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Autor(en) des Beitrags: Lüdemann, L; Förschler, A; Wust, P; Zimmer, C

Titel des Beitrags: Quantification of fMRI BOLD signal and volume applied to the somatosensory cortex.

Abstract: Functional magnetic resonance imaging based on blood-oxygenation-level-dependent (BOLD) signal variations is clinically used to investigate the impact of neurological disorders on brain function. Such disorders affect not only the localization but also the amplitude and extent of the BOLD signal. Statistical methods are useful to localize the BOLD signal but fail to quantify functional activity because they rely on arbitrary thresholds. This article presents a method that uses an a priori defined VOI (volume of interest) and independently quantifies the mean BOLD signal and extent of the activated volume. The technique is based on the separation of the VOI signal difference distribution into a noise and an activation contribution. The technique does not require any threshold and is nearly independent of the preselected VOI size. The technique was verified in a test group of 17 subjects performing bilateral finger tapping. The results were compared with those of conventional analysis based on statistical tools. A standard imaging technique using FID-EPI (free induction decay echo-planar imaging, TR = 4000 ms, TE = 66 ms, 60 images activation, 60 images rest) was employed. The activated volume, V, and signal difference, deltaS, of the motor cortex were determined with an accuracy of sigma(V) = 17.1% and sigma(deltaS) = 3.6%, respectively. The activated volume of the left hemispheric motor area was significantly greater (P =
0.025) then in the right hemispheric, VL = 7.35 +/- 2.29 cm3 versus VR = 6.39 +/- 2.34 cm3. The result is consistent with the findings obtained by other techniques. On the other hand, the statistical methods did not yield any significant difference in activation between both hemispheres. The VOI-based method presented here is an additional tool to study the extent and amplitude of the BOLD signal.