廣東藥科大學 附属第一医院 临床医学院
The First Affiliated Hospital/School of Clinical Medicine of Guangdong Pharmaceutical University
The First Affiliated Hospital of Guangdong Pharmaceutical University
ONCOLOGY DEPT

Validation of GTV delineation based on MRI, CT or FDG-PET/CT in head and neck cancer

Zhe WANG [1], Xicheng WANG [1], Yi KONG [1], Zhen WU [1], Xiaokang ZHENG [2]

1. The First Affiliated Hospital of Guangdong Pharmaceutical University, 510080, Guangzhou, China
2. Nanfang Hospital of Southern Medical University, 510515, Guangzhou, China

OBJECTIVES

To compare F-18-fluoro-2-deoxy-D-glucose positron emission tomography (FDG-PET)/computed tomography (CT), magnetic resonance (MR) and CT alone which based on the measurements of tumor volume in rabbits bearing head-and-neck cancer (HNC) with cross-sectional autopsy that to validate the gross tumor volume (GTV) delineation based on above three imaging methods.

METHODS

Twelve HNC models were established in New Zealand rabbits with transplantation of VX2 cell line. Modeling was successful in nine rabbits. Each rabbit received FDG-PET/CT, MR and CT scan in the same immobilization and position within 24 hours. Then all rabbits were sacrificed and cryopreserved, which underwent cross-sectional autopsy in the same position of imaging scan with sectional thickness of 4.0 mm. Autopsying was successful in six rabbits. The GTV was delineated based on FDG-PET/CT, MR, CT and cross-sectional autopsy as $GTV_{PET/CT}$, GTV_{MR}, GTV_{CT} and GTV_{SA}, respectively. After three-dimensional coregistration, the GTV defined independently based on MR, CT and FDG-PET/CT was validated with cross-sectional specimen via comparing the volume, overlap volume and volume difference ratio (VDR) during the GTVs.

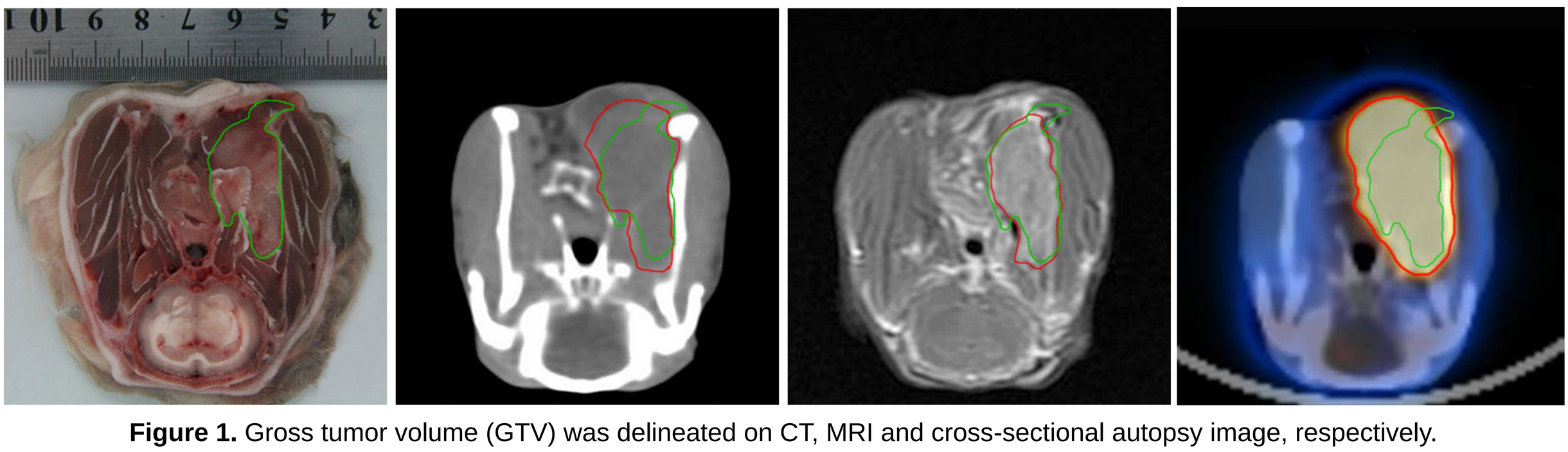

Figure 1. Gross tumor volume (GTV) was delineated on CT, MRI and cross-sectional autopsy image, respectively.

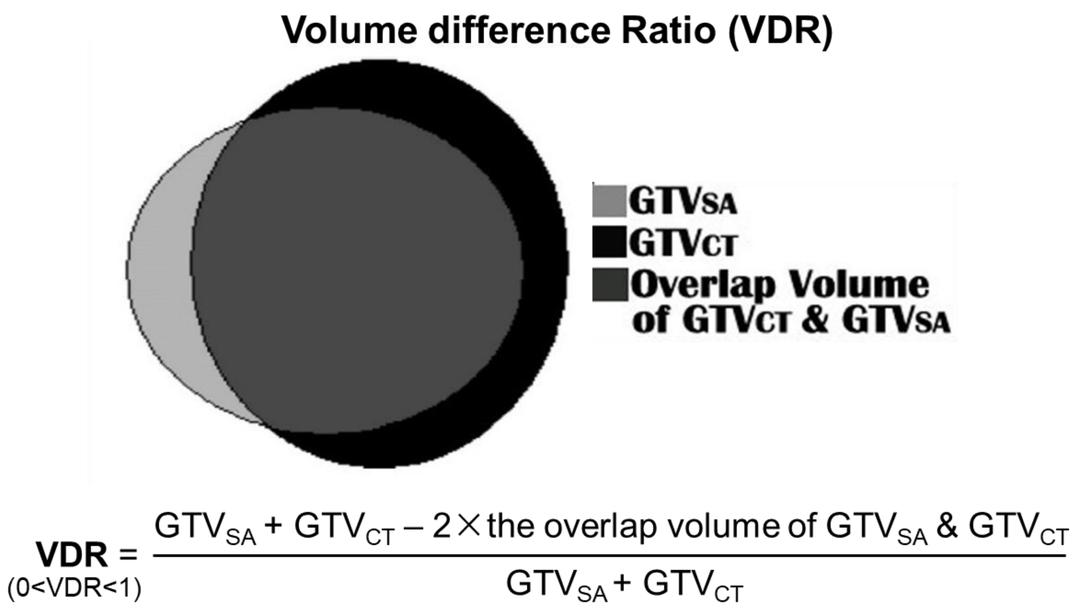

Figure 2. The definition of Volume difference ratio (VDR) [1].

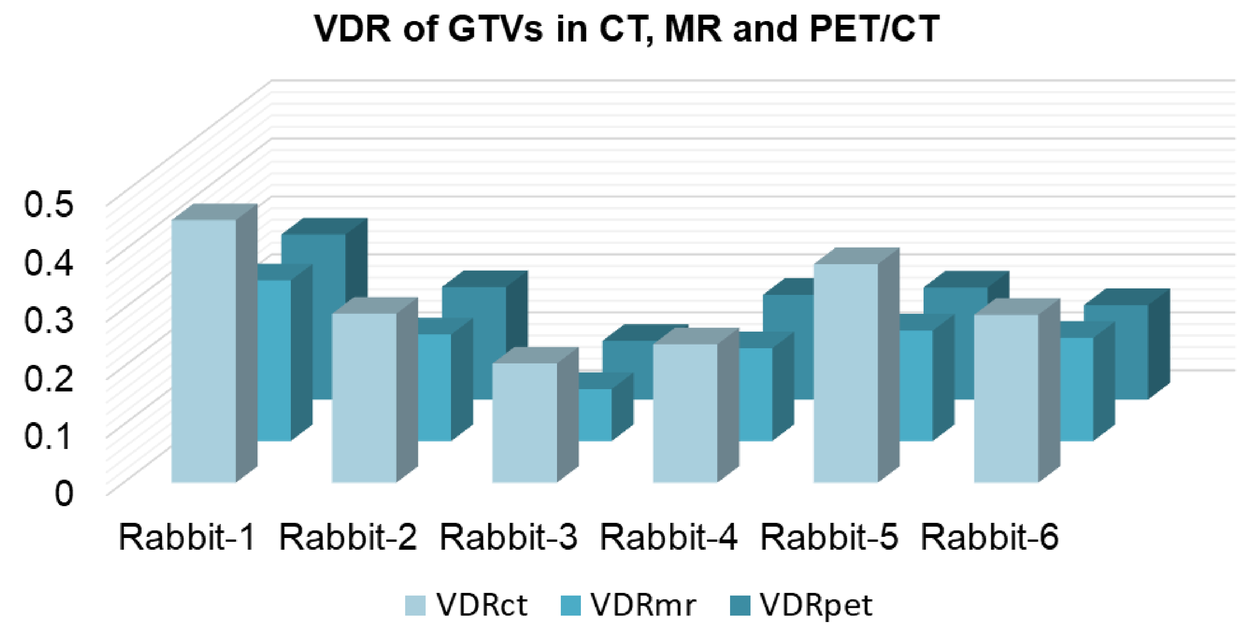

Figure 3. VDR of GTVct, GTVmr and GTVpet in 6 rabbits, respectively.

RESULTS

For the VX2 tumors in 6 rabbits, no significant difference (P>0.7) was observed between average GTVs delineated at cross-sectional autopsy (8.11 cm^3) with CT (8.02 cm^3), MR (7.89 cm^3) and PET/CT (8.65 cm^3), respectively. However, significant difference (P=0.023) was showed during average overlap volume (OV) of GTV_{SA} and GTV_{CT} (OV_{CT}, 5.57 cm^3), OV of GTV_{SA} and GTV_{MR} (OV_{MR}, 6.51 cm^3) and OV of GTV_{SA} and $GTV_{PET/CT}$ ($OV_{PET/CT}$, 6.7683 cm^3). Average OV_{CT} was smaller, but no significant difference (P=0.502) was seen between average OV_{MR} and $OV_{PET/CT}$. In addition, significant difference (P=0.032 and P=0.047, respectively) was observed between average VDR of GTV_{CT} (VDR_{CT}, 0.2970) and VDR of GTV_{MR} (VDR_{MR}, 0.1800) and VDR of $GTV_{PET/CT}$ ($VDR_{PET/CT}$, 0.1877), respectively. But no significant difference (P=1.000) was discovered between average VDR_{MR} and $VDR_{PET/CT}$.

CONCLUSIONS

In six rabbits for which the cross-sectional specimens were available, GTVs at CT, MR, FDG-PET/CT and cross-sectional autopsy were similar, whereas FDG-PET/CT and MR were found to be more accurate modality. However the GTV delineation of FDG-PET/CT in head and neck cancer is not superior to MR.

References: *1. Zheng X K, Chen L H, Wang Q S, et al. Influence of FDG-PET on computed tomography-based radiotherapy planning for locally recurrent nasopharyngeal carcinoma[J]. Int J Radiat Oncol Biol Phys. 2007, 69(5): 1381-1388.*

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Zhe WANG
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