The Cranial Nerves

ANATOMY AND ANATOMICO-CLINICAL CORRELATIONS

BY

ALF BRODAL
M.D.
Professor of Anatomy
University of Oslo, Norway

SECOND EDITION

BLACKWELL
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Foreword to the Original Edition

At first sight, it may seem hazardous to undertake the preparation of a monograph on the cranial nerves. The subject is a restricted one, even within the field of neurology, and the question arises as to whom such a book should be primarily addressed: the student, the general practitioner, the non-neurological specialist, or those who are daily concerned with organic disease of the nervous system? Will not many items necessarily be dealt with in too detailed a manner for one group of readers, while the same information will be superfluous for others?

This book settles any doubts on these questions. It may not be necessary for the candidate for medical examinations to know everything which the book contains, while the neurologist is — or ought to be — well acquainted with the fundamentals of the subject. Yet, for all the groups mentioned, this monograph represents a welcome addition to the Scandinavian medical literature, not only because it contains all relevant knowledge in this field necessary for each, but because it also integrates the anatomical, functional and clinical aspects of the subject.

These features of Professor Alf Brodal's treatment of the cranial nerves are characteristic of the wide range of his knowledge and interests. While at the same time pursuing original anatomo-physiological research, he manages to give short yet comprehensive descriptions of the structure, functions, and disfunctions of the nervous system, and this of a quality which is not common either on the Scandinavian or the international level. His *Nevro-anatomi i relasjon til klinisk nevrologi* of 1943, and the revised English version of 1948 (*Neurological Anatomy in Relation to Clinical Medicine*), are

standard works from which every student and doctor may profit, and to which every neurologist may turn with confidence for information.

It is to be hoped that this book will be the first of a series of similar works, both in neurology and in other fields of medicine; and that these monographs may help to re-create that integrated insight into medicine as a whole, which is in so much danger of being lost in the ever-increasing fragmentation of the subject into narrow specialities.

Mogens Fog, M.D.
Professor of Neurology,
University of Copenhagen

Preface to the First Edition

THE English edition of this book has been translated from the Norwegian, and in general follows this very closely. Some data from research done since 1956 have been included. The labellings of some of the illustrations have had to be translated, otherwise the illustrations have not been altered.

I am indebted to Dr David Bowsher, Department of Anatomy, University of Liverpool, for going through my translation and for correcting some errors and suggesting improvements in the wording.

Oslo, November 1958

A. BRODAL

Preface to the Second Edition

SOME recent data on the anatomy and physiology of the cranial nerves, particularly the stato-acoustic, have been included in the new edition. Figure 10 has been slightly altered in accordance with new findings. Otherwise the text and illustrations are as in the first edition.

Oslo, September 1964

A. BRODAL

Preface to the Original Edition

BIBLIOTHECA MEDICA has felt that in the Nordic countries there is a need for a description of the cranial nerves for the use of students and physicians. The aim of the present book, therefore, is to give a brief account of the anatomy of the cranial nerves, with particular emphasis on items of practical interest for clinical medicine. Since the cranial nerves and their functions cannot be understood except when evaluated in relation to the central nervous system as a whole, some features of the central connexions of the cranial nerves are included. The common symptoms occurring in diseases affecting the cranial nerves and their central connexions are briefly dealt with.

No attempt is made in this book to give an exhaustive presentation of all symptoms and variations of symptom constellations which may occur in diseases of the cranial nerves. Their anatomy explains why these variations are almost innumerable. A description which covers all of them, would, therefore, by far exceed the limits set for books in this series. However, knowing the anatomy and function of the various cranial nerves, the physician will be able logically to deduce the seat of damage to them. In the author's opinion this is a sounder and more reliable procedure than to attempt to make a given series of symptoms fit into one of the many syndromes which have been described (and which only rarely occur in their typical form). For this reason emphasis is put on the description of the anatomical and functional features. These will have to form the basis for any clinical reasoning in a particular case. Some special symptom-complexes which are seen fairly frequently are treated in an appendix.

References to original works are given to some extent, and

these chiefly to results of recent research. References to older works will be found in those listed.

For technical reasons it is only possible to bring a restricted number of simple diagrams to illustrate important anatomical data. For more complete illustrations the reader is referred to anatomical atlases. Some of the illustrations have been specially made for this book. Others have been borrowed from papers of other authors or from my own previous publications.

For the preparation of the illustrations I am indebted to the artist of the Anatomical Institute, Miss S. Mörch. My thanks are due to Miss O. Gorset for typing and secretarial assistance and to Dr Kr. Kristiansen, Oslo City Hospital, for going through the manuscript and for kind advice concerning the clinical features which are discussed in the text.

Oslo, May 1956

A. BRODAL

Contents

The Cranial Nerves in General

The name *cranial* or *cerebral nerves* is used for those peripheral nerves which leave the brain stem, to distinguish them from the spinal nerves which take their origin from the spinal cord and supply the neck, trunk and extremities. From ancient times it is customary to subdivide the cranial nerves into 12 pairs and to number them as follows: 1. The olfactory nerve. 2. The optic nerve. 3. The oculomotor nerve. 4. The trochlear nerve. 5. The trigeminal nerve. 6. The abducent nerve. 7. The facial nerve with the intermediate nerve. 8. The stato-acoustic nerve (representing the vestibular and cochlear nerves). 9. The glossopharyngeal nerve. 10. The vagus nerve. 11. The accessory nerve. 12. The hypoglossal nerve. For didactic reasons they will be considered in the reverse order in this book.

On account of the high degree of differentiation in the anterior part of the organism, not least on account of the development of the special sense organs in the head, the cranial nerves are more complex with regard to their structure and function than the spinal nerves. However, the two first pairs, the olfactory and optic nerves, are not cranial nerves in the proper sense. The optic nerve, for example, is actually to be compared to a tract within the central nervous system, which during development has been 'drawn out' from it. For practical reasons, these two nerves will be included in the following account. But they have to be left out of consideration when in this chapter some general features in the organization of the cranial nerves are to be dealt with. A knowledge of such general features will facilitate the comprehension of the individual cranial nerves.

In spite of certain differences between the cranial nerves proper, there are common features in their organization. When all the cranial nerves are considered together it turns out that

they are made up of the same functional types of fibres as the spinal nerves. Before considering the cranial nerves, it will, therefore, be appropriate to recall the somewhat simpler situation in the spinal cord.

As will be known, each spinal nerve is formed by the fusion of a ventral (anterior) and a dorsal (posterior) root (fig. 1). The fibres making up the ventral roots emerge as a series of filaments laterally on the ventral surface of the spinal cord, while those forming the dorsal roots emerge laterally on its dorsal surface. The fibre bundles which fuse to form one spinal nerve are derived from a disc-shaped part of the cord referred to as a spinal segment.

The *ventral roots* consist exclusively of fibres which conduct impulses in a centrifugal direction, that is from the cord to the periphery. These fibres have their perikarya (cell bodies, somata) in the grey matter of the cord and are called *efferent*. All fibres in the *dorsal roots* conduct impulses in a centripetal direction, that is from the periphery to the cord. They are thus *afferent*, and have their perikarya in the spinal ganglia which appear as swellings on the dorsal roots. These perikarya are pseudo-unipolar nerve cells, and emit a single axon which dichotomizes in a T-shaped manner, one branch coursing to the periphery and the other passing into the cord (fig. 1). The latter branch synapses with other nerve cells in the grey matter of the spinal cord (or with the cells in the nuclei of the dorsal columns).

Within the two groups of fibres, efferent and afferent, a further subdivision can be made according to the type of structures which they supply peripherally. Fibres which innervate skeletal muscles, tendons, joints and ligaments are called *somatic*. To this group belong also most of the sensory fibres from the skin. *Visceral* fibres are those which innervate internal organs, smooth muscles, vessels and glands. Since both groups of organs may receive impulses from the cord as well as send impulses to it, there will be altogether 4 fibre categories: *somatic afferent*, *somatic efferent*, *visceral afferent* and *visceral efferent*.