

# Clinical value of quantitative imaging in patients with gastrointestinal liver metastases

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## IMPACT PARAGRAPH



## MAIN AIMS AND RESULTS

Patients with cancer in the gastrointestinal tract undergo scans at multiple time-points: at diagnosis, and during treatment and during follow-up. These scans, or medical images, are then visually assessed by a radiologist to diagnose and stage the cancer, but also evaluate the response to treatment, for instance by using size measurements of the tumour. The past decades, it has been established that those medical images contain more data than just the eye can see. Radiomics is a method that is able to quantify the information from a medical image by converting them into quantitative features, i.e. radiomics features. These radiomics features describe the tumour on a pixel level, which is not possible for the radiologist to appreciate. Research has shown that it is possible to build promising models that could predict response or even predict outcome before the start of treatment.<sup>10,11</sup>

In this thesis, we identified that evidence for radiomics in patients that undergo thermal ablation (i.e., destruction of cancer cells with high temperatures) for metastases in the liver with primary colorectal cancer was lacking. In Chapter 3 and 4, this specific patient population was studied and we found that it was possible to predict local recurrence close to the ablation area based on the computed tomography (CT) scan both before and after ablation. Besides these promising results for the use of advanced quantitative assessment of medical images, we also found some less promising results. In Chapter 5, we found that a previously developed radiomics model was not successful when applied to a similar, but slightly different patient group. Likewise, we were not able to reproduce the promising results of a method that was able to diagnose a side-effect of chemotherapy on magnetic resonance imaging (MRI) in patients who receive chemotherapy before liver surgery. Finally, we studied a rare group of tumours in the gastrointestinal tract (gastrointestinal neuroendocrine tumours, or GEP-NET) and found that even though use of radiomics increased over time (Chapter 7), evidence was scarce for relevant clinical outcomes. One of the main clinical challenges is to predict the treatment course in GEP-NETs with liver metastasis and in this thesis, we used radiomics in an attempt to distinguish patients that had stable disease from patients with progressive disease, yet were unsuccessful (Chapter 8).

## RELEVANCE

The results of this thesis may have a twofold effect on future research in quantitative imaging and radiomics. The models presented in Chapters 3 and 4 have shown that radiomics can aid in prediction of outcome and what areas could be further studied.

Once externally validated in an independent patient group, these models may be incorporated in clinical risk scores to improve patient-specific treatment planning. However, Chapters 5 and 6 show that not all models are applicable in a different hospital or on a different population. This stresses the need for researchers to collaborate and validate their results in a second hospital or to tailor an existing model to their specific hospital or patient group. Finally, the results in Chapter 8 have shown that even if a certain approach may work for a specific cancer (colorectal cancer), it may not be suitable for another group (GEP-NET). These negative findings demonstrate which directions should be explored in future research and which should not be further pursued.

## TARGET POPULATION

Because this thesis has analysed liver metastases from the gastrointestinal tract, several groups may benefit from the results. At present, mainly researchers in the field of radiomics can benefit, since the existing models are not ready for clinical practice yet. Especially the challenges of radiomics analyses that were highlighted in this thesis with the negative results in Chapters 5 and 8, provide information on how to proceed with further research. Once the promising models are properly validated by independent researchers in a prospective setting, patients with liver metastases from the gastrointestinal tract and their treating physicians may also benefit. As described in this thesis, we have a long way to go to achieve this goal.

## ACTIVITIES

The results from this thesis have been distributed among the community by publication in peer-reviewed journals and presentations at multiple international conferences. The knowledge gathered in this thesis is further applied in follow-up research projects investigating radiomics for colorectal liver metastases on both CT and MRI. One of these studies aims to validate the radiomics model from Chapter 4: to predict local recurrence in the liver in an independent patient group from another hospital.

Radiomics shows potential for the use in clinical practice for the prediction of outcome. However, for the translation and use in actual clinical practice, it is essential that treating physicians understand the concept of radiomics and believe in its value. To this end, collaboration between researchers, computer scientists and clinicians is essential to explain and convince the treating physicians that radiomics could be a valuable addition to current tools.