The Hedgehog sign in the differential diagnosis of idiopathic normal pressure hydrocephalus

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Aim: The Hedgehog sign is a recently proposed qualitative MRI marker associated with gait impairment severity in idiopathic normal pressure hydrocephalus (iNPH). This sign is characterized by the presence of at least three enlarged perivascular spaces (ePVSs) in the sub-insular region, as seen in the axial slice aligned with the striatum, resembling the spines of a hedgehog [1]. A more pronounced variant, the Hedgehog-Halo (H-H) sign, with the same ePVSs surrounded by white matter hyperintensity with blurred edges has also been described [1]. The aim of this study was to evaluate the prevalence and diagnostic relevance of the Hedgehog and H-H signs in patients with iNPH and to first investigate whether this sign is specific for NPH or can be osbserved also in other neurodegenerative diseases and healthy controls.

Results: In the iNPH group, 55% of patients exhibited the Hedgehog sign while 22% had the H-H. sign. In PSP-RS, 57% of participants had the mild form and 15.7% showed the severe form. 35 % of PD patients showed the mild form and only 8.3 % had the H-H sign. In healthy controls, 20% of subjects presented the Hedgehog sign, while no participants showed the severe sign. A significant association with age was observed in the PD group, where the presence of the Hedgehog sign ($p = 0.0195$) and the H-H sign ($p = 0.048$) was associated with older age.

Materials and Methods: A total of 115 consecutive subjects evaluated at the Neuroscience Research Center of Magna Graecia University, Italy, were enrolled in the study. After excluding cases with poor quality or missing T2-weighted MR images, 85 subjects were included in the analyses: 18 with iNPH, 19 with progressive supranuclear palsy – Richardson syndrome (PSP-RS), 24 with Parkinson's disease (PD), and 24 healthy controls (HC). All participants underwent 3.0 Tesla brain MRI, including axial T2-weighted sequences. Three raters blinded to clinical data investigated the prevalence of the Hedgehog and H-H signs in each group, considering the hemisphere with the most severe involvement.

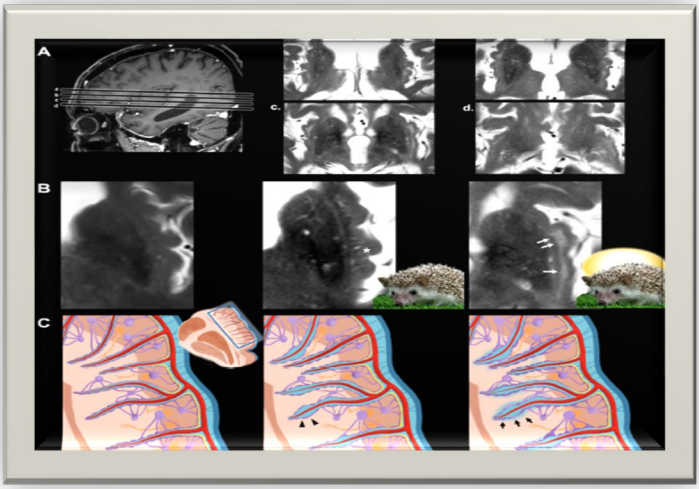

Figure 1.[1] "Interpretation of Hedgehog and Hedgehog-Halo signs in representative images. (A) T1-weighted sagittal image with annotated cutlines (left). These sections span the vertical breadth of the whole insula. The T2-weighted axial sections (right, a–d) represent a typical patient with Hedgehog-Halo (H-H) sign, most prominent in the (b,c) sections. (B) The magnetic resonance imaging interpretation of no signs/Hedgehog/H-H sign (from left to right). There are no enlarged perivascular spaces (PVS) visible in MRI (left). The Enlarged PVSs (asterisk) below the insular cortex, surrounding the putamen, appear like spikes spreading out from the striatum; a feature reminiscent of a Hedgehog (ie, the Hedgehog sign, middle). Some of the PVSs conglomerate with blurry edges (white arrows), forming a confluent area of hyperintensity, (ie, the Hedgehog-Halo (H-H) sign, right). (C) The schematic drawings of sub-insular PVSs. Normal (left). Hedgehog (Middleiguredilated PVS (black arrowheads). H-H (Right)—dilated PVS with fuzzy interstitial hyperintensities (black arrows, "halo" in H-H) that co-localize with enlarged PVSs." [1]

Discussion and Conclusion: Our findings confirm that the Hedgehog and H-H signs are common in iNPH patients and may serve as supportive imaging markers. However, they were observed with similar prevalence in PSP-RS and less frequently in PD and HC. This study provides novel data on the prevalence and specificity of these recently described imaging signs across iNPH and neurodegenerative diseases and supports the well-established radiological overlap between PSP and iNPH [2], [3].

References: [1]J. Ha et al., "The 'Hedgehog-Halo Sign' Is Associated with Gait Symptom Severity and Tap Response in Normal Pressure Hydrocephalus," Mov Disord Clin Pract, vol. 12, no. 1, pp. 21–33, Jan. 2025, doi: 10.1002/mdc3.14255.

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