PET/MR imaging of neoplastic and inflammatory lesions

Catalano, Onofrio Antonio

Chapter 10

Conclusions and future perspectives

PET/MR constitutes an innovative, promising and versatile hybrid imaging technology that may take advantage of the best strengths of each parent technology and overcome some of their weakness when standing alone. Although investigation of PET/MR capabilities has just started, it seems likely that it will play an increasing role in oncologic and inflammatory imaging.

At the expense of a fraction of the radiation burden of state of the art PET/CT, it is expected to provide a more accurate staging of most of the solid organ malignancies. We demonstrated that PET/MR improves staging in a heterogeneous population of cancer patients, leading to change in management in up to 18% of cases, as compared to same day PET/CT. We confirmed the improved staging performance of PET/MR versus PET/CT both in specific cancer populations, like in breast and colorectal malignancies, and in evaluating specific organs that are targets of metastases, like bones in breast cancer patients. Other subsequently published manuscripts, by different groups, have supported our initial data, confirming that PET/MR is advantageous over currently used imaging technologies in staging a plethora of neoplasms and in assessing critical target organs, for example, mediastinal lymph nodes in lung cancer and in esophageal cancer, and the liver parenchyma in colorectal cancer.

However, using PET/MR only for staging is reductive, although extremely accurate as an imaging modality. In fact, the technology, coupling the synchronous acquisition of several metabolic and functional parameters from PET and MR, with an ideal spatiotemporal matching and a high soft tissue contrast morphologic layout, might be capable of investigating the histology and molecular biology of inflammation and cancers, and likely also of other disease entities, for example neurodegenerative disease.

We forecast that in the near future PET/MR will be used as a single stop shop technology to discriminate benign from malignant lesions, stage the entire body as

well as accurately depict the local extension of disease, provide precise pre-treatment assessment that includes pre-operative road maps and likelihood of response to medical therapies, allow early establishment of treatment response, and produce biomarkers to explore the histology and molecular biology of cancers. PET/MR might also be employed to address specific critical clinical needs, like:

a. Non-invasive whole-body assessment of heterogeneity of cancers. PET/MR may highlight the lesions exhibiting different and more aggressive radiogenomic features for which treatment changes, including addition of local ablation therapies over chemotherapy, might be necessary.

b. Early assessment of treatment response in patients undergoing immunotherapy.

c. Quantification of cancer specific intracellular metabolic pathways, as well as receptor occupancy quantification, for which selected therapies are under investigation.

d. Assessment of residual disease in patients undergoing neoadjuvant chemotherapy with the possibility of avoiding surgery.

e. Quantification of drug delivery to targeted organs and of drug uptake by cancers, with possible implications on pre-treatment investigation of the best route of administration and on the most adequate dosages, as well as possible treatment adjustments during therapy.

Similarly, it will allow an accurate quantification of the inflammatory burden in several inflammatory entities, including but not limited to Crohn’s disease and rheumatoid arthritis, will guide proper treatment selection and will be used both for early detection of treatment response and for depiction of possible complications.