Integrative function of single neurons in the human subthalamic nucleus during checking behavior

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Objective: To study the role of the subthalamic nucleus (STN) in the processing of cognitive information during checking behaviour in patients with obsessive compulsive behaviour (OCD).

Background: Human behavior depends on complex interactions between cognition and emotion. How does the brain combine these two dimensions to make a decision and elaborate a goal-directed action remains unclear. One hypothesis is that such an integrative process might occur owing to the convergence of information through the basal ganglia. Recently, the associative and limbic STN have been proposed as potential targets for deep brain stimulation in patients with medically-resistant form of OCD[1]. We took the opportunity of the last study to investigate the role of STN neurons in the processing of cognitive information.

Methods: We used an instrumental task (CT), adapted from a matching to sample-task, that specifically offered the opportunity to verify once one subject has made a choice[2]. Single unit neuronal activity was recorded in the STN whereas patients with obsessive compulsive disorders (OCD) performed the CT.

Results: Among 125 single neurons recorded during task performance, 45 (36%) were task-related. Modifications of activity were observed in relation with: visual information during the study phase (28%), the choice phase (22%), or the checking phase (20%), movement execution during the choice phase (37%), or the checking phase (35%) and during the evaluation phase at the end of the task (56%). We found that STN neurons frequently responded in a polymodal manner to cognitive, premotor and emotional events. Moreover, discharge frequency was influenced by checking behavior.

Conclusions: These results suggest that STN neurons process multiple sources of information in accordance with the model of information convergence within the basal ganglia. They also demonstrate that the STN play a part in the physiology of doubt, a critical feature of OCD pathophysiology.

References

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2. Rotge JY, et al., Acta Psychiatr Scand. 2008 Jun;117(6):465-73.