

ABSTRACT

The impact of PET/CT scanning in the radiotherapy planning of non-small cell lung cancer

Background: In the current practice of radiotherapy planning and target volume determination in patients suffering from the non-small cell lung cancer (NSCLC), a contrast-enhanced CT is standard procedure. Contemporary studies have proven that PET/CT examination attains higher sensitivity and specificity in the diagnosis of lung cancer and also leads to higher accuracy in the process of target-volume delineation in NSCLC.

Aim: To compare radiotherapy plans made according to CT and PET/CT examinations in the same patient and to investigate the impact of changes in target volume sizes on tumor control probability (TCP) and normal tissue complication probability (NTCP) and the impact of combined PET/CT examination on the staging of the disease and treatment strategy.

Materials and Methods: Between October 2008 and November 2013, 42 patients suffering from pathologically proven inoperable locally advanced NSCLC that were referred to radical radiotherapy were involved in our study. They all underwent planning PET/CT examination. I carried out two separate delineations of target volumes and two radiotherapy plans, both with their own dose-volume histograms (DVH). I compared the following parameters of radiotherapy plans: staging, treatment purpose, the size of GTV and PTV, the exposure of organs at risk – lungs, spinal cord, heart and oesophagus. The parameters TCP and NTCP were also compared.

Results: PET/CT scan information led to a significant decrease in the sizes of target volumes: median $GTV_{CT} = 80,2 \text{ cm}^3 \pm 115$ (range 19,4 – 715,8 cm^3), median $GTV_{PET/CT} = 53 \text{ cm}^3 \pm 79$ (range 15,7 – 715,8 cm^3); $p < 0,001$; median $PTV_{CT} = 336,8 \text{ cm}^3 \pm 308,4$ (range 151,2 – 1204 cm^3), median $PTV_{PET/CT} = 288,4 \text{ cm}^3 \pm 283,1$ (range 107,9 – 1147 cm^3); $p < 0,001$. This thesis also observed a size change of target volumes that had a statistically insignificant impact on the radiation exposure of lung tissue, but there was a significant impact on radiation exposure of the oesophagus, heart and spinal cord. Although a significant reduction of the target volumes sizes was found, it wasn't reflected in the significant increase of the TCP value: median TCP_{CT} was $62,8 \% \pm 38,9$ (range 0,4 – 88 %) and median $TCP_{PET/CT}$ $61,3 \% \pm 38,8$ (range 0,4 – 88 %); $p = 0,5293$. I also found that there is a very strong direct linear relationship between all evaluated dosimetric parameters and NTCP values of all evaluated organs at risk.

Conclusion: This thesis found that the use of planning PET/CT in the radiotherapy planning of NSCLC has a crucial impact on the precise determination of target volumes, more precise staging of the disease and thus also an impact on possible changes of treatment strategy.