Title:

Machine learning XGBoost classification of postoperative delirium by intraoperative EEG metrics

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Abstract:

Postoperative delirium (POD) occurs in up to 50% of older adults undergoing major surgery with anesthesia[1] and is associated with long-term cognitive impairment[2–4] and increased risk of 1-year mortality[5] and Alzheimer's Disease[6]. As more older adults undergo surgery each year, there is a growing need for clinical prediction tools and research on delirium mechanisms—both of which may be addressed with electroencephalographic (EEG) brain biomarkers of delirium.[7] Therefore, EEG data from 46 patients[10–12] undergoing major surgeries with inhalational anesthesia were analyzed. 437 intraoperative EEG features from 4 referencing methods (system reference, local, current source density, and average mastoid) were used to identify the optimal feature set for classifying POD via an XGBoost algorithm using gradient boosted decision trees. Delirium incidence was determined from 3D-CAM[8] or Confusion Assessment Method (CAM)[9] scores measured twice daily through postoperative day 5 or hospital release. After repeated stratified k-fold cross validation (5 folds, 2 repeats), the average mastoid referenced EEG data had the highest mean AUC at 0.82 (0.20), ranking right parietal delta power and left frontal burst suppression ratio as important EEG features for classification. Two-sided permutation tests showed p=0.079 and p=0.003 for these features, respectively (model p=0.030). Results suggest that EEG features are a valuable predictive tool for POD independent of other clinical features, with the average mastoid reference providing the best data for predicting POD incidence. If the results generalize, these EEG measures and models could serve as new clinical prediction tools and guide future research on POD brain mechanisms.

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