Quantitative positron emission tomography

Detection of focal cortical dysplasia (FCD) is of paramount importance in epilepsy presurgical evaluation.

A study of Lin et al., fron the Epilepsy Center, Cleveland Clinic, Cleveland, Ohio, USA aims at utilizing quantitative positron emission tomography (QPET) analysis to complement magnetic resonance imaging (MRI) postprocessing by a morphometric analysis program (MAP) to facilitate automated identification of subtle FCD.

They retrospectively included a consecutive cohort of surgical patients who had a negative preoperative MRI by radiology report. MAP was performed on T1-weighted volumetric sequence and QPET was performed on PET/computed tomographic data, both with comparison to scanner-specific normal databases. Concordance between MAP and QPET was assessed at a lobar level, and the significance of concordant QPET-MAP+ abnormalities was confirmed by postresective seizure outcome and histopathology. QPET thresholds of standard deviations (SDs) of -1, -2, -3, and -4 were evaluated to identify the optimal threshold for QPET-MAP analysis.

A total of 104 patients were included. When QPET thresholds of SD = -1, -2, and -3 were used, complete resection of the QPET-MAP+ region was significantly associated with seizure-free outcome when compared with the partial resection group ($P = 0.023$, $P < 0.001$, $P = 0.006$) or the no resection group ($P = 0.002$, $P < 0.001$, $P = 0.001$). The SD threshold of -2 showed the best combination of positive rate (55%), sensitivity (0.68), specificity (0.88), positive predictive value (0.88), and negative predictive value (0.69). Surgical pathology of the resected QPET-MAP+ areas revealed mainly FCD type I. Multiple QPET-MAP+ regions were present in 12% of the patients at SD = -2.

The study demonstrates a practical and effective approach to combine quantitative analyses of functional (QPET) and structural (MAP) imaging data to improve identification of subtle epileptic abnormalities. This approach can be readily adopted by epilepsy centers to improve postresective seizure outcomes for patients without apparent lesions on MRI [1].

1)
Lin Y, Fang YD, Wu G, Jones SE, Prayson RA, Moosa ANV, Overmyer M, Bena J, Larvie M, Bingaman W, Gonzalez-Martinez JA, Najm IM, Alexopoulos AV, Wang ZI. Quantitative positron emission tomography-guided magnetic resonance imaging postprocessing in magnetic resonance imaging-negative epilepsies. Epilepsia. 2018 Jun 28. doi: 10.1111/epi.14474. [Epub ahead of print] PubMed PMID: 29953586.