AbstractID: 13718 Title: Comparative methods for PET image segmentation in pharyngolaryngeal squamous cell carcinoma

Purpose:
This study presents the performance assessment of various FDG-PET image segmentation methods in pharyngolaryngeal squamous cell carcinoma using experimental phantom and clinical studies where the surgical specimen served as reference

Method and Materials:
Various PET image segmentation techniques were evaluated including: l) manual delineation, 2) four thresholding-based methods (Nestle, Black, Biehl, and Schaefer), 3) the level set technique, 4) fuzzy clustering-based segmentation (FCM), and (5) stochastic expectation maximization (EM) approach. A cylindrical phantom was filled with an ^{18}F solution with an initial activity of 12.21 MBq/ml^{-1}. Three spherical target inserts of 1.0, 2.0, and 3.0 cm diameter are inserted in the cylinder and were filled with ^{11}C solution with an initial activity of 169.83 MBq/ml. A series of 10-minute long scans were acquired, providing a range of tumour-to-background ratios (T/B) ranging from almost 14 to 1.15. Three activities are selected high activity (T/B=14.1), medium activity (T/B= 4.1), and low activity (T/B=1.5). The algorithms were also evaluated using clinical studies where segmentation results were compared to the 3D (Biological Tumour Volume) BTV defined by histology on PET images of seven patients with T3–T4 laryngeal squamous cell carcinoma who underwent a total laryngectomy. The macroscopic tumour specimen was collected “en bloc”, frozen and cut into 1.7- to 2-mm thick slices then digitized and used as reference.

Results:
On the phantom data, Schaefer thresholding and level set provided the best performance, however, the clinical data seem to suggest that thresholding methods (with exception of Schaefer) and EM overestimated the average tumour volume while Schaefer, level set , and FCM underestimated it with FCM providing relatively the highest accuracy in terms of volume and overlap index.

Conclusion:
The BTVs delineated using the FCM technique seemingly was the most accurate segmentation technique and approximates closely the 3D BTV defined on the surgical specimen.