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Relationship between CT-derived gross tumour volume (GTV) and the FDG-PET/CT-derived metabolic tumour volume (MTV): An exploratory study in non-small cell lung cancer patients treated with radical radiotherapy

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Abstract

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Relationship between CT-derived gross tumour volume (GTV) and the FDG-PET/CT-derived metabolic tumour volume (MTV): An exploratory study in non-small cell lung cancer patients treated with radical radiotherapy

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Purpose: Fluorodeoxyglucose positron emission tomography/computed tomography (FDG-PET/CT) is routinely used in staging and radiotherapy (RT) planning for non-small cell lung cancer (NSCLC). Over and above established clinical factors, emerging literature has proposed the novel PET/CT-derived metabolic tumour volume (MTV) as a potential prognostic factor. This study aims to firstly describe the spatial overlap between CT-derived Gross Tumour Volume (GTV) and MTV and secondly, to investigate the impact of this overlap on progression-free survival (PFS).

Methods and Materials: To date, medical records of twenty Stage I-III NSCLC patients diagnosed over 2006–2011 who underwent staging and/or planning FDG-PET/CT were reviewed for tumour and treatment characteristics, site of relapse (locoregional and/or distant), and PFS. Metabolically active regions of primary tumour and nodal disease on FDG-PET/CT studies were manually contoured using Osirix® (v5.1.12) by consensus between two experienced observers (nuclear medicine physician and radiation oncologist) to derive the MTV. Both observers were blinded to all other clinical and imaging information. CT-derived GTVs used for actual RT were contoured with concurrent PET fusion in the Focal® planning system. Osirix®-based MTVs were then transferred to Focal® for comparison with GTVs. Agreement between GTV and MTV was assessed using the Dice similarity coefficient (DSC), a score from 0 to 1 which measures spatial overlap of two volumes, with 1 indicating perfect agreement. Univariate cox regression was conducted to assess the impact of Stage, histology and DSC on PFS.

Results: There were 14 males and 6 females with median age 69 years (range 56–89). Six patients had Stage I, 3/20(15%) Stage II and 11/20(55%) Stage III disease, with n = 7 adenocarcinoma, n = 4 large cell and n = 9 squamous cell tumours. Median RT dose was 66 Gy (range 60–70 Gy). Nine patients received chemotherapy, given concurrently in n = 8. With median follow-up of 19 months (5–73 months), n = 9 experienced isolated locoregional and n = 4 had distant relapse. The DSC between GTV and MTV contours was moderate at 0.58 +/− 0.18. There was no association found between Stage (p = 0.37) and tumour histology (p = 0.69) with PFS. Furthermore, given the moderate degree of overlap, small sample size and number/sites of relapse, the DSC was not associated with PFS (p = 0.86).

Conclusions: Preliminary results in a small cohort show a moderate overlap between GTV and MTV, as represented by the DSC. Further investigation in a larger sample will aid in clarifying the relationship between known clinical prognostic factors, novel metabolic parameters and the end-points of locoregional failure and progression-free survival.