Artifacts and Diagnostic Pitfalls in PET/MRI

PET/MRI has recently been introduced into clinical practice. It maximizes diagnostic information by unifying the excellent anatomical and physiological information from MRI and the metabolic information from PET (figure 1).

This “one stop shop” imaging modality makes it more time efficient, with an overall decrease in radiation exposure, especially when dealing with paediatric and young patients who require repeated imaging.

Each new imaging modality introduces new types of artifacts. Apart from having an effect on the visual impression of either PET or MR data, artifacts in PET/MRI can affect both PET and MR quantification analysis.

Currently 2-point Dixon volume-interpolated breath-hold examination (VIBE) air sequences are applied to derive an attenuation map (u-map) based on 4 tissue types: lungs, air, soft-tissue and fat (figure 2).

We present the most common PET/MRI image artifacts based on our preliminary experience imaged with a simultaneous integrated PET/MRI scanner (mMR Biograph, Siemens Healthcare, Erlangen, Germany).

These include artifacts related to the reduced field of view (truncation artifacts, figure 2), dental hardware (figure 3), inaccurate bone tissue segmentation, lung tissue mis-segmentation, fat/water swapping (figures 4,5) and EPI based distortion artifacts (figures 6,7).

PET/MRI images show (A) small FOVs apex: (A) Small FOVs with (E) time intensity curves. (B) 2-point Dixon volume-interpolated breath-hold examination (VIBE) sequences are used to derive a (C) 4 segment (air, fat, water, lung) PET/MRI attenuation map (u-map). Note the curvilinear delineation of the periphery of the patient owing to truncation artifacts that can be corrected using information from the MR-NAC image (D) MIP of the final attenuated PET image acquired with PET/MRI.

Figure 2: Coronal presentation of CT and MRI based attenuation maps.

Figure 3: Artifacts from metal dental implants are dependent on the type of material and are often unpredictable. Axial image at the level of the mandible shows a signal void on the (A) PET/MRI map and the (B) fused PET/MRI images, without any associated abnormal uptake.

Figure 4: (A) Diagnostic axial Dixon reformatted into the coronal plane of a patient with a mediastinal tumour. The image shows Dixon fat-water swaps (B) MIP of the final attenuated PET image.

Current MR-AC techniques have limitations compared to those from standard CT-AC and newly proposed changes are being investigated.

Clinicians reporting PET/MRI studies need to be aware of these limitations. Review of both the AC and non-AC images together with the MR and MR based attenuation maps should be performed to detect potential artifacts arising from MR-AC.