Meetings International
SciTechnol

J Diagn Tech Biomed Anal 2018, Volume: 7
DOI: 10.4172/2469-5653-C1-012

International Conference on

NUCLEAR MEDICINE AND RADIATION THERAPY

July 16-17, 2018 | Madrid, Spain

Target delineation with tri-modality image fusion for radiation therapy

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This study developed a new method of tri-modality image fusion, which can fuse and display all image sets in one panel and one operation. And a feasibility study in gross tumour volume (GTV) delineation using data from three patients with brain tumours was conducted, which included images of simulation CT, MRI, and 18F-fluorodeoxyglucose positron emission tomography (18F-FDG PET) examinations before radiotherapy. Tri-modality image fusion was implemented after image registrations of CT+PET and CT+MRI, and the transparency weight of each modality could be adjusted and set by users. Three radiation oncologists delineated GTVs for all patients using dual-modality (MRI/CT) and tri-modality (MRI/CT/PET) image fusion respectively. Inter-observer variation was assessed by the coefficient of variation (COV), the average distance between surface and centroid (ADSC), and the local standard deviation (SDlocal). Analysis of COV was also performed to evaluate intra-observer volume variation. The inter-observer variation analysis showed that, the mean COV was 0.14(±0.09) and 0.07(±0.01) for dual-modality and tri-modality respectively; the standard deviation of ADSC was significantly reduced ($p<0.05$) with tri-modality; SDlocal averaged over median GTV surface was reduced in patient 2 (from 0.57cm to 0.39cm) and patient 3 (from 0.42cm to 0.36cm) with the new method. The intra-observer volume variation was also significantly reduced ($p = 0.00$) with the tri-modality method as compared with using the dual-modality method. It was shown that the new method improved consistency and accuracy for target delineation in individualized radiotherapy.

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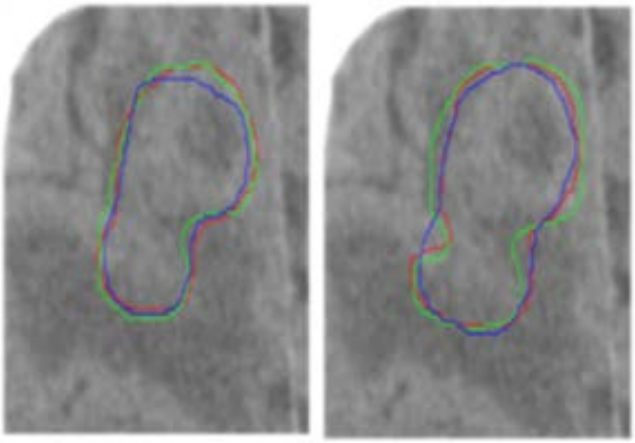

Fig. 1. GTVs in the same axial slice delineated by three radiation oncologists. (a) shows the GTVs generated in composite image of dual-modality ifusion and (b) shows the GTVs generated in composite image of the new trimodality image fusion. GTVs in red, green, and blue are contours delineated by radiation oncologists A, B and C respectively.