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Usefulness of ^{99m}Tc -pertechnetate SPECT-CT in thyroid tissue volumetry: phantom studies and a clinical case series

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Key Words: thyroid, hyperthyroidism, thyroid tissue volumetry, SPECT, SPECT-CT.

ABSTRACT

Background: An accurate measurement of the target volume is of primary importance in theragnostics of hyperthyroidism. **Objective:** Our purpose was to evaluate the accuracy of a threshold-based isocontour extraction procedure for thyroid tissue volumetry from SPECT-CT. **Methods:** Cylindrical vials with a fix volume of $^{99m}\text{TcO}_4$ at different activities were inserted into a neck phantom in two different thickness settings. Images were acquired by orienting the phantom in different positions, i.e. 40 planar images and 40 SPECT-CT. The fixed values of the iso-contouring threshold for SPECT and SPECT-CT were calculated by means of linear and spline regression models. Mean, Median, Standard Deviation, Standard Error, Mean Absolute Percentage Error and Root Mean-Square Error were computed. Any difference between planar method, SPECT and SPECT-CT and the effective volume was evaluated by means of ANOVA and post-hoc tests. Moreover, planar and SPECT-CT acquisitions were performed in 8 patients with hyperthyroidism, considering relevant percentage differences greater than $> 20\%$ from CT gold standard. **Results:** Concerning phantom studies, the planar method show higher values of each parameters than the other two methods. SPECT-CT shows lower variability. However, no significant differences were observed between SPECT and SPECT-CT measurements. In patients, relevant differences were

found in 7 out of 9 lesions with planar method, in 6 lesions with SPECT, but in only one with SPECT-CT.

Conclusion: Our study confirms the superiority of SPECT in volume measurement if compared with the planar method. A more accurate measurement can be obtained from SPECT-CT.