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The Requirements of Imaging for Radiotherapy in Head and Neck Cancer

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The ultimate objective of radiotherapy for patients with head and neck cancer is to achieve a high percentage of loco-regional control with a low incidence of morbidity, hence directly impacting on the overall survival and the quality of life.

In this framework, one of the first steps in the radiotherapy planning process is to precisely select and delineate the target volumes (i.e. the tumor) and the surrounding normal tissues potentially responsible for treatment morbidity if irradiated at a too high dose. For a long time, CT is used as the reference imaging modality as it can also be used for dose calculation (taking into account the Hounsfield units, which are surrogates of tissue density). This requires that the image acquisition is performed in treatment position, thus with the patients immobilized with a typical head-neck-shoulder mask on a flat tabletop.

In pharyngo-laryngeal tumors, our group has shown that MRI did not bring any advantage over CT neither for the delineation accuracy, nor for the inter-observer variability. On the contrary, more recently, several groups including our, have shown that providing the images are acquired, reconstructed and segmented in a proper way, FDG-PET improved the delineation of pharyngo-laryngeal tumor volumes. This improvement translated into an improvement in dose distribution, i.e. a lower dose was delivered to the surrounding normal tissues. This finding opens the way for a possible increase in the dose prescription –thus potentially increasing the probability of loco-regional control– without increasing the dose to the surrounding normal tissues. Furthermore, the use of PET with other tracers imaging biological pathways involved in radiation response (e.g. cell proliferation, tumor hypoxia) open a new avenue to specifically deliver an extra dose to the PET-positive area, i.e. the so-called “dose painting” approach.

After a short description of the radiotherapy processes, the lecture will focus on the usefulness of the various anatomic and functional imaging modalities for radiotherapy treatment of head and neck cancer patients. Methodological aspects and pitfalls with the use of multimodality images will be highlighted.