

# HOSPITAL PHYSICIAN®

## NEUROLOGY BOARD REVIEW MANUAL

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The *Hospital Physician Neurology Board Review Manual* is a peer-reviewed study guide for residents and practicing physicians preparing for board examinations in neurology. Each manual reviews a topic essential to the current practice of neurology.

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## Psychiatric Symptoms of Basal Ganglia Disorders: Evaluation and Management

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# Psychiatric Symptoms of Basal Ganglia Disorders: Evaluation and Management

William R. Marchand, MD, and John W. Thatcher, MD

## INTRODUCTION

There is compelling evidence that the basal ganglia circuits play an important role in the neurobiology of disorders that involve a spectrum of cognitive, emotional, and motor symptoms. It is well known that basal ganglia circuit dysfunction is implicated in movement disorders, including Parkinson's disease, Huntington's disease, Wilson's disease,<sup>1-3</sup> and tardive dyskinesia.<sup>4</sup> Individuals with basal ganglia movement disorders often exhibit cognitive and emotional symptoms. Basal ganglia pathology has also been implicated in many psychiatric conditions, including schizophrenia,<sup>5-7</sup> schizotypal personality disorder,<sup>8</sup> attention-deficit hyperactivity disorder (ADHD),<sup>9</sup> obsessive-compulsive disorder (OCD),<sup>10</sup> unipolar depression,<sup>11,12</sup> and bipolar disorder.<sup>13-21</sup> Many of these disorders have significant psychomotor symptoms,<sup>22</sup> such as psychomotor retardation associated with depression and the psychomotor agitation of mania.

Neurologists frequently treat basal ganglia movement disorders and therefore need to be able to evaluate and manage the psychiatric manifestations of these conditions. Psychiatric referral should be necessary only for more complicated cases. Neurologists also can greatly assist patients who present with basal ganglia disorders considered to be psychiatric conditions (eg, OCD) by initiating treatment that might be delayed while waiting for a psychiatric evaluation. This manual reviews the evaluation and management of psychiatric symptoms associated with 4 disorders of the basal ganglia: Huntington's disease, Wilson's disease, OCD, and Tourette's disorder. A future manual will address evaluation and management of Parkinson's disease.

## NEUROBIOLOGY OF BASAL GANGLIA CIRCUITS

The basal ganglia circuits (**Figure**) are composed of the basal ganglia, thalamus, and cortex. These information-processing loops are generally known as the *frontal-subcortical* or *corticostriatal* circuits.<sup>23,24</sup> Although

the function of the basal ganglia circuits is incompletely understood, there is evidence of involvement in motor control,<sup>23</sup> cognitive<sup>25-27</sup> and emotional<sup>28,29</sup> processing, and motor learning and adaptation.<sup>30,31</sup>

## NUCLEI OF THE BASAL GANGLIA

The basal ganglia structures consist of large numbers of cell bodies organized into nuclei and include the nucleus accumbens, caudate, putamen, substantia nigra, globus pallidus, and subthalamic nucleus (STN).<sup>23,24</sup> The caudate, putamen, and nucleus accumbens comprise the striatum. The nucleus accumbens, ventromedial caudate, ventral putamen, and olfactory tubercle are often referred to as the *ventral striatum*, which is primarily involved with emotional processing.<sup>32</sup> The globus pallidus consists of 2 subnuclei: the pars interna (GPi) and pars externa (GPe). Each nucleus has separate connections. The substantia nigra also consists of 2 subnuclei: the reticular division (SNr) and the pars compacta (SNc). The GPi and SNr are nearly identical and usually designated as the GPi/SNr.

Corticostriatal information processing occurs by way of signals that originate in the cortex, pass through the basal ganglia to the thalamus, and flow back to the frontal cortex (**Figure**). Five parallel corticostriatal subcircuits are generally recognized: the skeletomotor, oculomotor, dorsolateral prefrontal, orbitofrontal, and anterior cingulate.<sup>33</sup> The oculomotor and skeletomotor circuits are involved with motor control; the other 3 circuits are primarily involved with cognitive and emotional processing—the dorsolateral prefrontal with executive function, the orbitofrontal with limbic control, and the anterior cingulate with motivated behavior.<sup>34</sup> The corticostriatal circuits are anatomically segregated but also have connectivity brain regions outside of each circuit.<sup>35</sup> The basal ganglia serve as input, output, or intrinsic nuclei of the corticostriatal circuitry.<sup>36</sup> The input nuclei are the striatum and STN, the intrinsic nuclei are the GPe and the SNc, and the output nucleus is the GPi/SNr. The SNc, the locus of dopamine-containing neurons, receives most of its input from the striatum and sends much of its output back to the striatum.