EPP1018

Predicting unipolar and bipolar depression using inflammatory markers, neuroimaging and neuropsychological data: a machine learning study

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Introduction: About 60% of bipolar disorder (BD) cases are initially misdiagnosed as major depressive disorder (MDD), preventing BD patients from receiving appropriate treatment. An urgency exists to identify reliable biomarkers for improving differential diagnosis (DD). Machine learning methods may help translate current knowledge on biomarkers of mood disorders into clinical practice by providing individual-level classification. No study so far has combined biological data with clinical data to provide a multifactorial predictive model for DD.
Objectives: Define a predictive algorithm for BD and MDD by integrating structural neuroimaging and inflammatory data with neuropsychological measures (NM). Two different algorithms were compared: multiple kernel learning (MKL) and elastic net regularized logistic regression (EN).
Methods: In a sample of 141 subjects (70 MDD; 71 BD), two different models were implemented for each algorithm: 1) structural neuroimaging measures only (i.e. voxel-based morphometry (VBM), white matter fractional anisotropy (FA), and mean diffusivity (MD)); 2) VBM, FA, and MD combined with NM. In a subsample of 71 subjects (36 BD; 38 MDD), two similar models were implemented: 1) VBM, FA, and, MD combined with only NM; 2) VBM, FA, and MD combined with NM and peripheral inflammatory markers. Finally, the best model was selected for comparison with healthy controls (HC).
Results: Overall, the EN model based on all the modalities achieved the highest accuracy (AUC = 90.2%), outperforming MKL (AUC=85%). EN correctly classified BD and MDD with a diagnostic accuracy of 78.3%, sensitivity of 75%, and specificity of 81.6%. The most significant predictors of BD (variable inclusion probability (VIP) > 80%) were the parahippocampal cingulate, interleukin 9, chemokine CCL5, posterior thalamic radiation, and internal capsule, whereas MDD was best predicted by chemokine CCL23, the anterior cerebellum, and the sagittal stratum. In contrast, NM did not help to differentiate between MDD and BD. However, they help to distinguish patients from HC. Psychomotor coordination and speed of information processing discriminated between MDD and HC (VIP>90%), whereas fluency, working memory, and executive functions differentiated between BD and HC (VIP>80%).
Conclusions: In summary, BD was predicted by a strong proinflammatory profile, whereas MDD was identified by structural neuroimaging data. A multimodal approach offers additional instruments to improve personalized diagnosis in clinical practice and enhance the ability to make DD.

Disclosure of Interest: None Declared

EPP1019

Altruistic decision-making is associated with certain patterns of local brain functional connectivity

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Introduction: The brain mechanisms of altruism cannot be strictly localized; therefore, the analysis of brain functional connectivity (FC) can reveal intrinsic mechanisms of altruism or, conversely, anti-social tendencies in behavior.
Objectives: The objective was to investigate local FC patterns of altruistic decision-making using the "Pain versus Gain" (PvsG) paradigm.
Methods: The sample included 38 participants (18 females), 21.2±2.1 y.o. who signed the informed consent form and filled in the Interpersonal Reactivity Index questionnaire (IRI). The study protocol was approved by the local ethical committee. The PvsG task consisted of the control (CC) and experimental condition (EC) with 20 trials, each with 6 possible decisions. In the CC, participants had to decide which finger the second fake participant (FP) to move (one of five fingers or no move). In the EC, they were given money (1000 rubles) and had to choose in every trial between self-benefit (to keep 50, 40, 30, 20, 10 or 0 rubles) or FP's pain induced by the medical electromyostimulator (with 6 levels of intensity, from "highest" to absence), e.g., when a participant keeps no money, the FP receives no stimulation. The FP was not present, and his finger moves and hand reactions to the stimulation were pre-recorded and presented as feedback. 62-channel EEG was recorded simultaneously, and the time intervals for decision-making were used for the weighted Phase Lag Index (wPLI) computation between the reconstructed cortical sources. Spearman coefficients with p-values correction via permutations were calculated between FC difference (EC vs. CC) and the sum of money given out.
Results: The money given out correlates positively with the Empathic Concern (R=0.38, p=0.01), Perspective-taking (R=0.42, p=0.01), Fantasy scale (R=0.4, p=0.01), and does not correlate with the Personal Distress scale (R=0.17, p=0.28) of the IRI. Significant correlations were found between the money given out and the FC between the right lingual gyrus (lg) and caudal ACC in 4-30 Hz band (R=0.54, p<0.001) and FC between the caudal ACC and left insula in 8-13 Hz band (R=0.58, p<0.001).
Conclusions: The PvsG task is a valid paradigm for the investigation of brain mechanisms of altruistic decision-making. We described local FC correlates of prosociality formalized in the