

LETTER TO THE EDITOR

Reply: Is nucleus accumbens atrophy correlated with cognitive symptoms of Parkinson's disease?

Oury Monchi^{1,2} and Alexandru Hanganu¹

1 Centre de recherche de l'Institut Universitaire de Gériatrie de Montréal, Qc, Canada

2 Department of Radiology, University of Montreal, Canada

Correspondence to: Oury Monchi

E-mail: oury.monchi@umontreal.ca

Sir,

We thank Dr Mavridis for this very thoughtful comment about nucleus accumbens atrophy in patients with Parkinson's disease from a neurosurgical point of view. Indeed it had been previously reported that dopamine loss also occurs in the nucleus accumbens of patients with Parkinson's disease especially at the advanced stages (Farley *et al.*, 1977). Different groups, including our own have shown that patients with Parkinson's disease are affected differently on functions relying on the ventral versus the dorsal striatum (MacDonald *et al.*, 2011). To the best of our knowledge, Dr Mavridis' findings were the first to indicate *in vivo* that Parkinson's disease is also associated with nucleus accumbens atrophy (Mavridis *et al.*, 2011) and as suggested in the letter, nucleus accumbens might be associated with the neuropsychiatric non-motor symptoms that are present in the disease, like depression and anxiety (Sturm *et al.*, 2003; Paul *et al.*, 2005; Epstein *et al.*, 2006). Our current results would indicate that this is the case at least for cognition (Hanganu *et al.*, 2014).

However other cortical and subcortical atrophied regions were associated with cognitive deficits in Parkinson's disease in our study. Furthermore, it remains to be determined exactly how specific the nucleus accumbens volumetry changes are with respect to cognitive impairment versus other non-motor deficits observed in Parkinson's disease (such as depression, apathy, anxiety). Indeed, nucleus accumbens function has been associated with depression (Epstein *et al.*, 2006) and deep brain stimulation of the nucleus accumbens has been shown to decrease the non-motor deficits (Sturm *et al.*, 2003; Paul *et al.*, 2005). Additionally, patients with Parkinson's disease who have mild cognitive impairment, have been shown to have a larger presence of depressive symptoms and anxiety compared with patients with normal cognition

(Monastero *et al.*, 2013). Finally, it remains to be investigated whether this nucleus accumbens pathology is specific to Parkinson's disease. In particular, one study revealed no volume difference between early-onset Alzheimer's disease and healthy controls, but found a significant reduction in the bilateral nucleus accumbens volumes in patients with late-onset Alzheimer's disease compared to healthy controls (Pievani *et al.*, 2013).

In summary, nucleus accumbens atrophy in Parkinson's disease might be a marker for cognitive impairment and possibly for other non-motor symptoms in Parkinson's disease, but further multi-disciplinary studies are warranted to find out how specific it is.

References

- Epstein J, Pan H, Kocsis J, Yang Y, Butler T, Chusid J, et al. Lack of ventral striatal response to positive stimuli in depressed versus normal subjects. *Am J Psychiatry* 2006; 163: 1784–90.
- Farley I, Price K, Hornykiewicz O. Dopamine in the limbic regions of the human brain: normal and abnormal. *Adv Biochem Psychopharmacol* 1977; 16: 57.
- Hanganu A, Bedetti C, Degroot C, Mejia-Constain B, Lafontaine A-L, Soland V, et al. Mild cognitive impairment is linked with faster rate of cortical thinning in patients with Parkinson's disease longitudinally. *Brain* 2014; 137: 1120–9.
- MacDonald PA, MacDonald AA, Seergobin KN, Tamjeedi R, Ganjavi H, Provost J-S, et al. The effect of dopamine therapy on ventral and dorsal striatum-mediated cognition in Parkinson's disease: support from functional MRI. *Brain* 2011; 134: 1447–63.
- Mavridis I, Boviatsis E, Anagnostopoulou S. The human nucleus accumbens suffers parkinsonism-related shrinkage: a novel finding. *Surg Radiol Anat* 2011; 33: 595–9.
- Monastero R, Fiore P, Ventimiglia G, Camarda R, Camarda C. The neuropsychiatric profile of Parkinson's disease subjects with and without mild cognitive impairment. *J Neural Transm* 2013; 120: 607–11.

Paul RH, Brickman AM, Navia B, Hinkin C, Malloy PF, Jefferson AL, et al. Apathy is associated with volume of the nucleus accumbens in patients infected with HIV. *J Neuropsychiatry Clin Neurosci* 2005; 17: 167–71.

Pievani M, Bocchetta M, Boccardi M, Cavedo E, Bonetti M, Thompson PM, et al. Striatal morphology in early-onset and late-onset

Alzheimer's disease: a preliminary study. *Neurobiol Aging* 2013; 34: 1728–39.

Sturm V, Lenartz D, Koulousakis A, Treuer H, Herholz K, Klein JC, et al. The nucleus accumbens: a target for deep brain stimulation in obsessive-compulsive- and anxiety-disorders. *J Chem Neuroanat* 2003; 26: 293–9.