NEUROGENIC COMMUNICATION DISORDERS

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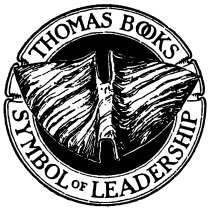
Aphasia and Cognitive-Communication Disorders

By

SAKINA S. DRUMMOND, PH.D.



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To: Buggle–Emo–Raja–Tiny

PREFACE

This text is the culmination of my insatiable curiosity to understand the relationship between brain functions and communication, and years of teaching-learning and clinical experiences. Although the brain has been acknowledged as a fascinating organ, it represents the essence of who and what we are as a species. The brain regulates all bodily functions and behaviors–one of which is communication. An understanding of human communication requires working knowledge of basic neuroscience, which involves the study of normal neural structures and mechanisms at both macroscopic and microscopic levels. This knowledge serves as the foundation for the diagnosis and management of anomalous functions in the clinical fields of neurology and speech-language pathology. Clinical preparation in each of these professions requires a comprehensive appreciation of the brain-behavior connection and consequences of brain dysfunction on human communication.

The text begins with a review of core concepts relating to the structures and interrelated functions of the brain; this information serves as the precursor to understanding the possible causes and nature of neurogenic communication disorders and related clinical issues. It also includes options for assessing the prevailing communication disorder and highlights the association between the etiologies and underlying neuropathology to overt communication symptoms; the rationale for their presentation is to foster essential critical thinking skills to derive at differential diagnosis and formulate a prognosis for recovery of the identified symptoms. The text ends with the offering of diverse management and treatment options that strive to either restore or stabilize the impaired communication and related functions.

The presented information has selectively focused on the description of language and cognitive-communication disorders secondary to

brain lesions. The text aims to guide students and professionals who diagnose, explain, and implement rehabilitation strategies for individuals with acquired neurogenic communication disorders. This objective is reflected in its elaboration of disrupted decoding and encoding of linguistic units such as symbols (words) representing semantics and morphology (meaningful units), and the rules (syntax and pragmatics) for using them during communication. The interconnectivity between language and cognition is stressed through establishing the influence of perceptual and cognitive functions on language/communication modalities of comprehension and production. Contributions from the fields of neuro- and psycholinguistics have been incorporated to help characterize and distinguish disorders such as aphasia, dementia, as well as traumatic brain injury and nondominant (right) hemisphere lesions. The text shares insights some of which are contrary to conventional ideologies; it has also made a discernable effort to refrain from entering into any provocative discussion on issues regarding the nature of human "mind" (psyche) or any psychiatric disorders.

The content presentation has considered contemporary reading and learning preferences as well. Every attempt has been made to provide pertinent information in a simplified format with key concepts being italicized in their preliminary contextual descriptions. Diagrams and tables are utilized for the visual learner with balanced attention to the need for specificity and comprehensiveness with simultaneous tempering of redundant information. I remain sensitive to the perennial perception that neuroscience and related communication disorders is a nemesis to students in the field of communication disorders; it is my sincere hope that not only will this text help alleviate any apprehensiveness toward this exciting and challenging topic, but that it will serve as an initiation to the quest for knowledge and undaunting curiosity.

Sakina S. Drummond, PH.D.

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NEUROGENIC COMMUNICATION DISORDERS

Chapter 1

DEVELOPMENT AND DESCRIPTION OF THE BRAIN

The human nervous system is organized into two components: a *central* (CNS) and *peripheral* (PNS) nervous system. This chapter focuses on the CNS, which includes the *brain* and the *spinal cord* each of which are encased by two different sets of protective tissues. The outer encasing is composed of a bony framework; the chain of bones, or the *vertebral column,* and protects the spinal cord while the brain is housed within the *cranium* (or skull). The inner protective casing is composed of three *meninges,* or layers of connective tissues (see Figure 5.2), which are organized in the following order:

- The *duramater,* implying "tough mother," is the outermost layer which is almost leathery in texture. It is further divided into an outer, *periosteal layer,* and the inner, *meningeal layer.* The gap between the duramater and the bony cranium is called the *epidural space.*
- The middle layer, the *arachnoid mater* appears "spider/web-like" because this translucent layer is infested by crisscrossing blood vessels. The space between the arachnoid and duramater is identified as the *subdural space,* however, the Anatomical Terminology Conference in 1997 has determined that this space is not readily identified except in the presence of a *hematoma* (or blood clot).
- The innermost *pia mater,* or "soft mother," is a fragile thin layer encasing the neural tissue. The space between the pia and arachnoid mater is termed the *subarachnoid space;* it is filled with the colorless *cerebrospinal fluid* (CSF).

The remainder of this chapter provides a review of the development of the different levels and structures that collectively form the human

brain. It also describes the functions ascribed to these structures in a fully developed (adult) brain with the intent that such information will provide an appreciation of the complexity of the neural circuitry and processes, as well as its potential for disrupting human communication behaviors in the presence of some disease or pathology.

BRAIN DEVELOPMENT

The development of the human brain has its foundation in the concepts of phylogeny and ontogeny. *Phylogeny* relates to the genetic evolution or developmental patterns between species. *Ontogeny* describes the development of the fertilized ovum from a unicellular to multicellular organism within a given species. The ontogenic development of the human brain as it progresses from *embryonic* (first 8 weeks of gestation) to *fetal* (after 9 weeks) changes are depicted in Figures 1.1 and 1.2, and they have been described through the following stages (Table 1.1):

1st week: The fertilized, single cellular ovum (or *zygote*) undergoes *mitosis* (cell division) at the rate of 50,000 cells per minute. The embryo appears as a hollow ball, or *blastocyst,* consisting of an outer cell mass that later forms the placenta, and an inner cell mass that evolves into a fetus in the later stages. Within two hours after fertilization, the embryo begins to distinguish the left from right side. Around day three, eight undifferentiated cells capable of becoming any structure are identified. Before the end of the first week about 100–150 of these undifferentiated cells are commonly described as embryonic stem cells.

3rd week: At this stage, the embryo is called the *gastrula* and it displays a distinctive organization of its cells as three *germinal* layers. The descendants of these germinal layers will ultimately form different tissues and organs of the human body. The internal germinal layer, *endoderm,* will develop into the visceral organs including the pancreas, bladder, urethria, thyroid, lungs, and the liver. The middle, *mesodermal layer* will form the muscle (smooth, striated and cardiac), connective tissues (including the bone), and the vascular system (heart and blood vessels). The cells in the outer, *ectodermal layer* will develop into the nervous system, skin, including hair and nails, as well as the eyes and ears. During the third week, some ectodermal cells segregate to form

1 1/2 mm long *neural plate,* which is the first sign of an evolving nervous system. The medial indented portion is identified as the *neural groove* and the raised edges as *neural folds.* The neural plate continues to develop so that the neural folds rise to form two lateral *neural ridges* almost encircling a medial *neural groove.* Two clusters of cells at the neck of the neural groove are identified as *neural crest.*

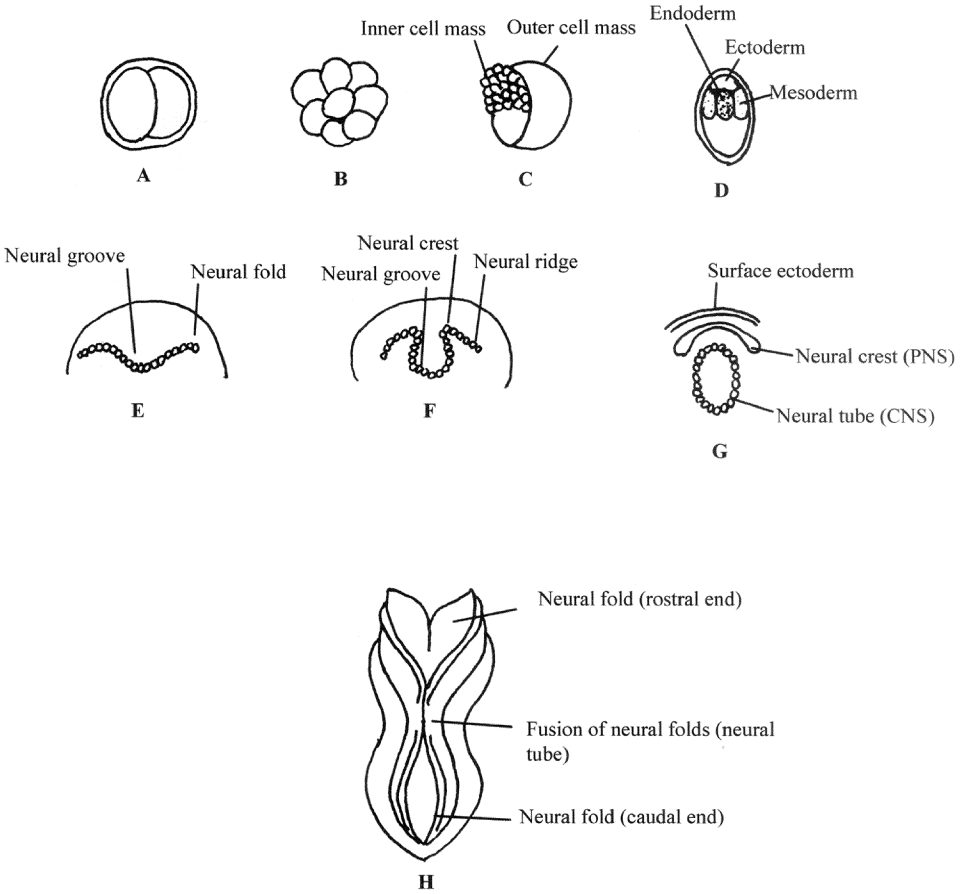

Figure 1.1. Development of the nervous system. A. One-day old fertilized ovum. B. At three days. C. Blastocyst at 5–6 days (transverse section). D. Gastrula with the three germinal layers (2–3 weeks). E. Formation of neural plate and two prominent landmarks (transverse section). F. Development of neural ridges and neural crests (transverse section). G. Mid-line fusion of neural folds resulting in formation of neural tube and separation of neural crest (transverse section). H. Dorsal view of the embryo at 4 weeks depicting the unfused rostral and caudal ends of the neural folds along with its central portion.