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Cortical thickness distinguishes idiopathic normal-pressure hydrocephalus from progressive supranuclear palsy: a machine learning approach

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Background: Progressive supranuclear palsy (PSP) and idiopathic normal pressure hydrocephalus (iNPH) share several clinical and radiological features, making the differential diagnosis challenging.

Objective: In this study, we aim to differentiate between these two diseases using a machine learning approach based on cortical thickness and volumetric data.

Methods: Twenty-three iNPH patients, 50 PSP patients and 55 control subjects were enrolled. All participants underwent a brain 3T-MRI, and cortical thickness and volumes were extracted using Freesurfer 6 on T1-weighted images and compared among groups. Finally, the performance of a machine learning approach with random forest using the extracted cortical features was investigated to differentiate between iNPH and PSP patients.

Results: iNPH patients showed cortical thinning and volume loss in the frontal lobe, temporal lobe and cingulate cortex, and thickening in the superior parietal gyrus in comparison with controls and PSP patients. PSP patients only showed mild thickness and volume reduction in the frontal lobe, compared to control subjects. Random Forest algorithm distinguished iNPH patients from controls with AUC of 0.96 and from PSP patients with AUC of 0.95, while a lower performance (AUC 0.76) was reached in distinguishing PSP from controls.

Conclusion: This study demonstrated a more severe and widespread cortical involvement in iNPH than in PSP, possibly due to the marked lateral ventricular enlargement which characterizes iNPH. A machine learning model using thickness and volumetric data led to accurate differentiation between iNPH and PSP patients, which may help clinicians in the differential diagnosis and in the selection of patients for shunt procedures.