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(G*) (POS-49) Segmentation in Quantitative Dynamic Nuclear Medicine: The Insufficiency of the TG-211 of the AAPM

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Purpose : The Task Group 211 report of the American Association of Medical Physicists (AAPM) made a literature review of various segmentation techniques for nuclear medicine. These methods are valid and strong in the context of static images; when faced with dynamic images, many challenges arise, and the user-dependency becomes problematic.

Material : Many dynamic TEP acquisitions had been made on small animals and other acquisitions have been made on a custom-designed dynamic phantom. The injected medical compound was either FDG or another radiopharmaceutical. The acquisitions lasted between 40 and 60 minutes.

Methods : For the analysis, three different classes of segmentation techniques have been used, according to TG-211: a gradient-based, statistics-based, and filling algorithms. The segmentations were performed on a specific reference timeframe and were static, i.e. the segmentation was not varying from one timeframe to the other.

To compare the results, the discrepancies between the segmentations were evaluated with various metrics, among which the Sørensen-Dice coefficient. Furthermore, since the segmentations are useful for pharmacokinetic analyses, the variations in the segmented volumes were assessed based on the quantitative impacts upon the time-activity curves (TACs).

Results : Concerning the segmentations themselves, the choice of timeframe upon which to base the algorithms has a great impact on the segmented volume. In the case of the small animals, this represents a large fraction of the total region of interest. In the case of the phantom, since the movement can be controlled and is known, the discrepancies are much less severe.

Concerning the TACs themselves, they are not as affected as had been expected: this could partially be explained by the fact that part of the voxels that are either present or not between segmentations are not the most active and, thus, have a lower impact on the statistics pertaining to the segmented region.

Conclusion : The TG-211 is a robust reference for static segmentations in nuclear medicine, but it is not trivial to apply its methods in a dynamic context. We conclude that the methods can be used, but it needs to be done carefully, as to be aware of the possible pitfalls pertaining to the transition from static to dynamic imaging.

Author: LAPORTE, Philippe

Presenter: LAPORTE, Philippe

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