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S. E. Fogh
Thomas Jefferson University and Hospitals

A. Farach
Jefferson Medical College

C. Intenzo
Thomas Jefferson University and Hospitals

R. Axelrod
Thomas Jefferson University and Hospitals

P. McCue
Thomas Jefferson University and Hospitals

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Authors

S. E. Fogh, A. Farach, C. Intenzo, R. Axelrod, P. McCue, A. Harper, A. Nelson, and M Werner-Wasik

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Fogh, S.E.,[1] Farach, A.,[2] Intenzo, C.,[3] Axelrod, R.,[3] McCue, P.,[4] Harper, A.,[5] Nelson, A.,[6] **Werner-Wasik, M.**[1]

[1]Department of Radiation Oncology, Thomas Jefferson University and Hospitals, Philadelphia, PA
[2]Jefferson Medical College, Thomas Jefferson University, Philadelphia, PA
[3]Department of Medical Oncology, Thomas Jefferson University and Hospitals, Philadelphia, PA
[4]Department of Pathology, Thomas Jefferson University and Hospitals, Philadelphia, PA
[5]Department of Radiology, Thomas Jefferson University and Hospitals, Philadelphia, PA
[6]MiMVista Corporation, Cleveland, Ohio

Purpose/Objective(s)

Radiation therapy in lung cancer relies on CT and functional imaging (FDG-PET) to delineate tumor volumes. Semi-automatic contouring tools have been developed for PET to improve on the inter-observer bias of manual contouring and intrinsic differences in imaging equipment. A common method involves using a threshold at a given percentage of the max activity, which may be less accurate with smaller tumors and tumors with low source to background ratio. To overcome this deficiency, a gradient algorithm, which detects changes in image counts at the border of the tumor, has been developed. Few studies have correlated these methods to pathological specimens.

Materials/Methods

Thirty-three patients with lung cancer underwent lobectomy and had available PET imaging prior to resection. We retrospectively contoured tumors using 1) a constant threshold algorithm which included all voxels within a defined region with counts exceeding 34% of the maximum counts in that region, and 2) a commercially-available gradient-based "PET edge" tool. Largest tumor diameters from both methods were compared to the largest diameter from gross pathology reports using Pearson's correlation coefficient (CC).

Results

CC between maximal diameter contoured with the gradient tool or 34% percent threshold and tumor diameter were 0.79 and 0.82, respectively. The median largest tumor diameters were as follows: from pathology reports, 2.1 cm (range 0.6-9.5 cm); from threshold method, 2.9 cm (range 2.1-10.7cm); from gradient tool, 2.8 cm (range 1.7-10.4 cm). Tumor diameters ≤ 2.1 had a poor correlation with PET derived diameters (CC = 0.19 for gradient method and 0.31 for threshold method). Tumors larger than 4 cm had the best correlation with automatic contouring techniques (CC = 0.87 for gradient method and 0.83 with threshold method). The percent threshold method was more highly correlated with pathological tumor size in tumors with SUVs less than 2.5 (CC = 0.75 for gradient technique and 0.92 for threshold technique) but no difference between the techniques was noted in tumors with SUVs of 2.5 or greater. Adenocarcinoma histology was more highly correlated with both the gradient and threshold method (CC = 0.92 and 0.93 respectively) vs. other histologies (0.04 and 0.09 respectively). The Average Percent Error using the gradient method was 28% +/- 58% and 47.8% +/- 62% for threshold method ($P = 0.0003$).

Conclusion

Maximal diameters obtained with gradient and threshold methods were correlated with maximal pathologic diameter. The gradient method had significantly less percent error then the threshold method. The threshold method demonstrated stronger correlation to patholicic diameter in tumors with SUVs below 2.5. Histology, size and SUV influenced correlation to pathology.