INGRAHAM
and
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NEURO SURGERY OF INFANCY AND CHILD

NEUROSURGERY
of Infancy and Childhood

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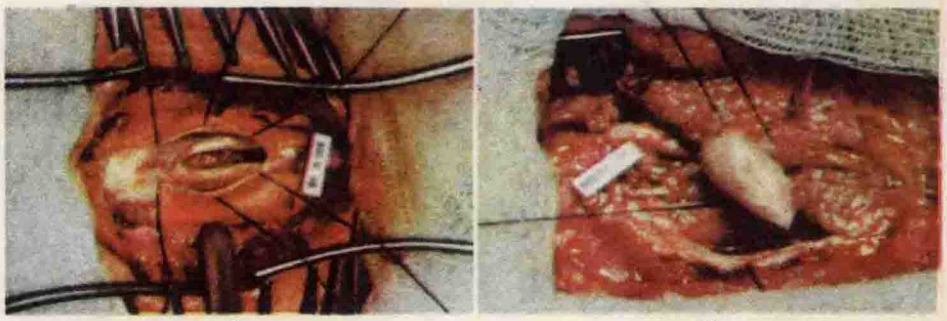
CHARLES C THOMAS · PUBLISHER
Springfield · Illinois · U. S. A.



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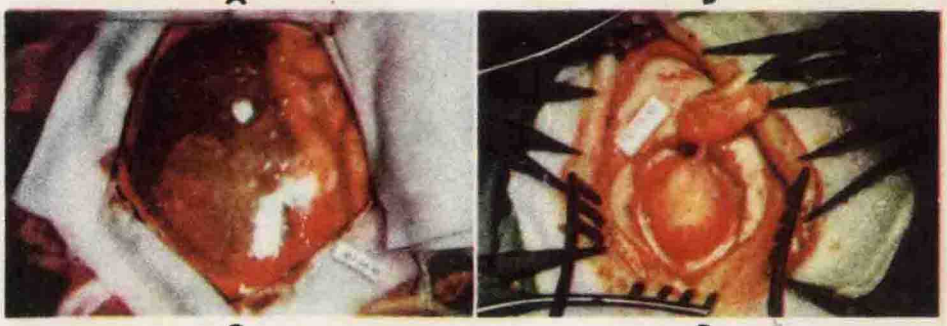

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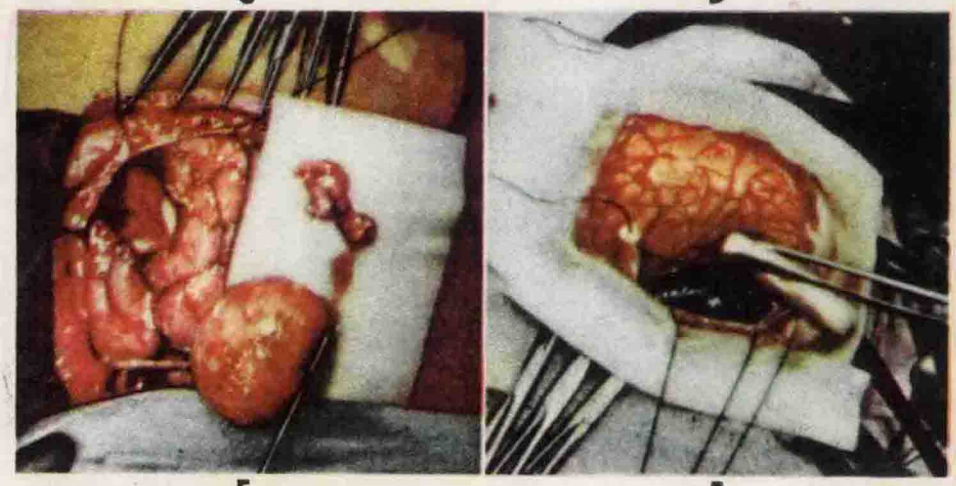

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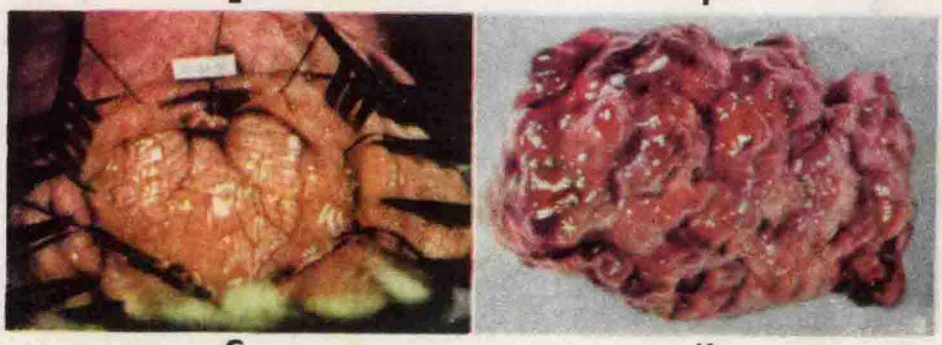

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Preface

THE PURPOSE of this book is not to serve as an encyclopedic text of reference covering in detail the entire field of neurosurgery in childhood. Many of the standard disciplines of adult neurological examination and surgical therapy are equally appropriate in childhood; these will receive only cursory attention. Others differ slightly, or are entirely peculiar to the management of infants and young children. It is these differences which will be stressed.

No attempt will be made to discuss critically all of the methods that have been described to treat various neurological disorders in childhood. Neither is it our intention to imply that the methods and beliefs set forth here are the only ones acceptable or indeed necessarily always the best available. Rather, this book is a description of the diagnostic studies, principles of patient care and methods of surgical treatment which have been developed or have been found most satisfactory to date in the experience of the neurosurgical service of The Children's Medical Center, Boston.

The central nervous system in childhood, as in adults, is involved in acute and chronic trauma, purulent and aseptic inflammatory processes, toxic degeneration, and a variety of benign and malignant neoplasms. In addition, there are a wide variety of congenital malformations involving neural tissue and its coverings which are subject to surgical improvement in early life.

The importance of growth as a modifying influence on surgical physiology will be emphasized many times in the sections to follow. Because the nervous system of the child is still growing and maturing, it is possible often to carry out prophylactic surgical procedures which, though not curative of an existing lesion, may be of great significance in arresting or slowing down a progressing disturbance of function. The results of preventive surgery of this type may be unimpressive at the time of execution or in the early post-operative course, but in the long run extremely rewarding to both doctor and patient.

In the field of pediatric neurosurgery we have learned much from our colleagues in neurology, pediatrics and pediatric general surgery. It is our feeling, however, that pre-operative diagnostic studies and supportive treatment as well as post-operative care are best managed under the direction of the neurosurgeon himself. His responsibilities should not begin only at the time operation is undertaken, nor should they terminate as soon as

the surgery has been completed. Continuous care of these children under one authority is superior to division of responsibility among several.

It is hoped throughout this text not only to emphasize broad aspects of central nervous system physiology and disease which are particularly pertinent to the growing child, but also to describe various practical methods and procedures which have been found valuable to us and may perhaps prove useful to those who treat children less frequently.

* * * * *

This book is based on the experience of the neurosurgical service of The Children's Medical Center. This experience has profited from the advice of many other services and many other individuals. It does not seem appropriate or feasible here to attempt to list the large numbers of persons who have participated in this work in the past 20 years, but their interest, cooperation and tolerance are acknowledged sincerely and gratefully. Appreciation is expressed especially to the Department of Radiology under the direction of Dr. E. B. D. Neuhauser and to the Department of Pathology under the direction of Dr. Sidney Farber from whose files so much source material has been generously contributed.

In assembling this material, particular credit goes to Mrs. Nathan Laskin and Mrs. Peter Schurr for their cheerful and efficient attention to the endless details connected with preparation of the manuscript. The photographs, without which this book would be lifeless, have all been produced by the Department of Visual Education of The Children's Medical Center, under the direction of Mr. Ferdinand R. Harding. To Miss Mildred Codding and Mrs. George Homans great thanks are due for their skill and patience in creation of the original drawings. The charts are the painstaking work of Miss Edith Pierson. The photomicrographs were made for the most part by Mr. Leo Goodman of the Boston City Hospital.

Mr. Charles C Thomas and his associates have been wise and helpful counselors at every stage in the preparation and publication of this book; their cooperation, advice and insistence on high publication standards are gratefully acknowledged.

We wish to express our gratitude to those who have contributed generously to the background for this work through the Kent Research Fund.

F.D.I.
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Contents

Part II

HYDROCEPHALUS

Part III

TRAUMA

Part IV

INTRACRANIAL TUMORS

Part V

INTRASPINAL TUMORS

Part VI

INFECTION

Part VII

CEREBRO-VASCULAR DISORDERS

Part VIII

EPILEPSY

Part IX

LEAD ENCEPHALOPATHY

Part X

PEDIATRIC NEUROSURGICAL ANESTHESIA

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PART I

CONGENITAL ANOMALIES OF THE CENTRAL NERVOUS SYSTEM AND ITS COVERINGS

Chapter I

Spina Bifida and Cranium Bifidum

Embryology

The cause of spina bifida and cranium bifidum is unknown. Whether a primary defect exists in the germ plasm which causes faulty development of the central neural axis, or whether some external agent is active after normal fertilization has occurred is of little practical significance. In the vast majority of individual patients with spina bifida or cranium bifidum, there is neither a family record of congenital abnormality nor is there a history of trauma, infection or metabolic disturbance during the first weeks of the mother's pregnancy.

The embryologic circumstances, however, which determine the type of spina bifida or cranium bifidum and the various accompanying neurological abnormalities have been studied in early human material by many investigators.[4, 21, 120, 146, 153, 185] The earliest recognizable development is differentiation of the three primary germ layers from a mass of multi-potential cells. Subsequently, at about the time of earliest segmentation, the central neural axis begins to form along the mid-dorsal aspect of the embryo. A groove appears between two longitudinally arranged mounds of cells, or neural crests. This groove deepens and the neural crests converge dorsally to form the primitive neural tube. This fusion begins at about the six-somite stage in the mid-portion of the embryo and progresses both cranially and caudally. Completion of invagination of the neural tube takes place normally in the region of the posterior neuropore at about the 30-somite stage or approximately the end of the fourth week after conception. Subsequent differentiation of the proliferating cells of this neural tube eventually results in the neuronal and supportive components of the central nervous system and perhaps part of the meninges.

During formation of the neural tube, simultaneous condensation and organization of mesodermal tissues begins to form the bone, cartilage, fat, connective tissue, blood vessels and meninges which surround and support the neural axis. Although the mechanism and extent to which ectodermal and mesodermal tissues influence one another at this stage is unkown, it is evident that the complicated differentiation of all germ layers may simultaneously go awry in single or adjacent segments. Depending upon which