Topic: Functional imaging methods of lung cancer
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Introduction:

The aim of my work was to assess the use of direct quantification of dual-energy CT (DE-CT) radiation in the diagnosis and monitoring of non-small cell lung cancer (NSCLC) therapy. The work consists of three studies that were performed on Department of imaging methods. The main objectives were to assess the contribution of iodine quantification from DE-CT examinations, to verify the setting and to incorporate the DE-CT examination of the chest into a routine investigation. Furthermore, to investigate the possible benefit of dual-phase DE-CT in evaluating both primary non-small cell lung cancer itself and lymph nodes in terms of iodine and size relationship in chemotherapy or targeted therapy, and finally to investigate the possible benefit of staging FDG-PET / CT to evaluate the effect of therapy on lymph nodes.

Methodics:

In all presented studies, the same DE-CT protocol was used in the early (arterial) and late (venous) stages. Using a dedicated software prototype, iodine content analysis was performed as the equivalent of blood circulation in lymph nodes and tumors. The main evaluated parameters were iodine content (mg), iodine uptake (mg / ml) and ratio of arterial enhancement fraction (%).

In the first study, retrospective analysis of 113 target lymph nodes in 24 NSCLC patients who underwent a staging and control DE-CT scan after several cycles of chemotherapy. According to the RECIST criteria, the nodes were divided into two groups (benign and malignant) and then into two groups according to the chemotherapy response (progressing and responding). In progressing and responding lymph nodes, an anatomical response with iodine content was observed.

In the second study, a total of 108 lymph nodes were evaluated in 38 NSCLC patients who underwent FDG-PET / CT staging and, after chemotherapy, underwent two DE-CT examinations. Subsequently, the lymph nodes were divided into four groups according to whether they were assessed as metastatic (positive or negative) in the stage of metabolic activity in the staging, and further developed according to DE-CT (progression or regression). For these four groups, the nodal size and iodine content relationship was monitored.

In the third study, 31 patients diagnosed with NSCLC who were treated with anti-EGFR therapy and who underwent DE-CT before starting this therapy and further investigations with the same treatment method were evaluated. Subsequently, the anatomical response to the therapy and the iodine content of the tumor in the arterial and venous phase of DE-CT was observed. Based on the iodine content, the prediction of the response to anti-EGFR therapy was also evaluated.

Results:

In the first study, a statistically significant difference in the AEF value between benign and malignant nodules, a statistically significant difference in the level of iodine content in the arterial phase of the staging examination was not found in the treatment of nonresponsive vs. non-response nodes. AEF in nodules for which there was no favorable response to therapy, and an increase in AEF between staging and control was demonstrated

in this group, which corresponds to an increase in arterial and a decrease in venous postcontrast saturation in the control.

In the second study, a statistically significant difference was observed in the development of AEF and iodine uptake in the venous phase of the study between a group of primarily metastatic nodules that progressed further and a group of primarily non-responding nodes with metastatic involvement during treatment. Furthermore, the correlation between the AEF and the response to treatment was confirmed, with AEF on average decreasing for AEF positive node metastasis, while on AEF on average the AEF increased on average.

In the third study, there was a statistically significant decrease in iodine uptake in tumors with a positive response based on anatomical parameters, in particular the iodine uptake (IU) values in the venous phase of the examination. In contrast, there was no evidence of a significant change in IU in non-responding tumors. In addition, the IU and AEF parameters were evaluated as possible predictors of the beneficial effect of anti-EGFR therapy; the iodine absorption values were higher in the responding tumors; statistical significance was demonstrated in the venous phase.

Conclusion:

The two-phase DE-CT is a promising functional imaging method to evaluate the therapeutic response in both primary non-small cell lung carcinoma and nodal metastases in the future by accurate quantification of the post-contrast increase in iodine content. However, it is necessary to state that routine use would require further studies with a larger number of patients and the need to simplify the quantification of iodine parameters. All three studies have shown that the arterial postcontrast phase alone is not a determinant for tumor or nodal metastasis, but statistically significant changes can be detected in the venous phase. The most beneficial parameter, however, was the arterial enhancement fraction (AEF), which is the relative value of both postcontrast phases.