MRI Volumetric Analysis of Substantia Innominata in Dementia

Riham Rabee*, Sean J. Colloby and John-Paul Taylor
Institute for Ageing and Health, Newcastle University, Campus for Ageing and Vitality, UK.

Introduction

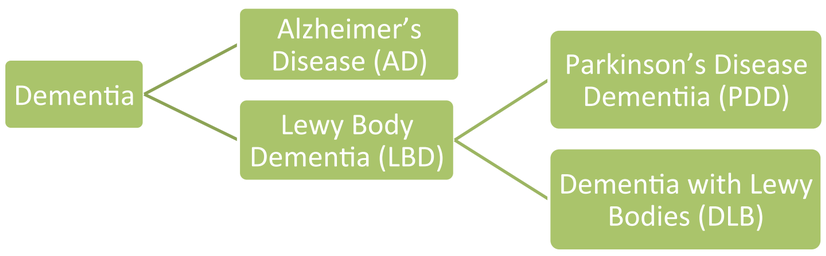

Fig 1. Categories of dementia

Studies have shown DLB symptoms are a result of cholinergic dysfunction. Fluctuating cognition, including attentional dysfunction, and visual hallucinations are core symptoms affecting patients with DLB.

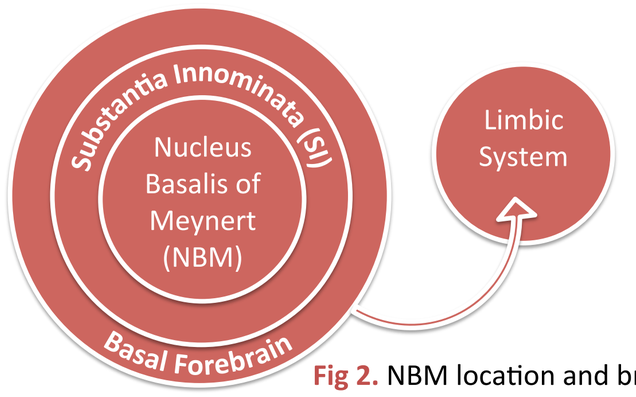

Fig 2. NBM location and brain connections

A major component of the cholinergic system is the Nucleus Basalis of Meynert. The connections between the basal forebrain and the limbic system play a crucial role in the effect on memory function and attention.

Aims

1. To investigate differences in the standardised SI volumes between groups
2. To investigate the relationships between SI volumes and selective clinical and cognitive variables in AD and DLB

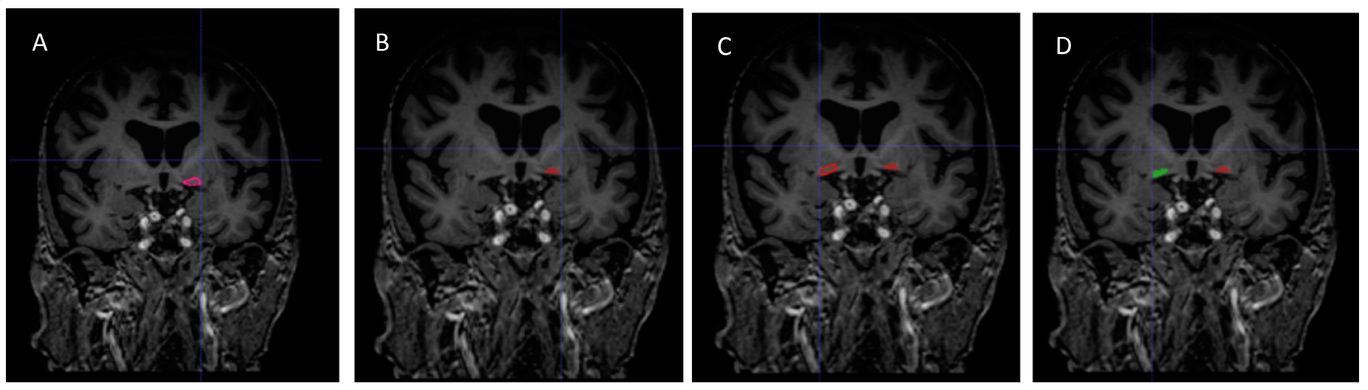

Fig. 4. MRI scans showing a segmented SI

Methods

Subjects

Subjects underwent T1 weighted MR scanning on a 3T MRI system using an 8 channel head coil.

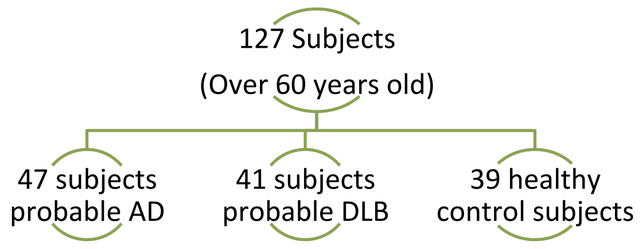

Fig 3. Subject Populations

Volumetric SI Analysis

The SI was defined using the following protocol (Table 1):

Coronal Sections	Borders (Fig 2A, B)	
• Anterior commissure crosses the two hemispheres (Fig 2A).	**Lateral**	• Medial putamen.
• Anterior commissure but with the absence of the joining of the crossing.	**Medial**	• Vertical line from the ventrolateral border of the stria terminalis to brain base.
• Anterior commissure exiting the temporal lobe bilaterally.	**Dorsal**	• Ventral section to the globus pallidus.
	Ventral	• Brain base containing the anterior perforated space.

Table 1. SI location

Segmentation of the SI volumes recorded in both the right and left hemispheres (Fig. 4). Standardised SI volumes were then calculated by expressing the values as % of their total intracranial volumes.

Results

Subjects

	Controls	AD	DLB
Subjects	39	47	41
Males (%)	25 (64)	33 (70)	26 (63)
Age, years	77 ± 6.4	79 ± 8.8	79 ± 6.2
TIV, mm³	1500 ± 134	1495 ± 134	1525 ± 192
MMSE	29 ± 1.0	21 ± 4.0	23 ± 5.0
CAMCOG Total	97 ± 3.3	68 ± 13.5	69 ± 14.9
NPI Total	-	9.3 ± 8.7	13.5 ± 11.0
UPDRS	1.2 ± 1.7	2.6 ± 2.4	24.0 ± 13.7
Cholinesterase Inhibitors (%)	0 (0)	25 (53)	32 (78)
RBD	0	0	10

Table 2. Subject demographics

SI volumes

Significant difference was observed between groups ($F=8.802$, $p<0.001$). Post-Hoc tests revealed significant differences between controls and AD ($p<0.001$) but not between controls and DLB ($p=0.24$, Fig 5).

Correlations

A negative correlation was found, controlling for age and TIV, between normalised SI volumes and MMSE score in AD ($r=-0.30$, $p=0.04$).

No other significant correlations were identified with SI volumes and cognitive measures in AD or DLB ($r\leq0.35$, $p\geq0.23$).

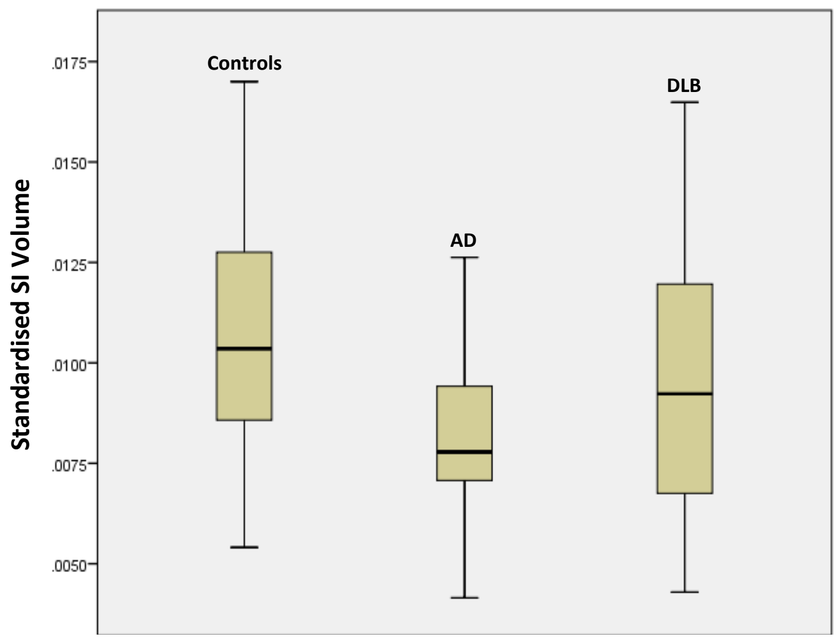

Fig. 5. SI volumes in controls, AD and DLB

Discussion and Conclusion

IN SUMMARY:

- Volumetric loss in the SI was greater in patients with AD than in DLB.
- A correlation between cognitive function and reduced SI volume was demonstrated in AD but not in DLB.

This is contrary to findings suggesting that DLB patients have greater cholinergic deficits than AD. Conflation of white and grey matter structures within the SI volume may have confounded results.

IN FUTURE:

Studies could focus on employing more sensitive methods that can separate grey and white matter structures within the SI, and to investigate their associations with cognitive decline.

References

1. McKeith, I.G. et al., Consensus guidelines for the clinical and pathologic diagnosis of dementia with Lewy bodies (DLB): report of the consortium on DLB international workshop. *Neurology*
2. McKeith, I.G. et al., Diagnosis and management of dementia with Lewy bodies. Third report of the DLB consortium. *Neurology*
3. Bradshaw, J. et al., Fluctuating cognition in dementia with Lewy bodies and Alzheimer's disease is qualitatively distinct. *J Neurol Neurosurg Psychiatry*
4. Shin, S et al. Neuroanatomical substrates of visual hallucinations in patient with non-demented Parkinon's disease. *J Neurol*
5. Choi, S. et al. Volumetric analysis of the substantia innominata in patients with Parkinson's disease according to cognitive status. *Neurobiol Aging*
6. Whitwell, J et al. Focal atrophy in Dementia with Lewy Bodies on MRI: a distinct pattern from Alzheimer's disease. *Brain*
7. George, S, MRI-based volumetric measurement of the substantia innominata in amnestic MCI and mild AD, *Neurobiol Aging*
8. Mark G Baxter, Andrea A Chiba, Cognitive functions of the basal forebrain, Current Opinion. *Neurobiology*
9. Niewiadomska G, Baksalerska-Pazera M, Riedel G. The septo-hippocampal system, learning and recovery of function. *Prog Neuropsychopharmacol Biol Psychiatry Neurosurg Psychiatry*
10. Duda, JE. Pathology and neurotransmitter abnormalities of dementia with Lewy bodies. Dement Geriatr Cogn Disord.

Acknowledgement

Special thanks to John-Paul Taylor and Sean Colloby of the Institute of Aging and Health for their generous support and backing throughout the entire project.

Further Information

Imperial College University
Faculty of Medicine

RR1810@IMPERIAL.AC.UK