Introduction and purpose
To evaluate the topological voxel-based FDG-PET SUV changes of bone marrow including dose from radiotherapy for locally advanced cervical cancer patients and their effect on hematological toxicity.

Material and methods
Between February 2013 and December 2014 fourteen patients were treated with using advanced radiotherapy delivery technique (IMRT or VMAT). Diagnostic FDG-PET with low-dose CT whole body scans were performed before and after radiotherapy (preRT and postRT - PET/CT). During the chemotherapy (six planned cycle) hematological toxicities were gathered for hemoglobin (HGB), white blood cell count (WBC), absolute neutrophil count (ANC) and for platelet count (PLT). Co-registration between the three CTs (2x PET/CT and planning CT) were performed using the optical flow unimodality deformation algorithm of Mirada RTx (version 1.6.2, Mirada Medical, Oxford, UK). Based on the CT information two region of interest (ROI) were defined: Body (only extracranial region) and bone marrow “BM” (using auto-thresholding followed by manual exclusion of CT contrast agents). ROI statistic (Min, Max, Mean, Median and SD) of the PET SUV and the dose matrix were collected. Each modality were resampled to match the preRT-PET with identical coordinate system. ROI statistics on the original and resampled volumes were compared. Voxel-based data were extracted for each patient dataset and heuristic programmatic statistical correlation were performed using Python (version 2.7). Sub-regions defined as followings: within/outside of irradiated region (voxels above/ below 1 Gy), active/non-active BM (above/below the preRT SUV average), and dose to absolute/relative volume of X Gy (where X represents any dose between 0 and 50 Gy). Correspondence between SUV changes and the dose were tested as well. All information was used to identify correlation with observed hematological toxicity (on log-scale) with p<0.05 significance level.

Results and discussion
The average number of voxel were 662,352 and 50,652 for Body and BM. 70/75 parameters of original and resampled volumes were within +/- 0.1 g/ml or Gy and considered as clinically equivalent. PreRT and postRT SUV changes in function of delivered dose correlated significantly. For HGB no predictive value were identified. Absolute volume receiving at least 30 Gy of dose of the active BM determined nadir WBC (p = 0.03) and nadir ANC (p = 0.01) (see Figure 1), while total BM only correlated with nadir WBC (p=0.041). Nadir PLT was determined by preRT SUV of the irradiated (>1Gy) active BM and the slope of changes between preRT and postRT SUV.

Conclusions
Active and total bone marrow region receiving at least 30 Gy should be monitored to reduce possible hematological toxicity. Voxel-based evaluation of functional imaging with dose information is a valuable option especially in combination with programmatic heuristic statistical testing.

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