**Impact of Partial volume effect and noise on dose volume histograms (DVH) for the dosimetry of Yttrium-90 microspheres.**

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**Abstract:**

Our aim was to evaluate the degradation of dose-volume histograms (DVH) induced by partial volume effect (PVE) and noise independently and for simulated SPECT and PET.

**Methods**

Spheres, with different diameters have been analytically modelled: 1 cm, 5 cm and 10 cm (S1, S2, S3 respectively). They were fed with uniform activity (contrast = 10) and contained in a homogenous water medium. We have analytically simulated the effects of PVE and noise. PVE was simulated with the convolution of a Gaussian point spread function (PSF) characterised by full width at half maximum (FWHM). The noise was simulated by a log-normal distribution characterised by relative standard-deviation (RSD). Two PVE levels: FWHM=5mm and 10mm and two noise levels: RSD=0.10 and 0.3 were applied on each spheres separately for distinct analysis. Then we have simulated the degradation of SPECT and PET devices, according to what is observed in clinical routine, with respectively (FWHM=10 mm, RSD=0.10) and (FWHM=5 mm, RSD=0.3).

The DVHs were computed from absorbed dose calculation using dose-point kernels (DPK) in each generated activity map, including the non-degraded one. Finally, DVHs were compared to theoretical ones, for the following absorbed dose criteria: D80, D50, Dmean and D20.

**Results**

PVE decreased D80, D50 and had no impact on the other absorbed dose criteria, except for S1 for which D20 was underestimated of 66%. The more PSF was close to sphere’s size, the more the PVE was important. As an example, for all spheres, D80 (for which one PVE had a major impact) was underestimated between 38% and 8.1% and between 61% and 20% for FWHM of 5mm and 10mm respectively.

Noise decreased D80 and increased D20 and had no influences on D50 and Dmean. For the most degrading noise level RSD=0.1, D80 was underestimated between 0.4% and 9.5%, D20 was overestimated for all spheres, between 6.4% and 12.2%.

The simulated SPECT underestimated D80 up to 80%, D50 up to 82%, Dmean up to 79%, and D20 up to 78%.

The simulated PET underestimated D80 up to 21%, D50 up to 17%, Dmean up to 12%, and D20 up to 4%.

**Conclusion**

This study highlights the impact of PVE and noise on the DVHs, showing the importance of controlling and evaluating these effects to set-up absorbed dose protocols.