was to investigate the relationship between radiation dose and electron spin resonance (ESR) signal and to evaluate the optimal conditions for the ESR technique. Additionally, the radiation dose from brachytherapy was measured in a solid phantom using alanine in combination with the ESR technique.

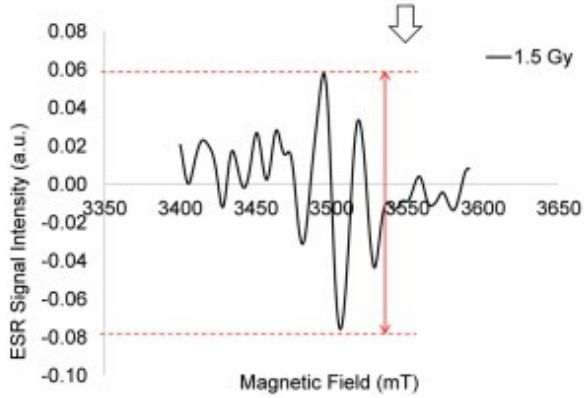
Materials and methods: The alanine dosimeter (FWT-50-10, Steris, USA), ionization chamber (TW30013, PTW Freiburge, Germany), and transferring tube were positioned inside the solid phantom (Krieger, T9193, PTW Freiburge, Germany), with the BEBIG Co-60 source located at the center of the phantom. Dwell times were calculated to obtain a radiation dose range of 0.06-1.5 Gy. Following irradiation, the alanine derivative was measured using an ESR spectrometer, and a graph was generated to determine the relationship between radiation dose and ESR signal.
The uncertainty and fading of the ESR signal were also evaluated.

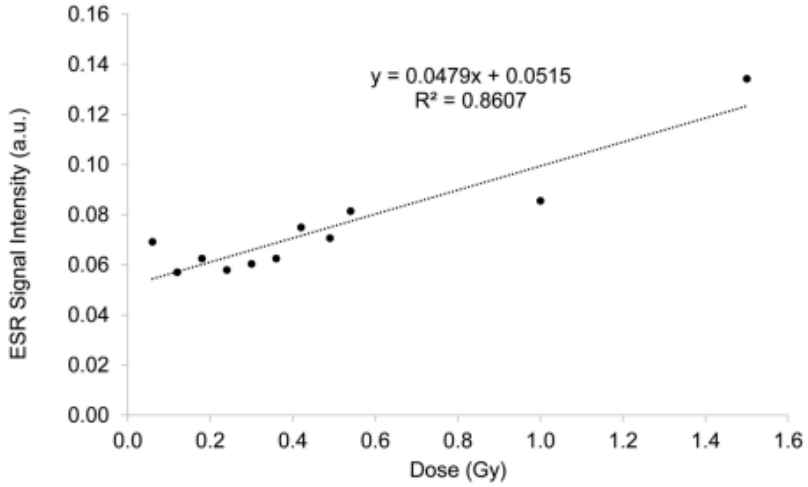
Results: The results indicate that there is a linear relationship (R2 = 0.877) between the radiation dose range of 0.49-1.5 Gy and ESR signal, with a microwave power of 1.5 milliwatt. The uncertainty of the ESR signal was found to be in the range of 0.12% - 3.79%. Signal fading was observed to be in the range of 7.2% - 27.4% over a period of two weeks.

Conclusion: Alanine and ESR technique can be used to measure absorbed dose in brachytherapy. The dose response of alanine was linear for radiation doses above 0.49 Gy. The advantages of alanine dosimetry are that alanine is tissue equivalent, nondestructive, small in size, and has low signal uncertainty.


alanine
Transfer tube
Co-60
IC




1.5 Gy
ESR Signal Intensity (a.u.)
Magnetic Field (mT)
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
3350
3400
3450
3500
3550
3600
3650


y = 0.0479x + 0.0515
R² = 0.8607
ESR Signal Intensity (a.u.)
Dose (Gy)
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6