

NEUROLOGIC EMERGENCIES
Recognition and Management

Second Edition



一九九五年十月九日



Neurologic Emergencies

Recognition and Management

Second Edition

Editor

Michael Salcman, M.D., F.A.C.S.

Professor and Head
Division of Neurosurgery
University of Maryland Hospital
University of Maryland School of Medicine
and
Director, Neuro-Trauma
Maryland Institute for Emergency Medical Services Systems
Baltimore, Maryland

Raven Press  New York

Raven Press, Ltd., 1185 Avenue of the Americas, New York, New York 10036

© 1990 by Raven Press, Ltd. All rights reserved. This book is protected by copyright. No part of it may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, or recording, or otherwise, without the prior written permission of the publisher.

Made in the United States of America

Library of Congress Cataloging-in-Publication Data

Neurologic emergencies : recognition and management / editor,
Michael Salcman. — 2nd ed.

p. cm.

Includes bibliographical references.

ISBN 0-88167-577-6

1. Nervous system—Diseases. 2. Nervous system—Wounds and injuries. 3. Medical emergencies. I. Salcman, Michael.

[DNLN: 1. Emergencies. 2. Emergency Medical Services.

3. Nervous System Diseases. WL 100 N4943]

RC346.N386 1990

616.8'0425—dc20

DNLN/DLC

for Library of Congress

89-70122

CIP

The material contained in this volume was submitted as previously unpublished material, except in the instances in which credit has been given to the source from which some of the illustrative material was derived.

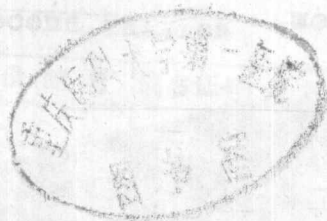
Great care has been taken to maintain the accuracy of the information contained in the volume. However, neither Raven Press nor the editors can be held responsible for errors or for any consequences arising from the use of the information contained herein.

Materials appearing in this book prepared by individuals as part of their official duties as U.S. Government employees are not covered by the above-mentioned copyright.

9 8 7 6 5 4 3 2 1

NEUROLOGIC EMERGENCIES
Recognition and Management

Second Edition



For my father, Arthur



Preface

Our initial intent in writing *Neurologic Emergencies* was to produce a practical volume of modest proportions, one that would prove useful to emergency room physicians, internists, and pediatricians who are called upon to see patients with neurologic emergencies in either the accident room or the general medical ward. We were pleased to learn, however, that many residents in neurology and in neurologic surgery were also using the book as a guide to acute diagnosis and therapy.

The favorable response to the first edition of this text has paradoxically required an extensive reorientation of both the tone and extent of subject coverage. Therefore, under the guidance of our readers, we have added six chapters on neoplastic emergencies, meningitis, encephalitis, and encephalopathy. In addition, the chapter on respiratory muscle failure has been divided in two so as to provide increased coverage of the acute polyneuropathies. Eight of the original 14 chapters have been extensively rewritten, and each of the others has been revised to some degree. In each case we have attempted to expand the coverage of treatment and diagnosis without sacrificing the discussion of pathophysiology essential to the successful management of complex neurologic disorders. These revisions and amendments have necessitated an increased number of contributors from the Department of Neurology and our own Neurosurgery Service at the University of Maryland Hospital and the Maryland Institute for Emergency Medical Services Systems. In doing all of this, we have attempted to maintain the comfortable size of the book, recognizing that a text that is kept close at hand should not be encyclopedic.

Michael Salzman

Preface to First Edition

Neurologic emergencies are among the most sudden and explosive of all medical catastrophes. By definition, these disorders involve a variety of nervous structures often considered by both specialist and nonspecialist alike to be of forbidding complexity. Nevertheless, the majority of patients with neurologic emergencies are first seen by emergency room physicians, internists, pediatricians, and neurologic housestaff. This book is for them, the front-line medical personnel, who diagnose, stabilize, and often salvage the patient before the arrival of the consultant.

Neurologic emergencies are increasing in frequency and yet they may often go unrecognized. This book, the first restricted to the treatment of such disorders, takes the position that effective early management can be instituted in the absence of a specific diagnosis as long as some determination has been made of the general pathophysiologic mechanisms involved. Such a philosophy is in keeping with the practical nature of the volume and is highlighted by the liberal use of flow diagrams to outline specific steps in many of the diagnostic and treatment protocols. Whenever possible, aspects of the anatomy and physiology of the nervous system are reviewed in chapters devoted to the clinical situations for which they are most appropriate.

Recent advances in neuroradiology, neuroanesthesiology, microneurosurgery, and medical neurology have revolutionized the treatment of elective neurologic patients over the past 10 years. The successful application of these techniques to emergency patients requires rapid and efficient initial management by front-line physicians who fully understand the unforgiving nature of the brain and spinal cord when faced with inadequate support. Quite often, simple transposition of the principles employed in the treatment of other medical and traumatic emergencies will salvage human beings. It is necessary to abolish the sense of therapeutic nihilism with which neurologic emergencies are usually approached, an attitude which, in and of itself, is a barrier to effective treatment.

The text opens with a general discussion of the pathophysiologic mechanisms involved in neurologic emergencies, the approach to the unconscious patient, and principles of cardiorespiratory management. Next, major sections are devoted to cerebrovascular and traumatic illnesses, the neurologic emergencies of greatest public impact. Certain special topics follow which have been deemed important based on the unique experience of the contrib-

uting authors gained at both a general university hospital and the contiguous Maryland Institute for Emergency Medical Services.

This book is intended as an introduction to the subject and not as a substitute for the exhaustive nosologic approaches of conventional neurology texts. It is hoped that the treatment protocols contained herein will require frequent and major revision by readers whose breadth and intensity of experience continue to grow. This book and its authors are dedicated to that growth.

Michael Salzman

Acknowledgments

Unintentional omissions and errors of fact are the responsibility of the editor and should not reflect on the many individuals who have contributed so much time and effort in the creation of this volume. I am especially grateful to Dr. Kenneth Johnson for collegial participation in the writing of this book and to Dr. R. Adams Cowley for the many lessons learned by neurosurgeons at the Maryland Institute for Emergency Medical Services (Shock Trauma). Diana Ruhling typed and collated much of the manuscript; her efforts were completed by Susan Schiavone. I would be remiss in not acknowledging the expert guidance of the editorial staff at Raven Press; no editor has ever been more ably served than I.

Contributors

- Gregory K. Bergey, M.D.,** *Associate Professor, Department of Neurology, University of Maryland School of Medicine, Baltimore, Maryland 21201*
- David L. Camenga, M.D.,** *Clinical Associate Professor, Department of Clinical Sciences, University of Minnesota School of Medicine, Department of Neurology, The Duluth Clinic, Ltd., Duluth, Minnesota 55805*
- Thomas B. Ducker, M.D., F.A.C.S.,** *Clinical Professor, Division of Neurological Surgery, University of Maryland School of Medicine, Baltimore, Maryland 21201*
- Julio H. Garcia, M.D.,** *Professor, Department of Pathology, Division of Anatomic Pathology/Neuropathology, University of Alabama at Birmingham, Birmingham, Alabama 35294*
- Fred Geisler, M.D., Ph.D.,** *Clinical Assistant Professor, Division of Neurosurgery, University of Maryland School of Medicine, Baltimore, Maryland 21201*
- Edward S. Gratz, M.D.,** *Assistant Professor of Pediatrics and Neurology, Departments of Pediatrics and Neurology, University of Maryland School of Medicine, Baltimore, Maryland 21201*
- Jonathan Greenberg, M.D., J.D.,** *Assistant Professor, Department of Neurosurgery, University of Miami School of Medicine, Chief of Neurotrauma Service, Jackson Memorial Hospital, Miami, Florida 33136*
- Maria Gumbinas, M.D.,** *Associate Professor, Department of Pediatrics and Neurology, University of Maryland School of Medicine, Baltimore, Maryland 21201*
- Kenneth P. Johnson, M.D.,** *Professor and Chairman, Department of Neurology, University of Maryland School of Medicine, Baltimore, Maryland 21201*
- Carol Lee Koski, M.D.,** *Associate Professor, Department of Neurology, University of Maryland School of Medicine, Baltimore, Maryland 21201*

- Ramesh K. Khurana, M.D.,** *Clinical Assistant Professor, Department of Neurology, University of Maryland School of Medicine, Baltimore, Maryland 21201*
- Sheldon L. Margulies, M.D., J.D.,** *Assistant Professor, Department of Neurology, University of Maryland School of Medicine, Baltimore, Maryland 21201*
- Jane Matjasko, M.D.,** *Associate Professor and Acting Chairman, Department of Anesthesiology, University of Maryland School of Medicine, Baltimore, Maryland 21201*
- Richard F. Mayer, M.D.,** *Professor, Department of Neurology, University of Maryland School of Medicine, Baltimore, Maryland 21201*
- Ernesto Potes, M.D.,** *Assistant Professor, Department of Neurology, University of Maryland School of Medicine, Baltimore, Maryland 21201*
- Margaret B. Rennels, M.D.,** *Associate Professor, Department of Pediatrics, University of Maryland School of Medicine, Baltimore, Maryland 21201*
- Daniele Rigamonti, M.D.,** *Assistant Professor and Chief of Cerebrovascular Surgery, Division of Neurosurgery, University of Maryland School of Medicine, Baltimore, Maryland 21201*
- Walker L. Robinson, M.D.,** *Assistant Professor and Chief of Pediatric Neurosurgery, Division of Neurosurgery; Acting Director of Neurotrauma Service, Maryland Institute for Emergency Medical Services Systems, University of Maryland School of Medicine, Baltimore, Maryland 21201*
- Michael Salcman, M.D., F.A.C.S.,** *Professor and Head, Division of Neurological Surgery, University of Maryland Hospital and Maryland Institute for Emergency Medical Services Systems, University of Maryland School of Medicine, Baltimore, Maryland 21201*
- Granger G. Sutton, Jr., M.D.,** *Associate Professor, Department of Neurology, University of Maryland School of Medicine, Baltimore, Maryland 21201*
- Aizik L. Wolf, M.D.,** *Assistant Professor, Division of Neurosurgery, University of Maryland Hospital and Maryland Institute for Emergency Medical Services Systems, University of Maryland School of Medicine, Baltimore, Maryland 21201*
- Joanna L. Woyciechowska, M.D., Ph.D.,** *Clinical Assistant Professor, Department of Clinical Sciences, University of Minnesota School of Medicine, Department of Neurology, The Duluth Clinic, Ltd., Duluth, Minnesota 55805*

Introduction

The nervous system has an eloquent but limited range in regard to the repertoire by which it expresses its response to injury. Since a wide variety of diseases set into play similar vascular, neuronal, and metabolic disturbances, the immediate management of a neurologic emergency is often directed at these dysfunctional states and not necessarily at the underlying disease. As a consequence, it is more important for the general physician to have a proper understanding of such pathophysiologic mechanisms as cerebral edema, uncal herniation, and cerebrovascular insufficiency than it is to commit to memory the many arcane details of rare encephalopathies and uncommon tumors, details that are certainly more appropriate to a textbook of neurology than to a slim introduction to emergency neurologic management.

Thus, this volume discusses the recognition and management of clinical problems such as the unconscious patient and status epilepticus—each a symptom complex by which a variety of disease processes might present within an emergency context—without discussing the individual underlying diseases themselves. A corollary to the principle that the treatment of the secondary effects of injury must often overshadow immediate attention to the cause is the observation that even the most specific aspects of the expression of common pathophysiologic mechanisms are usually determined by the location of the disease process within the nervous system and only partially by the inherent nature of the lesion.

Thus, faced with a neurologic emergency, we should ask ourselves about the locus of the disturbance (neocortex, brainstem, spinal cord) and whether the pathophysiologic mechanisms involved include elevated intracranial pressure, brain edema, or cerebrovascular insufficiency. Our initial therapeutic maneuvers always must be directed at keeping the brain viable through support of the respiration and the general circulation. These efforts are then followed by an attempt to eliminate the effects of pressure, swelling, and infarction. Consistent with this approach to the patient, the opening chapters of this book concern themselves with the basic pathophysiology of central nervous system damage, evaluation and treatment of the unconscious patient, and the application of the general principles of cardiorespiratory support to disturbances of the central nervous system.

Of course, many of the causes of altered states of consciousness, disturbed cerebral blood flow, and elevated intracranial pressure are all too

common, and they should be recognized easily by every physician. For example, cerebrovascular diseases remain the third leading cause of death in Western nations, and this situation is unlikely to change as long as the population continues to age. The different types of stroke typically present as apoplectic events and usually are seen by neurologic specialists after they have been first detected by internists, general practitioners, emergency room physicians, and cardiologists. Similarly, every physician must deal with the high incidence of neoplasia in our population and the frequency with which cancer and its complications involve the nervous system.

Because new medical and surgical treatments are constantly being developed for stroke and tumor, it is vitally important that early recognition be followed by effective management, usually by the primary physician, until speedy and appropriate consultation can be obtained. It is clear that delays in diagnosis, institution of therapy, and referral are responsible for some of the morbidity and mortality seen after cerebrovascular emergencies. This is especially true in cases of intracerebral and subarachnoid hemorrhage. Fortunately, the redundancy with which the nervous system is organized permits some resiliency in the face of early damage; therefore, it is clearly advantageous to treat the patient when an aneurysm has just bled or a transient ischemic attack has just occurred and not when a stroke has evolved into a completed deficit.

Trauma to the central nervous system is another leading cause of death and disability within our society, especially for those individuals most likely to be exposed to diving accidents, athletic injuries, falls, and auto trauma (i.e., the young). Most patients admitted to the Shock-Trauma Unit of the University of Maryland Hospital have suffered a serious injury to the brain, spinal cord, or peripheral nerves, often in combination with multisystem involvement of the chest, abdomen, and extremities. The principles of treatment remain much the same, however, and attention is first directed to support of the general circulation and maintenance of effective respiration.

Except in cases of major scalp avulsions, the presence of shock should never be ascribed to a craniospinal injury; its cause will almost always be found to be intrathoracic or intra-abdominal, and the treatment of shock always takes priority. On the other hand, it is important to remember that the moderate hypotension that often accompanies an acute spinal injury is the result of a partial sympathectomy and is attended by a slowed pulse rather than by the tachycardia of true hypovolemia. The massive infusions of colloid and blood required by a patient in shock can easily throw a patient with a serious spinal injury into pulmonary edema.

After treatment of major systemic injuries, attention is turned to the central nervous system. Within the recent past, the introduction of computerized tomography, intracranial pressure monitoring, steroids, and dehydrating agents has revolutionized the care of the head-injured patient. Unfortunately, similar claims cannot be made for spinal injury, although

evaluation of these patients by evoked potential techniques (as well as detection of early indications for surgical treatment) is becoming increasingly refined. So-called minor trauma to the nervous system not uncommonly presents within an emergency context, either by the sudden onset of excruciating pain or by a loss of peripheral nerve function. Improperly or unsuccessfully treated injuries to the intervertebral disks and peripheral nerves are responsible for a disproportionate loss of time on the job for the adult working population.

Seizures are a common denominator of many intracranial diseases and become a major problem when they are of an unremitting or continuous nature. Once measures have been instituted to effect their control, it is important to determine the underlying cause of the seizures as well as their likely significance for the patient. The etiology, treatment, and prognosis of seizures are closely tied to the age of the patient and are separately discussed for adults and children. Another emergency, fortunately uncommon, in which treatment is primarily medical is acute respiratory muscle failure. The latter is usually due to a failure of conduction along the intercostal and phrenic nerves, or a failure of transmission across the myoneural junction of the respiratory muscles themselves. The outlook for patients in myasthenic crisis or for those with ascending polyneuropathy is good as long as the respiratory complications are properly managed.

Many emergency room patients are confused and disoriented when first seen; others are combative, agitated, or depressed. The so-called recreational use of illicit drugs and alcohol in our society is a major problem and is only one example of the diagnostic importance of encephalopathy. A similar clinical presentation can be produced by a variety of infectious diseases in the nervous system. Encephalitis and meningitis must be rapidly recognized and dealt with when they arise in isolation and when they present as complications of traumatic and neoplastic conditions.

Neurologic emergencies in children represent a particular challenge since they are often unsuspected, perhaps because the neurologic examination of children appears forbidding. Transposition of the principles employed in the evaluation of unconscious adult patients is often useful in performing examinations on patients who are too young to give a history and who are otherwise unable to participate in sensory and cerebellar testing. Of course, interpretation of the physical findings elicited must take into account the properties of the developing and changing nervous system. In addition to vascular accidents, trauma, and myriad causes of unconsciousness (especially poisonings), children are subject to diseases peculiar to their age group. Many metabolic and developmental disorders are quite rare and indolent, but at least one, Reye's syndrome, is being recognized with increasing frequency and usually presents with explosive suddenness. In addition, certain structural anomalies of the central nervous system are among the most common of all types of birth defects, and their proper management

often requires that treatment be instituted within the first day of life. The philosophic issues involved in the treatment of such children are just as perplexing as the underlying nature of the disorders being treated, but some successes have been achieved and an aggressive attitude is warranted. The recognition of hydrocephalus in children is especially important, not only when it occurs in relative isolation, as in cases of aqueductal stenosis, but also as a complication of many traumatic, infectious, and neoplastic processes in the pediatric age group. It should be remembered that tumors of the central nervous system are the second most common group of neoplasms in children and that most occur in and around the ventricular system, especially in the posterior fossa.

From the foregoing it should be clear that a host of societal and demographic factors have produced a virtual epidemic of neurologic emergencies, both in number and in manner of presentation too common and too polymorphous to be handled alone by the relatively few specialists available for the job. It should also become apparent to the specialist and generalist alike that the therapy of neurologic emergencies differs considerably in tempo, philosophy, and execution from the manner in which gradually evolving neurologic diseases are usually approached. It is the purpose of this volume to serve as a general introduction to the principles of emergency medical management as these apply to the nervous system and thus to ameliorate some of the factors tending to late and ineffective treatment. For this reason it is important to dispel the common belief that the nervous system is some sort of terra incognita, the terrain of which is best explored by the specialist alone. Above all else, it is hoped that some of the chapters in this book will help residents in neurology and neurosurgery, as well as physicians in other specialties, to answer the question of what to do and what not to do until the consultant arrives.

*Michael Salzman
Baltimore, Maryland
January 1990*

Contents

General Considerations

1. Cerebral Circulatory Disturbances in Neurologic
Emergencies: Pathophysiology 1
Julio H. Garcia
2. The Unconscious Patient 17
Michael Salcman
3. Cardiorespiratory Management in
Neurologic Emergencies 39
Jane Matjasko

Stroke and Tumor

4. Diagnosis and Management of
Subarachnoid Hemorrhage 73
Michael Salcman
5. The Medical and Surgical Management of Stroke 97
Michael Salcman and Daniele Rigamonti
6. Neoplastic Emergencies 117
Michael Salcman

Trauma

7. Management of the Acute Head-Injury Patient 135
Fred H. Geisler and Jonathan Greenberg
8. Management of Traumatic Spine Injuries and
Acute Paralysis 167
Jonathan Greenberg and Fred H. Geisler
9. Acute Nerve Root Compression 199
Michael Salcman
10. Management of Peripheral Nerve Injuries 221
Thomas B. Ducker

Medical Emergencies

11. Emergency Management of Seizures in Adults 235
Gregory K. Bergey and Granger G. Sutton, Jr.
12. Acute Polyneuropathy..... 261
Carol Lee Koski and Ramesh K. Khurana
13. Treatment of Respiratory Muscle Failure 281
Ernesto Potes and Richard F. Mayer
14. Acute Viral Encephalitis 307
Kenneth P. Johnson
15. Bacterial Meningitis 321
Edward S. Gratz and Margaret B. Rennels
16. Toxic and Metabolic Encephalopathies..... 343
*David L. Camenga, Sheldon L. Margulies, and
Joanna L. Woyciechowska*

Pediatric Emergencies

17. Pediatric Neurologic Emergencies 381
Maria Gumbinas
18. Pediatric Neurosurgical Emergencies..... 399
Walker L. Robinson and Aizik L. Wolf

- Subject Index..... 421