TABLE 454-8 NEURAL PATHWAYS UNDERLYING SOME STANDARDIZED AUTONOMIC TESTS

Test Evaluated	Procedure	Autonomic Function
HRDB	6 deep breaths/min	Cardiovagal function
Valsalva ratio	Expiratory pressure, 40 mmHg for 10–15 s	Cardiovagal function
QSART	Axon-reflex test 4 limb sites	Postganglionic sudomotor function
BP_{BB} to VM	BP_{BB} response to VM	Adrenergic function: baroreflex adrenergic control of vagal and vasomotor function
HUT	BP_{BB} and heart rate response to HUT	Adrenergic and cardiovagal responses to HUT

Abbreviations: BP_{BB}, beat-to-beat blood pressure; HRDB, heart rate response to deep breathing; HUT, head-up tilt; QSART, quantitative sudomotor axon reflex test; VM, Valsalva maneuver.

elevation. The pattern of color change is a measure of regional sweat secretion. A postganglionic lesion is present if both QSART and TST show absent sweating. In a preganglionic lesion, the QSART is normal but TST shows anhidrosis.

Orthostatic BP Recordings Beat-to-beat BP measurements determined in supine, 70° tilt, and tilt-back positions are useful to quantitate orthostatic failure of BP control. Allow a 20-min period of rest in the supine position before assessing changes in BP during tilting. The BP change combined with heart rate monitoring is useful for the evaluation of patients with suspected OH or unexplained syncope.

Tilt Table Testing for Syncope The great majority of patients with syncope do not have autonomic failure. Tilt table testing can be used to make the diagnosis of vasovagal syncope with sensitivity, specificity, and reproducibility. A standardized protocol is used that specifies the tilt apparatus, angle and duration of tilt, and procedure for provocation of vasodilation (e.g., sublingual or spray nitroglycerin). A positive nitroglycerin-stimulated test predicts recurrence of syncope. Recommendations for the performance of tilt studies for syncope have been incorporated in consensus guidelines.

SPECIFIC SYNDROMES OF ANS DYSFUNCTION

MULTIPLE SYSTEM ATROPHY (CHAP. 449)

Multiple system atrophy (MSA) is an entity that comprises autonomic failure (OH or a neurogenic bladder) *and* either parkinsonism (MSA-p) or a cerebellar syndrome (MSA-c). MSA-p is the more common form; the parkinsonism is atypical in that it is usually unassociated with significant tremor or a response to levodopa. Symptomatic OH within 1 year of onset of parkinsonism predicts eventual development of MSA-p in 75% of patients. There is a very high frequency of impotence in men. Although autonomic abnormalities are common in advanced Parkinson's disease (Chap. 449), the severity and distribution of autonomic failure are more severe and generalized in MSA. Brain magnetic resonance imaging (MRI) is a useful diagnostic adjunct: in MSA-p, iron deposition in the striatum may be evident as T2 hypointensity, and in MSA-c, cerebellar atrophy is present with a characteristic T2 hyperintense signal ("hot cross buns sign") in the pons (Fig. 454-2). Cardiac postganglionic adrenergic innervation, measured by uptake of fluorodopamine on positron emission tomography, is markedly impaired in the dysautonomia of Parkinson's disease (PD) but is usually normal in MSA. Neuropathologic changes include neuronal loss and gliosis in many CNS regions, including the brainstem, cerebellum, striatum, and intermediolateral cell column of the thoracolumbar spinal cord.

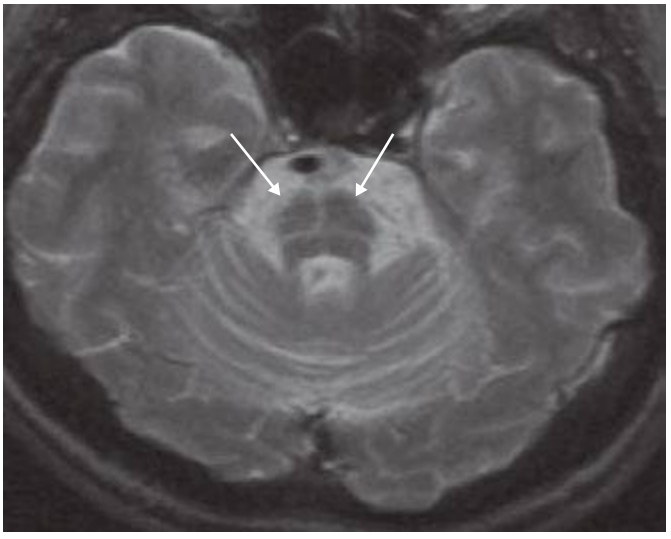

FIGURE 454-2 Multiple system atrophy, cerebellar type (MSA-c). Axial T2-weighted magnetic resonance image at the level of the pons shows a characteristic hyperintense signal, the "hot cross buns" sign. This appearance can also be seen in some spinocerebellar atrophies, as well as other neurodegenerative conditions affecting the brainstem.

MSA is uncommon, with a prevalence estimated at 2–5 per 100,000 individuals. Onset is typically in the mid-fifties, men are slightly more often affected than women, and most cases are sporadic. The diagnosis should be considered in adults over the age of 30 years who present with OH or urinary incontinence and either parkinsonism that is poorly responsive to dopamine replacement or a cerebellar syndrome. MSA generally progresses relentlessly to death 7–10 years after onset, but survival beyond 15 years has been reported. Factors that predict a worse prognosis include rapid progression of disability, bladder dysfunction, female gender, the MSA-p subtype, and an older age at onset. Attempts to slow the progression of MSA have thus far been unsuccessful, including trials of lithium, growth hormone, riluzole, rasagiline, minocycline, and a recent trail of rifampicin.

Management is symptomatic for neurogenic OH (see below), sleep disorders including laryngeal stridor, and gastrointestinal (GI) and urinary dysfunction. GI management includes frequent small meals, soft diet, stool softeners, and bulk agents. Gastroparesis is difficult to treat; metoclopramide stimulates gastric emptying but worsens parkinsonism by blocking central dopamine receptors. The peripheral dopamine (D_2 and D_3) receptor antagonist domperidone has been used patients with various GI conditions in many countries and is now available in the United States through the U.S. Food and Drug Administration's (FDA) Expanded Access to Investigational Drugs program.

Autonomic dysfunction is also a common feature in dementia with Lewy bodies (Chap. 448); the severity is usually less than that found in MSA or PD. In multiple sclerosis (MS; Chap. 458), autonomic complications reflect the CNS location of MS involvement and generally worsen with disease duration and disability.

SPINAL CORD

Spinal cord lesions from any cause may result in focal autonomic deficits or autonomic hyperreflexia (e.g., spinal cord transection or hemisection) affecting bowel, bladder, sexual, temperature-regulation, or cardiovascular functions. Quadriparetic patients exhibit both supine hypertension and OH after upward tilting. *Autonomic dysreflexia* describes a dramatic increase in BP in patients with traumatic spinal cord lesions above the T6 level, often in response to stimulation of the bladder, skin, or muscles. A distended or obstructed bladder, suprapubic palpation, catheter insertion, and urinary infection are common triggers. Associated symptoms can include facial flushing, headache, hypertension, or piloerection. Potential complications