

NEURONAL FIRING IN RESPONSE TO MICTURITION IN THE SUBSTANTIA NIGRA PARS COMPACTA AND THE VENTRAL TEGMENTAL AREA IN CATS

Aims of Study

Parkinson's disease patients are well known to have not only motor but also urinary autonomic disorders, suggesting central dopaminergic pathways are involved in the micturition function. However, there is little evidence that the substantia nigra pars compacta (SNc) and the ventral tegmental area (VTA), the major dopamine containing nuclei in the midbrain, should participate in regulating micturition.

Methods

We recorded neuronal firing in the SNc and the VTA in response to isovolumetric micturition reflex in 15 male cats under ketamine anaesthesia. In each recording site, we performed electrical microstimulation to analyze bladder responses. Using double recording of the neurons in the SNc/VTA and those in the pontine storage center (PSC), we performed correlation analysis of both sites of the neuronal firings and antidromic stimulation.

Results

Forty-nine neurons in the SNc/VTA showed firing in response to the bladder storage/micturition cycles. There were 4 types of firing patterns. The major neurons were tonic storage neurons (61%), and tonic micturition neurons were second common (18%). The rest were phasic storage neurons (12%) and phasic micturition neurons (9%). The storage neurons were found in the rostral SNc/VTA (A3 to A6 in the Horsley-Clarke coordinates), whereas the micturition neurons were found in the caudal SNc/VTA (A2 to A3), respectively. Electrical stimulation of the majority of neurons inhibited micturition, whereas that of some caudal SNc/VTA neurons (6 neurons) evoked micturition. Double recordings were made in 24 pair of the neurons in the SNc/VTA and the PSC, which showed no time-correlation in a millisecond order between the both sets of neuronal firings. Antidromic stimulation applied to 15 pair of the recording sites showed no antidromic response in either the SNc/VTA or the PSC.

Conclusions

The existence of a variety of heterogeneous discharge patterns observed in the SNc and the VTA neurons suggest that these neurons may organize a complex neuronal circuitry. The major role of the neurons in the SNc/VTA is suppression of the micturition reflex, which may exert indirectly via the pontine storage centre. The findings may provide implication in the pathophysiology of urinary disorder in PD.

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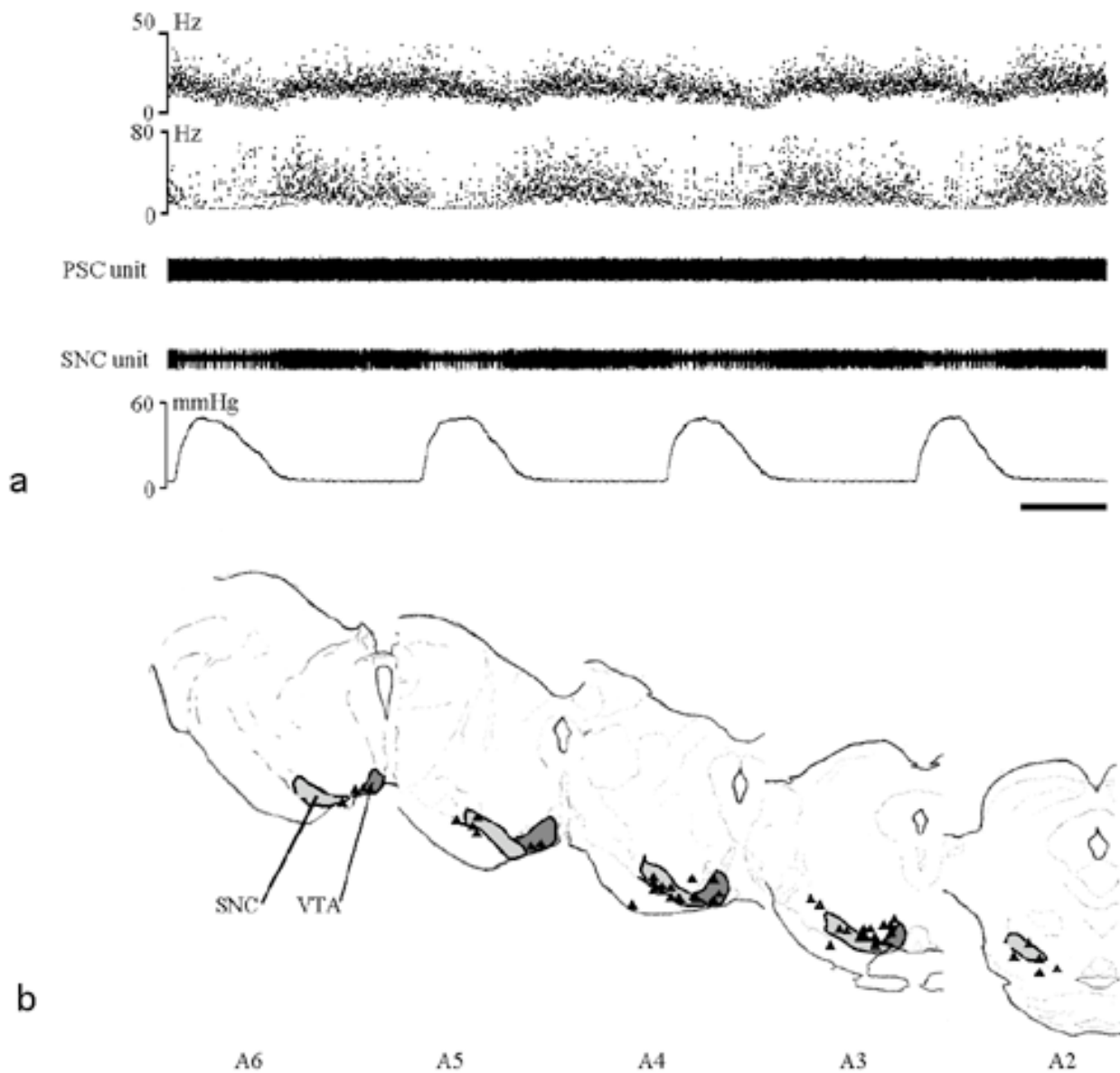


Figure a An example of double recording of the SNC/VTA neurons and the PSC neurons. Tonic storage neurons (constant firing) in the SNC/VTA ; tonic storage neurons (constant firing) in the PSC.

Figure b Location of the responses to electrical stimulation in the SNC/VTA.

filled triangle : inhibition of micturition reflex

open triangle : facilitation of micturition reflex (only 3 sites in A2-3)