Institutionen för klinisk vetenskap, intervention och teknik
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Radiomics in cancer prognosis: Applications and limitations of quantitative texture analysis

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ABSTRACT

Medical imaging has become an integral part of clinical diagnostics since the discovery of X-rays at the end of the 19th century. Recent advances in computing power have opened up the possibility to extract quantitative data from medical images beyond what is visible to the human eye, so-called radiomics. Additional information from standard imaging modalities such as computed tomography (CT), magnetic resonance imaging (MRI), and positron emission tomography scan (PET) can thereby be acquired.

Texture analysis is one of the most studied methods within the concept of radiomics. The textural parameters calculated describe spatial relationships between voxel intensities and image heterogeneity. Methods based on gray level co-occurrence matrices (GLCM) are among the most common implementations of texture analysis of medical images. Recent studies have shown relationships between textural parameters and outcome parameters such as overall survival, treatment response and molecular markers in different types of cancers.

In this thesis, the potential application of textural analysis to be used as a prognostic tool in different cancers without requiring major changes to clinical imaging practice was evaluated.

In study I, a GLCM-based tool supporting analysis of 3D volumes was developed and applied for texture analysis of MRI images of low-grade glioma. The mutation status of isocitrate dehydrogenase (*IDH)* in low-grade glioma could be predicted using the GLCM textural parameter Homogeneity.

In study II, the use of semiautomatic segmentation was shown to reduce intra- and interobserver variation at CT volumetry of esophageal tumors when compared to manual segmentation. The influence of differing skill levels between the observers could also be reduced.

Study III showed that textural analysis could be used to predict ypT-status of post-neoadjuvant esophageal adenocarcinoma. Significant differences in textural parameters were observed between esophageal adenocarcinoma and squamous cell carcinoma, which suggest that the two tumor types should be analyzed separately in future studies involving textural analysis of esophageal cancer. The addition of PET image data during CT segmentation of esophageal tumors did not improve the correlation between the included textural parameters and ypT-status or overall survival.

Study IV found no additional variation in textural parameters due to use of contrast media for normal hepatic tissue or hepatic lesions, implying that reproducible contrast medium timing should not be an issue at perfusion CT texture analysis of hepatocellular carcinoma.

In conclusion, this thesis shows that histopathological differences in tumors can be observed using non-invasive diagnostic imaging through textural analysis. The method is applicable to both CT and MRI and on different types of tumors.