

AMERICAN ACADEMY OF NEUROLOGY AUTONOMIC NERVOUS SYSTEM FELLOWSHIP CORE CURRICULUM

A. INTRODUCTION

The program for subspecialty training in Autonomic Neurology is aimed to provide neurologists with basic and advanced knowledge of the anatomy, physiology and pharmacology of the autonomic nervous system (ANS); the nosology and diagnosis of central and peripheral autonomic disorders; the indications, techniques, and pitfalls of noninvasive clinical autonomic function testing; and the basis of nonpharmacological and pharmacological treatment of autonomic dysfunction.

B. GOALS

The goals of the program are to provide (1) the scientific rationale for evaluation and treatment of disease of the ANS, through didactic lectures or discussions based on assigned readings relevant to the anatomy, physiology, and pharmacology of the ANS; (2) hands-on experience in performance of autonomic testing, including the indications, interpretation, and pitfalls of tests of sudomotor, cardiovagal, and adrenergic function; (3) opportunity for clinical evaluation and management of patients with autonomic symptoms, by participating in Autonomic Clinics or consulting services.

The aims are to prepare the trainee (1) to provide local expertise at the level of his or her neurologic practice in regard to clinical evaluation and management of autonomic disorders; (2) to serve as a resource for, and be actively involved in, teaching and research efforts related to the ANS; and (3) to interact successfully with non-neurologists involved in evaluation and management of patients with autonomic disorders, including cardiologists, endocrinologists, gastroenterologists, other internists, family practitioners, and urologists.

C. OBJECTIVES

Upon completion of the training program, the participant should have acquired the following fund of knowledge and skills:

1. Anatomical organization of the central autonomic control centers, the parasympathetic, sympathetic and enteric nervous systems, and visceral afferents
2. Basis of cardiovascular, respiratory, gastrointestinal, pupillary, sudomotor, and other autonomic reflexes
3. Basis of autonomic neurotransmission, including neurotransmitter synthesis, distribution, and release mechanisms, receptor subtypes, effects on their target organs

4. Autonomic pharmacology, including pharmacokinetics and pharmacodynamics of drugs affecting the ANS
5. Clinical and laboratory diagnosis of central and peripheral disorders of autonomic function, including neurodegenerative disorders associated with generalized autonomic failure, peripheral autonomic neuropathies, focal or target-specific autonomic syndromes, and effects of drugs
6. Indications, techniques, and limitations of noninvasive recordings of arterial pressure, heart rate and sudomotor output, including theoretical and practical knowledge of the equipment used to obtain those recordings
7. Performance, supervision, and interpretation of tests of orthostatic tolerance (heart rate and blood pressure responses to standing or passive head-up tilt); cardiovagal function (including heart rate response to deep breathing); Valsalva maneuver; and sudomotor function
8. Interpretation of the results of humoral, microneurography, and power spectral analysis evaluation of autonomic function
9. Interpretation of tests of pupillary function, gastrointestinal motility, urodynamics, penile erection, and thermography
10. Expertise in nonpharmacologic and pharmacological management of orthostatic intolerance syndromes (including orthostatic hypotension, syncope, and postural tachycardia), gastrointestinal dysmotility, neurogenic bladder, and sudomotor disorders
11. Knowledge of the complex pathophysiological mechanisms involved in neuropathic pain syndromes (including complex regional pain syndromes), and application and limitations of autonomic testing to help determine the contribution of sympathetic outflow to pain and to vasomotor and sudomotor components of the syndrome

D. CONTENT

I. BASIC SCIENCE

A. ANATOMY

1. Central organization of autonomic control
2. Sympathetic system
3. Parasympathetic system
4. Visceral afferents
5. Enteric nervous system

B. PHYSIOLOGY

1. Patterns of activity of central autonomic neurons

2. Synaptic transmission in autonomic ganglia
3. Autonomic neuroeffector junctions
4. Cardiovascular reflexes
5. Cardiorespiratory interactions
6. Thermoregulation
7. Autonomic control of the bladder
8. Control of gastrointestinal motility
9. Control of sexual function
10. Control of the eye
11. Control of immune function
12. Relationship with the endocrine system
13. Sleep and autonomic function

C. NEUROCHEMISTRY

1. Basic neurochemistry of the central autonomic circuits
2. Preganglionic neurotransmission and receptors: acetylcholine and co-transmitters
3. Chemical coding in the sympathetic ganglia: norepinephrine, neuropeptides, and ATP
4. Chemical coding in the parasympathetic system
5. Humoral and local modulation of autonomic neurotransmission
6. Neuropeptides in primary visceral afferents
7. Chemical coding in the enteric nervous system

D. PHARMACOLOGY

1. Receptor mechanisms regulating central autonomic function
2. Nicotinic receptors: distribution, agonists, and antagonists
3. Muscarinic receptors: subtypes, distribution, agonists, and antagonists
4. Alpha adrenergic receptors: subtypes, distribution, agonists, and antagonists
5. Beta adrenergic receptors: subtypes, distribution, agonists, and antagonists
6. Autonomic neuropeptide receptors

II. LABORATORY EVALUATION OF AUTONOMIC FUNCTION

A. SUDOMOTOR FUNCTION

1. Thermoregulatory sweat test (physiology, method, pitfalls, interpretation)
2. Sudomotor axon reflex test (physiology, method, pitfalls, interpretation)
3. Sweat imprint method
4. Skin potentials

B. CARDIOVAGAL FUNCTION

1. Noninvasive evaluation of heart rate variability in the time domain
2. Power spectral analysis

C. GLOBAL EVALUATION OF CARDIOVASCULAR REFLEXES

1. Valsalva maneuver (physiology, methods, pitfalls, interpretation)
2. Head-up tilt (physiology, methods, pitfalls, interpretation)
3. Responses to standing (physiology, methods, pitfalls, interpretation)

D. OTHER NONINVASIVE CARDIOVASCULAR TESTS

1. Cold pressor test
2. Handgrip maneuver
3. Venoarteriolar reflex
4. Flare response

E. CLINICAL RESEARCH METHODS TO INVESTIGATE CARDIOVASCULAR REGULATION

1. Power spectrum analysis
2. Microneurography
3. Neck suction
4. Lower body negative pressure
5. Pharmacological assessment of postganglionic sympathetic outflow and baroreflex sensitivity.
6. Transcranial Doppler and mesenteric blood flow
7. Positron emission tomography
8. Local and systemic hemodynamics

F. PUPILLARY AND LACRIMAL FUNCTION

G. GASTROINTESTINAL MOTILITY

H. BLADDER FUNCTION

I. SEXUAL FUNCTION

J. HUMORAL MARKERS

1. Plasma catecholamines (indications, methods, pitfalls)
2. Peptides
3. Endocrine markers

III. CLINICAL AUTONOMIC DISORDERS

- A. Pure autonomic failure
- B. Degenerative central nervous system disorders such as multiple system atrophy
- C. Secondary central nervous system disorders
- D. Peripheral neuropathies
 - Acute autonomic neuropathies

- Chronic autonomic neuropathies
- E. Disorders of orthostatic tolerance
- F. Paroxysmal acral dysautonomia
- G. Focal autonomic disorders
- H. Drug and toxin- induced autonomic neuropathies
- I. Pain and the autonomic nervous system
- J. Miscellaneous

IV. MANAGEMENT OF AUTONOMIC DISORDERS

- A. Orthostatic hypotension
- B. Orthostatic intolerance
- C. Neurocardiogenic syncope
- D. Hyperhidrosis
- E. Gastrointestinal dysmotility
- F. Neurogenic bladder
- G. Impotence