Autocontouring versus manual contouring.

Mathieu Hatt, Dimitris Visvikis, Catherine Cheze Le Rest

▶ To cite this version:

Regarding Autocontouring and Manual Contouring: Which Is the Better Method for Target Delineation Using 18F-FDG PET/CT in Non–Small Cell Lung Cancer? By K. Wu et al

M Hatt, D Visvikis, C Cheze Le Rest

To the editor: We read with interest the study of Wu et al *(1)* regarding autocontouring methodologies for target delineation in PET/CT for NSCLC. 17 NSCLC tumors were delineated with both automated and manual approaches, using either combined PET/CT or CT and PET independently. As expected, the manual contouring of the PET uptake provided a better correlation with the maximum diameter of the primary tumor compared to auto-contouring using a fixed threshold at 50% of the tumor maximum uptake. We believe that this result is largely associated to various shortcomings of using fixed threshold approaches, a point that needs to be clearly emphasized.

The authors have previously demonstrated that the best correlation between the maximum tumor diameters derived from histo-pathological examination in comparison to the image derived ones was obtained using a 50% fixed threshold *(2)*. This conclusion was reached by comparison to the results obtained using other fixed threshold values (from 20% to 55%), with a modest correlation of 0.77 and non-statistically significant differences with the other fixed threshold values tested. Most significantly the use of a 50% fixed threshold led to differences larger than 1cm in half of the tumors considered. Such differences in terms of the maximum tumor diameter will most certainly lead to larger differences in the overall 3D volume. Considering similar comparisons based on 3D NSCLC tumor volumes determined by histo-pathology, other authors have demonstrated that an "optimal" threshold value cannot be determined, showing considerable variability ranging from 20% to 42% (31%±11%) of the maximum, while CT-based volumes significantly overestimated the pathologic volume *(3)*.

It is therefore important to emphasize that a fixed threshold (irrespective of its absolute value) is not an adequate methodology to address the delineation of elevated uptake signal in PET, due to its binary, deterministic nature and lack of robustness versus varying contrast and noise conditions *(4,5)*. In order to account for these widely documented literature findings concerning tumor target delineation incorporating PET uptake information, fixed thresholding should be avoided and at the very least, methodologies considering target-to-background ratios such as adaptive thresholding *(5,6)* should be favored. Eventually, the wider availability of automatic segmentation approaches *(7-10)*, some of which allow accounting for the presence of heterogeneous tumor uptake distributions *(7)*, may allow improving the accuracy and reproducibility associated with adaptive thresholding *(11)* for functional tumor volume determination.

Considering all these facts we do agree with the authors that manual contouring should be preferred to autocontouring at 50% threshold for functional tumor volume delineation. On the other hand, one should consider that manual delineation of the PET uptake is not the ideal approach either for multiple reasons. Most importantly it represents a long process particularly when it has to be performed in 3D and it is inherently of very low reproducibility *(11)*.

We therefore recommend that future studies investigating this issue include the use of advanced image segmentation approaches *(4-10)* which have demonstrated improved performance in comparison to fixed threshold, and may therefore lead to alternative / complementary conclusions

regarding the role of manual contouring. Irrespective of the performance of a segmentation algorithm, operator intervention will always be necessary in order to appropriately identify the functional uptake of interest and avoid the inclusion of non-tumor specific activity uptake.

1. Wu K, Ung YC, Hwang D, et al. Autocontouring and Manual Contouring: Which Is the Better Method for Target Delineation Using 18F-FDG PET/CT in Non–Small Cell Lung Cancer? J Nucl Med 2010;51:1517-1523.
2. Wu K, Ung YC, Hornby J, et al. PET CT thresholds for radiotheraphy target definition in non-small-cell lung cancer: how close are we to the pathologic findings? Int J Radiat Oncol Biol Phys. 2010;77:699–706.
3. Yu J, Li X, Xing L, et al. Comparison of Tumor Volumes as Determined by Pathologic Examination and FDG-PET/CT Images of Non–Small-Cell Lung Cancer: A Pilot Study. Int. J. Radiat. Oncol. Biol. Phys., 2009;75(5):1468-1474.
4. Hatt M, Turzo A, Roux C, et al. A fuzzy Bayesian locally adaptive segmentation approach for volume determination in PET. IEEE Trans Med Im 2009;28(6):881-893.
5. Nestle U, Kremp S, Schaefer-Schuler A, et al. Comparison of Different Methods for Delineation of 18F-FDG PET-Positive Tissue for Target Volume Definition in Radiotherapy of Patients with Non-Small Cell Lung Cancer. J. Nucl. Med., 2005;46(8):1342-8.
6. Daisne JF, Sibomana M, Bol A, et al. Tri-dimensional automatic segmentation of PET volumes based on measured source-to-background ratios: influence of reconstruction algorithms. Radioth. Oncol., 2003;69:247-250.
7. Hatt M, Cheze le Rest C, Descourt P, et al. Accurate automatic delineation of heterogeneous functional volumes in positron emission tomography for oncology applications. Int J Radiat Oncol Biol Phys 2010;77(1):301-308.
8. X. Geets, J. A. Lee, A. Bol, et al, "A gradient-based method for segmenting FDG-PET images: methodology and validation", Eur J Nucl Med Mol Im 2007;34:1427-1438.
9. D. W. G. Montgomery, A. Amira, and H. Zaidi, "Fully automated segmentation of oncological PET volumes using a combined multiscale and statistical model", Medical Physics, 2007;34(2):722-736.
10. Yu H, Caldwell C, Mah K, et al. Automated Radiation Targeting in Head-and-Neck Cancer Using Region-Based Texture Analysis of PET and CT Images. ? Int J Radiat Oncol Biol Phys. 2009;75(2):618-625.
11. Hatt M, Cheze Le Rest C, Aboagye EO, et al. Reproducibility of 18F-FDG and 18F-FLT PET tumor volume measurements. J Nucl Med. 2010;51(9):1368-1376.