Texture analysis in colorectal liver metastases

9. Valorisation addendum

Valorisation addendum

Colorectal cancer (CRC) is the most common form of cancer in The Netherlands, with 15.550 new cases in 2015[1]. Incidence is expected to rise to 17.000 new cases in 2020 because of the implementation of the nationwide screening program, the growing incidence (especially in men) and the growing and ageing population[1]. Once CRC is diagnosed, the next step is to determine its stage. The stage of CRC is based on the local tumour extent and on whether there are signs of cancer spread to lymph nodes and other organs. This is typically assessed with imaging, including a CT scan or MRI of the abdomen and a CT scan or X-ray of the chest. In case of stage IV cancer, cancer has spread to distant organs, with one of the most important sites of metastases being the liver. This is considered 'advanced' CRC and is generally treated with chemotherapy. Some patients may benefit from chemotherapy with even a curative path in combination with surgery. However, there are still many patients for whom chemotherapy will only be a palliative solution. To date, we still have an insufficient insight into which factors determine the course of the disease and consequently to determine which patients are at risk to develop advanced disease[2]. Moreover, once the metastatic disease is present it remains unclear which patients will likely show a good response to treatment and which patients will not.

So far, the mainstay of imaging evaluation has been to assess the morphology (e.g. shape, signal) and size of tumour lesions[3]. In other words, we have so far mainly focussed on things that can be appreciated by the 'naked eye'. There is, however, much more information 'hidden' in images that could potentially provide us with more in-depth knowledge about the underlying tumour biology. This information can be distilled when we look at images with more sophisticated methods. An example of such a method is CT texture analysis, which is a mathematical method that assesses the distribution of signal intensities on CT images[4].

Relevance

The results of this thesis show that CT texture analysis can be a useful adjunct for the imaging of colorectal liver metastases as it can provide quantitative 'imaging markers' to predict the course of the disease. For example, texture analysis has shown capable of predicting the occurrence of metastases within six months after diagnosis, which enables an early selection of patients at risk of developing metastases. This is in line with the current trend to promote "personalised medicine", which means that medical decisions, practices, interventions and/

or products are tailored to the individual patient, based on their predicted disease risk profile. In future practice, novel imaging tools such as texture analysis may thus aid in optimising treatment for individual patients, thereby aiming to ultimately improve outcome and survival. Moreover, when patients can be better informed about their risk profile, this can lead to a better-informed decision-making process between doctor and patient.

Target population

There are several people who could benefit from the results presented in this thesis (once properly validated and confirmed by further studies). First, obviously, all colorectal cancer patients can benefit from CT texture analysis as it is a non-invasive tool that can provide the patient's treating physicians with additional information that provides a better insight into their disease and can thus help optimise treatment to obtain the best possible outcome. Second, healthcare professionals who are in the decision-making process among patients with CRC could benefit from the 'imaging biomarkers' provided by texture analysis. Finally, in the field of radiology, the results obtained with texture analysis in colorectal cancer may be extrapolated and explored further in other malignancies, but also in other non-oncologic conditions including chronic liver disease such as steatosis and cirrhosis. Further research is needed, to explore these opportunities.

Products

Currently, there are a few commercial products available that incorporate texture analysis within daily used imaging software. This is mainly because to date, evidence on the clinical utility of texture analysis is still relatively sparse. Once the clinical added value is confirmed by further and larger studies, the incorporation of texture analysis into clinical imaging tools should be further explored therewith building on the important bridge between research and clinical practice.

Innovation and future

Up until now, CT texture analysis has not been part of daily radiological clinical practice. With this thesis, we aimed to give an overview of the current potential of this method and its possible beneficial role as a clinical diagnostic tool. Future research should focus on building on this preliminary evidence by performing large-scale validation studies, detailed correlation with pathology and standardisation of scanning protocols.

Moreover, it will be interesting to apply texture analysis as a post-processing method not only to CT data but also to MRI sequences including both routine morphological sequences as well as exciting novel functional imaging techniques such as diffusion-weighted and perfusion imaging that focus on more and more specific aspects of the tumour biology. Finally, imaging features such as texture should be combined with other clinical features such as histopathology and genomics in order to build smart multiparametric clinical models that can offer comprehensive insights into a patient's disease profile and prognosis.

References

1. Cijfers over kanker. 2015. http://www.cijfersoverkanker.nl2017).
2. Manfredi S, Lepage C, Hatem C, Coatmeur O, Faivre J, Bouvier AM. Epidemiology and management of liver metastases from colorectal cancer. Annals of surgery 2006; 244(2): 254-9.
3. Eisenhauer E, Therasse P, Bogaerts J, et al. New response evaluation criteria in solid tumours: revised RECIST guideline (version 1.1). European journal of cancer 2009; 45(2): 228-47.
4. Ganeshan B, Miles KA. Quantifying tumour heterogeneity with CT. Cancer imaging : the official publication of the International Cancer Imaging Society 2013; 13: 140-9.