

Lecture 2

Book: Students with Learning Disabilities

Chapter 2- Medical Aspects

Dr. Dae Young Jung

(Changwon National University, South Korea)

Summary

Neurology and learning disabilities: all learning occurs in the brain and is facilitated by the nervous system. Neurology is the medical specialty that focuses on the structure and function of the nervous system. Based on the theory that subtle or minimal disorders in the nervous system result in learning problem, neurology is the medical specialty most frequently involved with the field of learning disabilities.

Central nervous system structure and function: the basic unit of the nervous system is the nerve cell or neuron. The nervous system consists of many forms of neurons but a cell body, axon and dendrites are characteristics of each nerve cells. Nerve impulses are conducted from one nerve cell to another across a juncture called the synapse through the action of chemicals called neurotransmitters. In this way, messages regulating behavior are sent throughout the body. The nervous system has 2 major regions :the central nervous system (CNS) and the peripheral nervous system (PNS). The CNS consists of the spinal column and the brain. The PNS, made up of nerves and other sensory structures that lie outside the CNS, connects the CNS to the rest of the body. The CNS includes the integrative and thinking portions of the nervous system. The spinal column serves as a connecting link between the brain and the body.

Brain: the brain has three main parts –

1. The cerebrum fills up most of the skull. It is involved in remembering, problem solving, thinking, and feeling. It also controls movement.
2. The cerebellum sits at the back of the head, under the cerebrum. It controls coordination and balance.
3. The brain stem sits beneath the cerebrum in front of the cerebellum. It connects the brain to the spinal cord and controls automatic functions such as breathing, digestion, heart rate and blood pressure.

The cerebrum has received the most attention from neurologists concerned with learning disabilities. It is divided into the right and left hemispheres, sometimes called right brain and

left brain. These two are connected by the corpus callosum, a large tract of nerve fibres that serves as a communication pathway between them. The cerebral hemispheres appear to function cross laterally i.e they relate at least with some functions, to the opposite sides of the body. There is also evidence that the 2 hemispheres differ their role in learning. For example, the right hemisphere deals with non verbal stimuli such as visual imagery, visual discrimination, temporal and spatial orientation, music, art, holistic thought and creative expression. The left hemisphere is associated with logic and intellect and appears to be dominant in information processing of words and symbols as well as mathematics, analytic thinking, sequencing, and other cognitively related processes. Additionally, language functions are largely controlled by the left hemisphere. However, it should be noted that although hemispheres may specialize with regard to certain functions, they are not totally independent. Much of learning and behavior depends on the interactions of both hemispheres.

Neurobiological origins of the central nervous system: Some theories suggest that there is an inseparable relationship between the CNS and the process of learning and that consequently, damage to one or more of the brain's structures may hinder functions specific to that structure.

Neurodiagnostic technology and neurobiological findings: Because of problems in the use of indirect methods, neurologists now frequently use procedures and equipment that allow more direct examination of the brain. Many procedures use hardware or machines that allow more direct measurement of brain activity and structure. They have been used to diagnose CNS dysfunction and establishing relationships between neurological abnormalities and learning disabilities. They include the electroencephalogram (EEG), brain electrical activity mapping (BEAM), computerized axial tomography (CAT), positron emission tomography (PET), and magnetic resonance imaging (MRI).

Postmortem studies: This is another area of medical research that uses more direct procedures for examining brain structure anomaly. These studies are conducted by performing brain autopsies on persons who have documented learning disabilities and whose cause of death would not interfere with examination of a possible reason for brain abnormalities. Postmortem studies have included only about eight individuals and larger number of deceased subjects are needed. Although tentative, these studies offer insights about the brain structures of individuals with dyslexia.

Etiological perspectives:

- **Acquired trauma:** Injury to the CNS that originates outside the individual and results in learning disorders is called acquired trauma. Acquired CNS damage can occur during gestation, at birth or after birth. They are as follows:
 1. **Prenatal causes:** complications during pregnancy have been linked to a variety of learning problems. The most common cause associated with subsequent learning difficulties is maternal drug consumption including alcohol, prescription and non prescription drugs, and chemicals found in cigarette smoke. These drugs easily pass into the fetus through the placenta and tend to concentrate in the still developing brain.

2. **Perinatal causes:** Events that affect the child during the birth process are called perinatal causes. This includes prematurity, anoxia, prolonged labor, and injury from medical instruments such as forceps. Birth complications have been associated with later learning disabilities characteristic of minimal brain damage, such as language and motor problems and attention deficits.
 3. **Postnatal causes:** Accidents and disease occurring after birth that are associated to lead to brain damage and learning problems include smoke, high fever, encephalitis, meningitis, and head trauma. Out of these, the most common is acquired cerebral trauma associated with head injury.
- **Genetic/ hereditary influences:** Human genes are found in the nucleus of a chromosome which is a microscopic unit that determines individual characteristics. Each individual has 23 pairs of chromosomes, one pair of which is the sex chromosome. Females have two x chromosomes and males have one x and one y chromosome. Chromosomal aberrations associated with learning disabilities typically relate to abnormal sex chromosome numbers. For example, the most commonly found chromosomal variation in males is an extra x chromosome (XXY). Males with this condition called Klinefelter syndrome, typically exhibit reading and language problems as well as poor motor coordination and a tendency to be withdrawn. Two chromosomal abnormalities are linked with learning problems in females. An extra x (XXX) and a missing x (XO). When one chromosome is missing (referred to as Turner syndrome), characteristics such as spatial deficits, problems in mathematics, attention deficits or hyperactivity and poor handwriting are often exhibited.
 - **Environmental influences:** Medical research has focused attention on hazards such as exposure to lead and allergic reaction to dietary substances. Large doses of lead toxicity has been linked primarily to retardation and other major impairments. Currently, some believe that exposure to minimal amounts of lead result in behaviors associated with learning disabilities like attention and speech problems. Allergic reactions to food have also been linked to learning disabilities. For example Feingold (1976) proposes that hyperactivity and learning problems in some children may be caused by an allergic reaction to the ingestion of a natural or synthetic chemical compound called salicylate found in artificial colors and flavors as well as in certain foods like apples, tomatoes and berries.
 - **Biochemical abnormalities:** Imbalance in the production of neurotransmitters such as serotonin, dopamine etc are assumed to cause difficulties in neural impulse transmission and consequent learning and behavior problems. For example, some attention deficits have been associated with over rapid neural impulses that do not permit adequate time for the brain to process incoming information.

Medical model diagnosis and treatment approaches: Pharmacological treatment used for learning disabilities and related disorders consists mainly of administering stimulant drugs to improve cognitive and attention deficits as well as manage hyperactive behaviors. Stimulant drugs fall into the category of psychotropic drugs, which are drugs that influence moods,

behavior and cognition. One concern with pharmacological treatment is that the medications have side effects. Furthermore, side effects may be pronounced in preschool-aged children. Some authorities believe that a combination of behavioral intervention and medication may allow smaller doses of the medications to be prescribed.

Medical specialists:

- **Pediatric neurologist:** parents and school personnel may consult a pediatric neurologist regarding students with unexplained learning problems, especially when physiological involvement is suspected. The pediatric neurologist mainly establishes or rules out the presence of specific nervous system disorders as they relate to learning. Because the brain cannot be examined directly during the neurological examination, the physician depends on behavioral indicators to establish dysfunction.
- **Neurological examination:** The following are important features (a) a clinical interview and observation of the child (b) an interview of the parents (c) a review of medical records (d) a review of school records and (e) a series of tests that measure brain functioning. Assessments include measures of attention, executive functioning, memory, language, visuospatial abilities, sensory-perceptual functioning, fine motor skills, academic performance, intellectual abilities (IQ tests) and emotional or behavioral functioning.
- **Otologist and audiologist:** Otolology is the care and prevention of damage and diseases to the ear, and the otologist is a medical doctor who specializes in this area of medicine. An audiologist on the other hand, is a nonmedical specialist who assesses the extent of hearing loss and prescribes appropriate prosthetic devices, such as hearing aids.
- **Ophthalmologist and optometrist:** Ophthalmology is the care and cure of diseases and injury to the eye and related structures. The ophthalmologist is required to complete medical school, serve an internship in general medicine and surgery, and pursue additional specialized training in the structure, function and diseases of the eye. Optometry refers to the examination of the eyes, analysis of their function, and use of preventive or corrective measures to ensure maximum vision and comfort.