This research work is part of the RADIAL project, carried out by the institute for minimally invasive surgery from Strasbourg (IHU), where one of the objectives is to improve the treatment and the prevention of liver cancer.  
Being the second leading cause of cancer-related death worldwide, liver cancer is considered as a major public health challenge.

We present the different types of liver cancers, and particularly the hepatocellular carcinoma, which will be the main topic of our work.

We describe the different steps of hepatocarcinogenesis, which transforms healthy hepatic cells into cancerous ones, by analyzing the evolution of the cells and the associated pathological changes.

The current ways to establish a diagnosis are either through extraction and inspection of tissue samples or non-invasively by analyzing medical images.

We outline the different modalities usually exploited to establish a diagnosis, and focus on the computed tomography for the rest of this research work.

We first present the different imaging modalities available to perform a diagnosis, before detailing the two branches of the radiomics field. We review liver radiomics studies and focus on the deep learning radiomics branch for its ability to extract features from the input directly. We present our multiphase cascaded architecture to segment the liver and its tumor, before applying this to weakly annotated datasets. We finally use extracted features from our multiphase architecture to predict the histological grade.

The analysis of medical images is commonly performed by the naked eye, but technological advances allow the creation of computer assisted diagnosis tools.

We present the radiomics technique allowing the extraction of quantitative features from images. Extracted features are most engineered, thus considering the classical radiomics pipeline as hand-crafted, hence the name of *HCR* (HandCrafted Radiomics).

To depict the lack of reproducibility present in the vast majority of the *HCR*-liver related studies, we expose the conclusions of our review where *RQS* (Radiomics Quality Score) were analyzed.

The emergence of deep learning allows creation of algorithms where features are learned from the input directly. The radiomics field benefited from the development of DL, and a new branch was created, the *DLR* (Deep-Learning Radiomics).

We review the DLR studies performed on the HCC, and raise the issue of segmentation, often manually performed and thus suffering from high inter and intra-variability.

To combat this variability a lot of work has been done to perform automatic segmentation of liver and its tumors.

The first methods developed to perform this task were based on anatomical prior-knowledge or manual interactions, and often failed when facing pathological cases.

Automatic deep learning segmentation can address most of these issues by looking for relevant features directly from the images only.

We review the different DL related liver tumor semantic segmentation studies and extract the key common settings for our own research work.

From these key settings, we focus on the cascaded architecture, allowing in the case of tumors segmentation the implementation of two specialized networks (one for the liver on an entire CT slice and the second for the tumor, but only on the liver region).

To prove the ability of DL networks to segment liver tissues, and to prove that a cascaded architecture combined with multiphase CT images allows the best accuracy, we perform semantic segmentation of liver tissues on an internal dataset.

To complete missing annotations in a weakly annotated or non-annotated dataset, we use the same architecture.

And finally, we focus on the prediction of the histological grade, being an indicator of the evolution of the disease. We investigate whether the features extracted from our cascaded multiphase semantic segmentation are relevant enough to perform this task.