Craniocerebral Trauma

Progress in Neurological Surgery

Vol. 10

Series Editors
H. Krayenbühl, Zurich; P. E. Maspes, Milan; W. H. Sweet, Boston, Mass.

Assistant Editors
P. Paoletti, Pavia; Ch. Poletti, Boston, Mass.

Advisory Board

Craniocerebral Trauma

Editors
H. Krayenbühl, Zürich; P. E. Maspes, Milan; W. H. Sweet, Boston, Mass.

List of Contributors
R. Braakman, Rotterdam; F. Cohadon, Bordeaux; S. Galbraith, Glasgow;
P. Guillermain, Marseille; W.K.Hass, New York, N.Y.; P.Jallon, Bordeaux;
B. Jennett, Glasgow; T. W. Langfitt, Philadelphia, Pa.; P. Loiseau, Bordeaux;
Z.H.Rappaport, New York, N.Y.; H.J.Reulen, Ravensburg; .Schürmann, Mainz;
G. Teasdale, Glasgow; . van Dongen, Rotterdam; R.P. Vigoureux, Marseille

96 figures and 73 tables, 1981

Progress in Neurological Surgery

Drug Dosage
The author and publisher have exerted every effort to ensure that drug selection and dosage set forth in this text are in accord with current recommendations and practice at the time of publication. However, in view of ongoing research, changes in government regulations, and the constant flow of information relating to drug therapy and drug reactions, the reader is urged to check the package insert for each drug for any change in indications and dosage and for added warnings and precautions. This is particularly important when the recommended agent is a new and/or infrequently employed drug.

All rights reserved
No part of this publication may be translated into other languages, reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, recording, microcopying, or by any information storage and retrieval system, without permission in writing from the publisher.

© Copyright 1981 by S. Karger AG, P. O. Box, CH-4009 Basel (Switzerland)
Printed in Switzerland by Meier + Cie AG Schaffhausen
ISBN 3-8055-0134-X

Contents

Preface XII
Discussion 59
Physiopathology 60
Local Factors 61
General Factors 62
Pathogenesis 63
Experimental Techniques 63
Observed Lesions 64
Lesional Mechanics 65
Study Material 66
Macroscopic Operative Criteria 67
Clinical Criteria 67
Recent Trauma 68
Closed Trauma 68
Overall Study 69
General Considerations 69
Incidence 69
General Etiologic Factors 71
Lesional Topography 71
Clinical Study 72
Symptomatology 72
Synthesis of Clinical Data 81
Investigative Examination 84
Radiologic Investigation 84
Ophthalmologic Examination 84
Echoencephalography 85
Radionuclide Scintiscanning 85
Measurement of Intracranial Pressure 86
Electroencephalography 88
Acid-Base Modifications in CSF 92
Study of Cerebral Blood Flow 92
Cerebral Angiography 93
Computerized Tomography 104
Discussion 107
Outcome and Results 109
General Factors Affecting Prognosis 109
Overall Outcome and Sequelae 112

Contents VII

Particular Clinical Features 115
Study of Simple Lesions (Simple Contusion-Laceration) 115
The Effect of Lesional Topography 116
Severity of Brain Damage - Altered Consciousness and Other Indicators
B. Jennett, Glasgow 164

Patterns of Structural Brain Damage 165
When to Assess Severity 166
Impaired Consciousness 167
What is Coma? 168
Going into Coma - Lucid Interval, Drowsiness, and Stupor 169
Coming Out of Coma - Wakeful States of Reduced Responsiveness 171
Coming Out of Coma - Post-Traumatic Amnesia 173
Monitoring Coma 174
Coma or Response Scale 176
Response Score (Coma Sum) 177
Reliability of the Coma Scale with Different Observers 177
Validity of Response Scale as an Indicator of Severity 179
Uses of the Coma Scale 181
Other Aspects of Coma 181
Motor Response Pattern 182
Pupil Reaction and Size 182
Eye Movements 183
Respiration and Other Autonomic Features 184
Assessment of Severity at Different Stages after Injury 186
Initial Assessment 186
Contents VIII

Talking or Not : Amnesic or Not 186
Depth of Coma at Initial Assessment 187
Evidence of Focal Brain Damage 188
Skull Fracture 189
CT Scanning as Evidence of Severity 190
Complications and Outcome as Indices of Severity 191
Administrative Classification of Severity 192
Describing Severity in Individual Patients 193
Describing Severity in Series of Patients 193
Conclusion 195
References 196

Computer Tomography in Head Injury
K. van Dongen and R. Braakman, Rotterdam 198

Introduction 198
Principle of CT versus Conventional Radiography 199
Application of CT in Neurotraumatology 202
Fracture 202
Subgaleal Hematoma 202
Brain Contusion 203
Intracerebral Hematoma 213
Epidural Hematoma 219
Subdural Hematoma 228
Acute Subdural Hematoma 228
'Chronic' Subdural Hematoma 235
Hygroma 241
Brain Swelling 243
Herniation 243
Brain Death 244
Clinical Applicability and Prognostic Value 245
Comparison with Other Techniques 247
Future Developments 247
Angio-Computer Tomography 248
References 248

Acute Traumatic Intracranial Hematomas
G. Teasdale and S. Galbraith, Glasgow 252

Introduction 253
Water Intoxication and Hyponatremia 298
Other States of Hypoosmolar Induced Brain Edema 300
Disturbances of the Acid-Base Balance 301
Specific Measures 302
Decompressive Measures 302
Steroids 303
High-Dose Dexamethasone 305
Lethality 305
Timing of Steroid Administration 306
Neurological Evaluation 307
Complications 308
Final Outcome 309

Contents X

Recommendation 311
Controlled Hyperventilation 311
Ventilator Management 313
Hypertonie Solutions 313
Mechanism of Action 314
High-Dose Barbiturates 316
Diuretics 316
Prophylactic Anticonvulsant Therapy 318
Guidelines for the Management of Severe Brain Trauma 318
References 318

Post-Traumatic Epilepsy
P. Loiseau and P. Jallon, Bordeaux 323

Introduction 323
Factors in PTE Occurrence 325
Predisposition Factors 326
Trauma 326
Early Seizures 328
Electroencephalogram 329
Clinical and Other Aspects 330
Incubation 330
Clinical Aspects of Seizures 331
EEG Patterns in PTE 333
Computerized Axial Transverse Tomography 334
Interictal State of the PTE 334
PTE Neuropathology 335
The Importance of Rehabilitation Programs in the Prevention and Alleviation of Head Injury Sequelae
F. Cohadon, Bordeaux 344

Introduction 345
Head Injury as a Somatic Injury 346
Initial Anatomical Damage 347
Secondary Evolution of the Lesions 348
Functional Restoration 348

Contents XI

Resumption of the Original Neuronal Systems Activities 349
Vicarious Phenomena within a Functional System 350
Complete Reorganization of a Function 351
Reeducation and the Actual Process of Restoration 352
Cranial Trauma as Psychic Trauma 353
Psychic Trauma 354
The Patient's Answer 354
Personality Factors 355
The Role of the Environment 355
The Need for a Psychological Reeducation 357
Reorganization of CNS Function and Personality 358
The Extent of Functional Recovery 358
The Patient's Adaptation to Residual Deficits 359
Principles of Rehabilitation 360
The Management of Severe Head Injuries 362
General Aspects of Management 363
Reanimation Period 363
Secondary or 'Awakening Period' 364
Readaptation Period 365
Different Types of Evolution 365
Rapid Resolution of Coma, or Awakening 366
Chronic Coma 366
Preface

This volume 10 is the swan song, i.e., the final number, of Progress in Neurological Surgery under the aegis of its present editorial group. Our fundamental goal has been to present a series of analyses of all of the valuable neurosurgical work all over the world. Each chapter's essayists have been asked to appraise critically all that has been published or is known in a tightly circumscribed field so that the busy clinician may turn to that chapter for such information and advice. The essayists have been asked not only to report all, but to assess the value of all that has been reported, from their vantage point as special experts in the area in question. This difficult task has of course been achieved with variable success, but it is a goal toward which we hope our successors will continue to strive.

The three senior editors have all retired from their posts as service or department chiefs and wish to express in this final preface particular thanks to their three junior colleagues in the editorial division who have done more...
of the work and received less of the kudos than their seniors.
Professor Pietro Paoletti has served with us from the very beginning.
Among many other services in connection with these volumes he played the
key part in bringing together in the first place the three senior editors to try
to achieve the objectives of this new series. Dr. Charles Poletti has carried
the burden, aided by staff he has recruited, of placing into more acceptable
and lucid English the invited manuscripts submitted for volumes 5-10. This
role was played for volumes 1-4 by Dr. R. Lewis Wright and his wife Sarah.
While their task has often been onerous when the text was prepared by one
whose native tongue was not English, it has not been negligible in a number
of instances when the author's original language was in fact English. The
editors thank the numerous non-American, non-English contributors for
their extra labors in converting their thoughts into English, recognizing that
this may have been more of a chore for them than the job at the editorial
end of polishing the text they submitted.
The subject of this our last volume, craniocerebral trauma, is one which
needs frequent review. The revelations of intracranial contents displayed in
such startling and unequivocal fashion by computed tomographic scans are
nowhere more fruitful for detailed diagnosis and rational treatment than in
patients with trauma. In a striking technical advance the problem of differentiating
between swelling due to edema and that due to focal hemorrhage has
been solved by a riskless noninvasive procedure. It remains for us to maximize
the value to the patients of this marvellous new information described
in the chapter by van Dongen and Braakman of Rotterdam. One needs to use
it and the less readily obtainable data with respect to cerebral blood flow and
metabolism presented to us by our colleagues from the New York University
and the University of Pennsylvania to deal with various facets of the problem.
These have been laid before us in their nonsurgical aspects by Reulen and
Schürmann of West Germany and in various of their surgical aspects by
Vigouroux and Guillermain and by the Glasgow school of Jennett. Finally,
the subjects of posttraumatic epilepsy and of rehabilitation are handled by
three of our colleagues from Bordeaux. The editors are happy that such a
distinguished group has consented to undertake this tutorial assignment.
This series of Progress in Neurological Surgery will be continued by a
new Editorial Board comprised of active, prominent neurosurgeons under
the chairmanship of Dr. Alex M. Landolt. It may be relevant as our final
gesture to warn our successors that one of the editorial roles, that of selecting
the authors to write for such volumes as these, is not an easy one. We
have no ready solution for the happily infrequent situation in which authors
submit an inadequate treatment of their topic - the bane of all who would take responsibility for treatises with many invited authors. We have not been able to muster the fortitude to refuse to publish such submissions. It is probably preferable to have an excess of proposed chapters for a volume than just enough. Then, if one or two authors fail to come through with their texts by the appointed deadline date, the book can simply go to press without them. The editors must reckon with the fact that the very person who is the best qualified to write the chapter in question because of his critical analysis of a long personal experience is apt to have become even busier clinically because of worldwide recognition of the fact. Moreover, the more persuasive his contributions are in neurosurgery the more likely are his university and/or clinical colleagues to be seeking his services elsewhere. Major administrative responsibilities both in his own center and in the national and international organizations he serves may have wiped out his relatively free time. Examples of individuals who have contributed to Progress in Neurological Surgery despite massive diverse responsibilities are to be found in every volume. The writing of chapters such as these in essentially a labor of love.

We close with our fervent thanks to all those authors in volumes 1-10 who have engaged in such labor, and we wish our successor editors and authors good luck throughout many future volumes.

H. Krayenbühl, Zürich
P. . Maspes, Milan
W. H. Sweet, Boston