INTRA- AND INTER-RATER AGREEMENT IN THE ASSESSMENT OF NIGROSONME-1 HYPERINTENSITY ON 1.5T AND 3.0T SUSCEPTIBILITY-WEIGHTED IMAGING

Al Busaidi A, Bantan N, Davagnanam I

UCL Institute of Neurology, London, United Kingdom
Absence of Nigrosome-1 (N1) hyperintensity on SWI-MRI is a relatively new sign in Parkinson’s disease (PD) with a high diagnostic accuracy on 3T-MRI.

Pathology in PD starts in substructures in the dorsolateral substantial nigra (SN) called Nigrosomes, with N1 representing the largest cluster of dopaminergic cells in the pars compacta (SNpc) [1,2].

N1 appears as an ovoid hyperintensity in the SNpc ventralis, bounded medially by SNpc dorsalis, & anteriorly & laterally by SN pars reticulata (SNpr), resembling a Swallow tail. Loss of the hyperintensity reflects loss of SN dopaminergic neurones [1,2,3].
PURPOSE

➤ To assess the feasibility of N1 hyperintensity detection on departmental 1.5T & 3T Susceptibility Weighted imaging (SWI)

➤ To measure the intra- & inter-rater agreement, & compare them with the literature.
 METHODOLOGY: PATIENTS

➤ Retrospectively, 100 consecutive patients who underwent SWI-MRI were assessed after excluding 12 patients due to severe artefact.

➤ Forty nine patients were scanned on 3T (Skyra & Trio; Siemens), & 51 were scanned on 1.5T (Espree & Avanto; Siemens).

➤ The voxel size was 0.9x0.9x1.5 mm for Skyra, 0.9x0.9x1.8 mm for Trio & 1.1x0.9x2.0 mm for Espree & Avanto.

➤ Two Neuroradiology fellows familiar with the sign assessed the SNpc individually for the presence or absence of N1 hyperintensity. A consensus reading followed.

➤ They were blinded to the clinical history and field strength.
METHODOLOGY: ASSESSMENT

➤ Assessment was done on successive axial sections at the level of the inferior third of the red nucleus. Windowing and magnification were utilised.

➤ Intra-rater analysis was done on 34 patients & inter-rater analysis was done on 100 patients.

➤ Patients with unilateral or bilateral absence of N1 hyperintensity were considered abnormal.

➤ Absolute Agreement (AA) and Kappa coefficient (K) statistics was done on IBM SPSS version 22

➤ Image quality was assessed visually & the scans were divided into high & low quality groups
RESULTS

- Intra-rater AA was 85% for each assessor (K=0.686 & 0.659, P<0.001).
- Inter-rater AA was 88%, (K= 0.545, P<0.001). Agreement for 3T scans was good (K= 0.671, P<0.001) compared with a moderate agreement for 1.5T (K= 0.453, P<0.001). Absolute agreement was 91.8% and 78.4% respectively.
- The 5 PD patients were correctly identified in the consensus reading with bilaterally absent hyperintensity; 3 scanned on 3T and 2 scanned on 1.5T.
- Excluding PD patients, 6 patients (13%) had a negative sign on 3T; two with Dementia with Lewy bodies (DLB). Twelve (24.5%) had a negative sign on 1.5T.
- There were 16 patients in the lower quality group; 14 scanned on 1.5T.
A list of the patients with absent N1 hyperintensity after excluding PD patients.
Axial images of 1.5T & 3T SWI-MRI, showing (A) N1 hyperintensity in Non-PD, (2) absent hyperintensity in PD, & (3) absent & present hyperintensity in non-PD.
Nigrosome-1 hyperintensity can be seen on both 1.5T and 3T. However, its absence is not exclusive to PD [4], with a possible role in DLB.

In the literature, inter-observer agreement on 3T ranged between good & excellent [1, 5, 3], & intra-observer agreement was reported as excellent [1, 3]. Our agreement values were lower, with a good agreement on 3T & moderate agreement on 1.5T.

Possible reasons include lower spacial resolution & non-utilisation of multi-planer reconstruction.

All <60 year olds with absent N1 hyperintensity were scanned on 1.5T.

A higher proportion of the lower quality MRIs were scanned on 1.5T, probably due to its lower spacial resolution & signal to noise ratio.
LIMITATIONS AND CONCLUSIONS

➤ Limitations:

➤ Retrospective, absent control group, non-standardised clinical assessment, images from 4 scanners, lack of comparison with another modality (e.g. DAT-SPECT), & difficulty of blinding to field strength.

➤ Conclusion

➤ Although Nigrosome-1 hyperintensity can be seen on both field strengths, 3T is superior in the assessment of Nigrosome-1, with currently considerable limitations of 1.5T.

➤ Improved study design, imaging techniques & scanner innovations may help increase the confidence in Nigrosome-1 assessment in the diagnostic workup of Parkinson’s disease.
REFERENCES


