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Review of: The Integrated Nervous System: A Systematic Diagnostic Approach

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INTRODUCTION

Written by a neuroanatomist, a pediatric neurologist, and an adult neurologist, *The Integrated Nervous System* is a problem-based text written for an introductory neuroscience course for medical and allied health students. The format is patient-centered and focuses on the effects of neurological disorders, the methodology of diagnosis, and patient outcomes. This book is unusual in the field of neuroscience texts in that, in addition to teaching basic and clinical neuroscience, it also stresses the psychological and psychosocial problems of neurological patients and the roles of various health care professionals in treatment and rehabilitation.

The Integrated Nervous System is organized into three sections:

1. The Basics of Neurological Problem Solving introduces the student to the anatomy of the nervous system, the process of giving a neurological examination, and the thought processes behind clinical thinking. It includes three chapters:

- **Chapter 1: Synopsis of the Nervous System.** This chapter gives the basics of the organization of the nervous system, gross and microscopic neuroanatomy, and neurophysiology. Its focus is on the importance of understanding these basics in order to determine the location and etiology of any neurological problem. The chapter is richly illustrated with color diagrams and photos. The various parts of the nervous system are covered in more detail in later chapters.
- **Chapter 2: The Neurological Examination.** This chapter is a template for a complete neurological physical examination. It describes the step-by-step process of examining the cranial nerves, motor systems, sensory systems, as well as higher mental functions such as mental status, executive functions, language, and memory. It focuses on the anatomical rationale for each examination. Throughout, it cites examples of diseases which would cause anomalies in the results of the various tests.
- **Chapter 3: Clinical Problem Solving.** After a brief introduction focusing on the importance of the patient's history and neurological examination, the chapter presents a system of sequential analysis of problems within the nervous system. This is done by evaluating a virtual patient, Crash McCool, presented in a clinical scenario. This chapter explains how data gathered from the history and neurological exam are organized in a Basic Localization Matrix. An Expanded Localization Matrix - including the tests for the subcategories of the mental status exam, cranial nerve exam, and systems exams - is used to evaluate the location of the lesion presented in this chapter. The use of two other worksheets, a History Worksheet and an Etiology Matrix, are also used to reach a diagnosis of Crash's problem. The

authors next methodically list and explain possible etiologies including paroxysmal, trauma, vascular, drugs and toxins, infections, metabolic, inflammatory/autoimmune, neoplastic, paraneoplastic, degenerative, and genetic causes. A diagnosis is reached in Crash's case and neurological investigations to confirm the conclusion are presented. Finally, the patient's treatment and outcome are presented. The Expanded Localization Matrix, Etiology Matrix and History Worksheet are included on the DVD for use with the clinical scenarios in the following chapters.

2. Applying the Basics to Clinical Cases consists of nine chapters, each devoted to one aspect or area of the nervous system. The chapters use a common template with each chapter beginning with a clinical scenario involving one of Crash's relatives. The authors then lead the student through the steps of clinical reasoning needed to discover the diagnosis. Worksheets found on the DVD are to be used by the student to develop a methodology for attacking the clinical problems. As the student progresses through the chapters, relevant anatomical and functional facts are explained. The possible etiologies are discussed and the most likely chosen as the diagnosis. The clinical studies needed to confirm the diagnosis are explained. Each chapter ends by describing the virtual patient's progress through treatment and the final outcome. Most chapters also explore the psychological and social implications of the condition. Additional "e-cases" for each chapter are found on the accompanying DVD. The chapters in this section include:

- **Chapter 4: Fifi (peripheral nervous system).** This chapter expands on the anatomy and physiology of the peripheral nervous system by examining another virtual patient, Crash's wife Fifi. Fifi awoke with motor and sensory symptoms two weeks after having a brief gastrointestinal illness. Progressing through the systematic process described, the lesion is localized to the motor and sensory fibers of the peripheral nervous system. The anatomy specific to peripheral nervous system is presented. All possible causes of the lesion are presented with a discussion of the probability of each cause. It is determined that Fifi's signs and symptoms are consistent with Guillain-Barre syndrome. The history and symptoms of this autoimmune disease are discussed, followed by clinical studies performed on Fifi to verify the diagnosis and determine treatment. Fifi's progress through the treatment is presented as well as her final outcome. The importance of physical therapy in her treatment is stressed.
- **Chapter 5: Cletus (spinal cord).** Using the template, the spinal cord is explored through an injury sustained in an automobile accident by Crash's cousin Cletus. After reminding readers to fill out the worksheets from the DVD and reviewing the main clinical points of the case, the anatomy of the spinal cord is presented in detail. It is richly illustrated with photos of a cadaver dissection and an MRI, and with color illustrations. The contents of the filled-out Expanded Localization Matrix are evaluated and various spinal cord injuries are discussed. This chapter is particularly interesting because the spinal cord injury was not due to the automobile accident, but to hypoxia sustained during surgery for a ruptured aorta. The authors take this opportunity to emphasize the risks of additional injury induced by medical interventions and difficulties patients and their families may have in adjusting to permanent disability.
- **Chapter 6: Bernard (brainstem).** This chapter features Fifi's uncle Bernard who lives in a small town with few medical resources. Bernard presents with unilateral hearing loss followed by slight unilateral facial weakness. Anatomical considerations focus on the close proximity of many structures in the brainstem and on the functional connections between various cranial nerves. The Weber and Rinne tests for hearing and the caloric test for vestibular function are explained. After seeing several health care professionals in "the big city", Bernard is diagnosed with vestibular schwannoma. This chapter underscores difficulties many patients have in obtaining technologically advanced healthcare.
- **Chapter 7: Bobo (motor control).** Initiation, cessation, and coordination of movement are explored in chapter 7. Fifi's sister Bobo presents with gait anomalies, increased muscle tone, illegible writing, decreased facial expression and stooped posture which developed over several months. The text takes the student through the history and physical exam. The relevant neuroanatomy including the cerebellum, basal ganglia, corticospinal tracts, and rubrospinal tract and neurophysiology are discussed. In presenting possible etiologies, Parkinson's disease, Wilson's disease, Huntington's disease, familial parkinsonism/dystonia syndrome, and dopa-responsive dystonia are discussed. Bobo's diagnosis is dopa-responsive dystonia and the rationale for her treatment and her recovery are discussed.
- **Chapter 8: Etienne (cerebral vasculature and stroke).** Crash's uncle Etienne collapses during a heated exchange with his boss. At the emergency room his blood pressure was elevated, although alert he could not speak, and he had motor symptoms on the right. The anatomy of the cerebrovasculature is presented with photos of dissections, angiograms, and CT. Various syndromes seen following stroke are explained including medial and lateral pontine syndromes, medial and lateral medullary syndromes, and locked-in syndrome. The NIH Stroke Scale is introduced.

Etienne's treatment included intravascular tPA to dissolve the clot followed by angioplasty and the insertion of a stent. The rehabilitation after release from the hospital is stressed.

- Chapter 9: Armand (cognition and dementia). This chapter introduces the elements of cognitive function. It compares the brain with a massive computer with numerous interconnected parallel processing systems allowing extremely rapid responses to complex situations. The chapter features Armand, Crash's elderly uncle. Armand has become increasingly forgetful and has episodes of unexplained anger. The pathophysiology of common forms of dementia are presented, including Alzheimer's disease, various frontotemporal dementias, Lewy body dementia, corticobasal degeneration, progressive supranuclear palsy, and Creutzfeldt-Jacob disease. The possibility that dementia may result from a combination of causes is emphasized when Armand is diagnosed with Alzheimer's disease with a component of vascular dementia.
- Chapter 10: Didi (Levels of consciousness). Chapter 10 teaches about the levels of consciousness by introducing Crash and Fifi's children who have childhood absence epilepsy. The states of consciousness are presented and the contributions of the reticular formation, thalamus, and cerebral cortex are discussed. The text systematically explains numerous possible causes of Didi's "spells" and eliminates those that are not supported by the evidence. Types of epileptic seizures and examples of EEG tracings are introduced. Didi is diagnosed with childhood absence epilepsy and his treatment and outcome are given.
- Chapter 11: Chantal (Meninges, cerebrospinal fluid, and venous drainage). Chantal is an obese, hypertensive 37-year old female with a history of headaches. After an automobile accident she seeks treatment at a local emergency room and is found to have bilateral papilledema, but otherwise normal neurological responses. This scenario triggers a review of the meninges, CSF, and venous drainage of the brain and skull as well as the visual pathway. Possible etiologies of increased intracranial pressure are discussed. In Chantal's case, a CT scan showed no intracranial mass lateral and 3rd ventricles reduced in size, and swollen optic nerve heads. Lumbar puncture was normal, MRI confirmed the results of the CT, and MRA showed no anomalies of the vessels. Because of lack of other findings, she is diagnosed with idiopathic intracranial hypertension, a disease most often found in very obese, hypertensive women.
- Chapter 12: Mickey (Limbic system). Chapter 12 has two major functions: [1] to introduce the neuroanatomy and neurophysiology of the portions of the brain controlling attention, impulse control, learning, mood regulation, memory and behavior and [2] to show the difficulty in diagnosing children and teens with behavioral disorders. Mickey is Crash's younger brother. In grade school he was diagnosed with attention-deficit/hyperactivity disorder (ADHD) and prescribed Ritalin. This controlled his behavior for a few years, but he then developed "tics". His medication was changed several times with no alleviation of symptoms. He improved in his early teens, but became worse by age 17 at which time the "tics" returned and he became violent. The chapter first analyzes the features of Mickey's disorder. It then discusses the neuroanatomy and neurophysiology of the prefrontal cortex and its circuits through the basal ganglia and cerebellum. The anatomy and physiology of the limbic system is covered next. The Diagnostic and Statistical Manual of Mental Disorders (DSM) is introduced. Mickey's disorder is found to have features of four of the listed disorders (ADHD, Tourette's disorder, mathematics disorder, and obsessive-compulsive disorder). Each of these disorders is discussed. Mickey is diagnosed with Tourette's disorder.

3. Supplementary Considerations: Rehabilitation and Ethics contains two chapters. "Neurorehabilitation" focuses on the neurological problems that may be alleviated by rehabilitation, the function of each health care professional during the process, the therapeutic approaches to various conditions, and the differences in the treatment of children and adults. The ethics chapter presents a five part clinical vignette, followed by questions and discussion.

Although written for a problem-based learning (PBL) curriculum, *The Integrated Nervous System* is an appropriate supplementary text for any clinically-based neuroscience course or an excellent reference book. The DVD contains all the illustrations in the text, animations of reflexes and neuronal pathways, additional case studies, worksheets for the clinical cases, and information on neural imaging. Suggested readings are in the form of journal articles listed at the end of each chapter. Also, an annotated bibliography, organized by topic and with a synopsis of each entry, is found at the back of the book. A helpful glossary is also included.