# Towards quantification of Gd-nanoparticles concentration with SPECT

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**Résumé**

**Introduction:** Gadolinium nanoparticles (NP) could be used for tumors radiosensitization. Indeed, it has been demonstrated on simulations that when the x-ray beam hits densely packed NPs, the photoelectric effect increases, leading to the emission of additional electrons depositing their energy more locally [1]. The quantification of NP concentration is a crucial task for radiotherapy treatment as this will define the delivered dose. Image based quantification could be done, for example, on spectral photon counting CT (SPCCT) for Gd detection or single photon emission CT (SPECT) for detection of NPs coupled with In-[111] tracer.

This presentation is focused on Gd-NP quantification on phantoms with nanoSPECT/CT scanner. We compare these preliminary results to the SPCCT measurements and outline the pros and cons of each modality for quantification tasks. We will also show the very first preclinical images.

**Methods:** For the image quantification we use eight 500$\mu$l tubes filled with saline solution with different concentrations of Gd-nanoparticles coupled with In-[111]. We obtain radioactivity concentration distribution with nanoSPECT/CT (Bioscan Inc., Washington D.C., USA) images calibrated with a gamma counter. These quantification measurements are compared to results from SPCCT (Philips Healthcare, Haifa, Israel).
The first preclinical tests is done on the same machines. We scan 5 animals with chondrosarcomas 1h, 2h and 24h post injection.

**Results:** The preliminary results show that activities above 1 MBq could be observed on nanoSPECT/CT images and that the discrepancy between quantification activity measurements and gamma counter ground values is _˜10-20%. Such a large disagreement could

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be due to several factors that has not yet been corrected: attenuation, scattering, collimator detector response, motion, dead time, kinetic of the activity distribution, partial volume effect (spill-in/spill-out) etc. We illustrate importance of the last one in the bias of quantified measurements.

**Conclusions:** The quantification of Gd nanoparticles is possible with SPECT and SPCCT imaging. The preliminary results obtained in phantoms show the linear correspondence between the concentration of nanoparticles in SPCCT images and activity concentration in SPECT images.

**References:**

Kirkby, C. and Ghasroddashti, E. (2015). Targeting mitochondria in cancer cells using gold nanoparticle-enhanced radiotherapy: a monte carlo study. Med Phys, 42(2):1119–1128.

**Mots-Clés:** Image quantification, nanoSPECT/CT, Gadolinium nanoparticles