3D ^{7}Li magnetic resonance imaging analysis in patients with bipolar disorder

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Background: Lithium (^{7}Li) is an effective first-line treatment for bipolar disorder but is underutilized in clinical practice due to concern over side effects and difficulties in predicting response among patients. Although novel multinuclear MRI has demonstrated a heterogeneous distribution of lithium, robust determination of its anatomical distribution presents a computational challenge, especially in subjects with low lithium concentrations.

Aims: (i) Devise and compare methods for measuring brain lithium signal intensity and variability using unmodified ^{7}Li-MRI data. (ii) Investigate the relationship between brain lithium signal intensity and variability, serum Li levels and clinical characteristics using the appropriate method.

Methods: Euthymic bipolar patients (n = 26) on long-term lithium treatment underwent ^{7}Li-MRI using a balanced steady-state free precession gradient echo sequence (15×15×25 mm^3 voxel). Brain ^{7}Li-MRI signal intensity and signal-to-noise ratio (SNR) were determined based on a region of interest approach comparing manual annotation and thresholding methods. Mean brain Li signal intensity and coefficient of variation (COV) were calculated and relationships between clinical variables were investigated.

Results: Threshold analysis (SNR= 6.27 $\pm$ 0.7) demonstrated brain rain ^{7}Li signal heterogeneity (signal intensity = 64374.68 $\pm$ 6201.01; COV= 20.5 ± 4.29%) between subjects . Mean brain ^{7}Li signal strongly correlated with serum lithium concentration ($r = 0.79$; $p<0.001$) but not with dose ($r = 0.27$; $p = 0.28$), lithium-related side effects ($r = -0.13$; $p = 0.56$) or mood rating scales in this euthymic cohort.

Conclusion: Analysis of unmodified ^{7}Li-MRI data indicates a clear relationship between brain and serum lithium levels, providing a strong foundation for evaluating interpolation and data normalization based sophisticated analysis in the future.