Loss of dorsolateral nigral hyperintensity on 3.0 tesla susceptibility-weighted imaging in dementia with Lewy bodies

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Introduction

The diagnosis of dementia with Lewy bodies (DLB) may be challenging. Alzheimer's dementia (AD) is the most frequent misdiagnosis. Susceptibility-weighted imaging (SWI) using 3T MRI can detect a dorsolateral hyperintense signal area ("swallow tail" sign) in the substantia nigra (SN) of healthy controls. It corresponds to the nigrosome-1 and lacks in Parkinson's disease. We evaluated its diagnostic utility in DLB patients.

Methods

We recruited 15 DLB patients (8 men, mean age 76 ± 7), 11 AD patients (4 men, 74 ± 8), 8 frontotemporal dementia (FTD) patients (3 men, mean age 64 ± 12) and 10 control subjects with subjective memory complaint (SMC) (5 men, 67 ± 9). All subjects performed MRI study including axial SWI sequences, visually assessed by two blinded neuroradiologists independently. A third rater resolved disagreements. DLB diagnosis required unilateral or bilateral loss of nigral hyperintensity.

Results

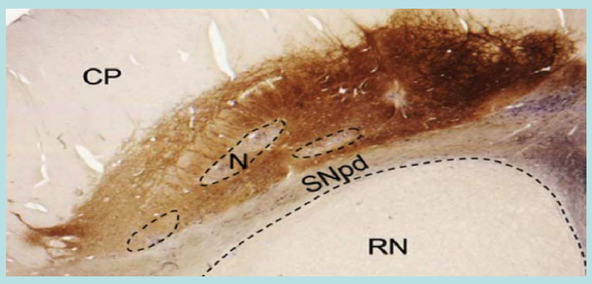
Age (p = 0.04, Kruskal Wallis Test) slightly differed among the groups, as FTD patients were younger, while sex (p = 0.68, chi2 test) did not differ. The patients did not differ in disease duration and MMSE scores. Raters agreed 86% (kappa = 0.71, p < 0.0001). Twelve out of 15 DLB patients lacked nigral hyperintesity unilaterally or bilaterally, unlike the other groups (AD: 4/11; FTD: 2/8; SMC: 1/10; p = 0.0028, chi2 test).

Conclusions

The assessment of dorsolateral nigral hyperintensity using 3T SWI was able to differentiate DLB from AD, FTD and SMC with good diagnostic accuracy. It can be a reliable and noninvasive method to help clinical diagnosis of DLB.

SN and nigrosomes

Immunohistochemical studies showed at least 5 different clusters of dopaminergic cells in the SNpc of healthy subjects (calbindin D_{28k} -)



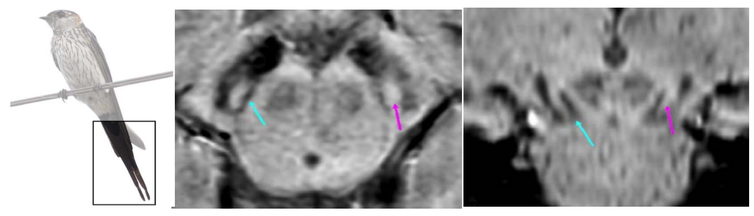
Nigrosome 1

- The largest nigrosome
- In the caudal and medio lateral SN
- Maximal dopaminergic neuronal loss in PD (98%)

SWI and swallow tail sign

Magnetic susceptibility is the ability of a substance to induce a variation of the local magnetic field in the presence of an external magnetic field. SWI allows to enhance the contrast of substances with different magnetic susceptibility to the surrounding tissue background (blood, calcium ...)

SWI can detect nigrosome-1 as a hyperintense signal area, called the "swallow tail" sign, in healthy controls

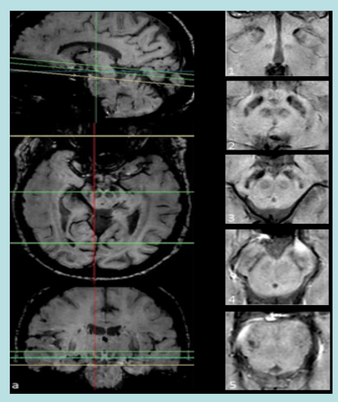


Subjects

	DLB (n=15)	AD (n=11)	FTD (n=8)	Ctrl (n=10)	p Value
Sex (M/F)	8/7	4/6	3/5	5/5	NS[A]
Age	76 ± 7	74 ± 8	64 ± 12	67 ± 9	0,04[B]
Age at onset	71 ± 7	69 ± 8	61 ± 13	/	NS[B]
Disease duration	5 ± 3	5 ± 3	3 ± 2	/	NS[B]
MMSE	17 ± 6	13 ± 5	19 ± 6	28 ± 2	<0,001[B]

A= Chi-square Test; B= Kruskal Wallis Test

RM 3 Tesla (Ingenia®, Philips Medical System, Eindhoven, The Netherlands). 32-channel head coil.



SWI
TR = 31
TE = 7.2
Flip angle = 17
Voxel size = 0.80x0.81x1.60
Scan duration = 3 min

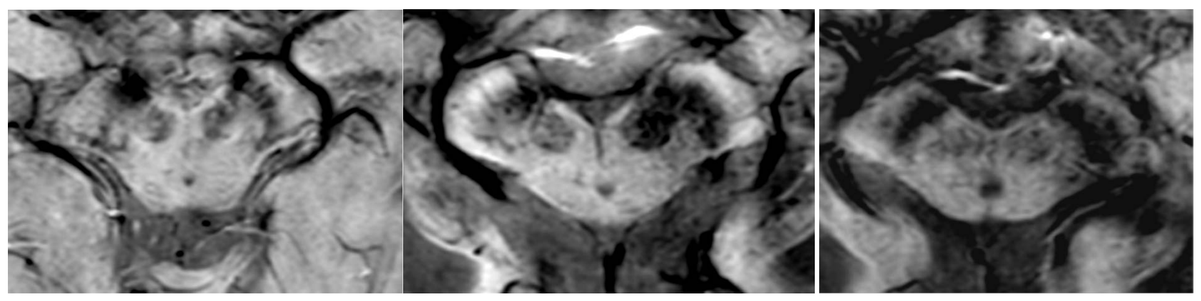
SN was sampled in craniocaudal direction by obtaining 5 axial sections and displayed by MPR reconstruction starting from an oblique plane, parallel to corpus callosum

Comparisons

Loss of dorsolateral nigral hyperintensity

	DLB	AD	FTD	CTRL
TOT	12/15 (80%)	4/11 (36%)	2/8 (25%)	1/10 (10%)
UNIL	4/15 (27%)	2/11 (18%)	1/8 (12.5%)	1/10 (10%)
BIL	8/15 (53%)	2/11 (18%)	1/8 (12.5%)	0/10 (0%)

Chi-quare: p=0.0028
DLB vs AD: p=0.024
DLB vs FTD: p=0.01
DLB vs CTRL: p=0.001
DLB vs ALL: p=0.0004



Diagnostic accuracy

	DLB vs AD	DLB vs FTD	DLB vs CTRL	DLB vs ALL
Sensitivity	80%	80%	80%	80%
Specificity	64%	75%	90%	76%
PPV	75%	86%	92%	63%
NPV	70%	67%	75%	88%
Accuracy	73%	78%	84%	77%

Gold standard: clinical diagnosis!

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