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Handbook

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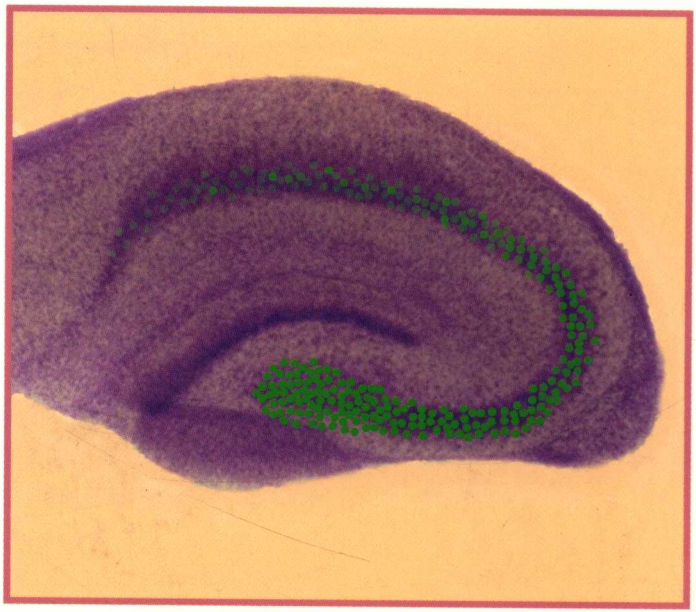
Handbook of Neuroanesthesia

Fifth Edition

Philippa Newfield
James E. Cottrell



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FIFTH EDITION

Handbook of Neuroanesthesia

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COVER ART

By Frank D. Fasano, MAMS, BFA
Artistic rendition of neuronal apoptosis in brain hippocampus

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FOREWORD

The inexorable march of technologic advance in both the clinical neurosciences and anesthesia makes the publication of successive editions of this handbook imperative. From the time of the first edition, dramatic innovations in CNS imaging, minimally invasive therapeutic interventions, and the pharmacology of anesthesia have increased the complexity of neurosurgical care. The reader's attention should be drawn to chapters on deep brain stimulation, awake craniotomy, intraoperative MRI imaging, and anesthesia for interventional radiologic techniques. These cutting-edge treatment paradigms cannot advance without the partnership between neuroanesthesia and neurosurgery.

Along with our ability to develop and implement technical advancements, we must seamlessly integrate initiatives that improve patient safety. Facilitating communication among all members of the OR team assumes primacy in this endeavor. The aviation industry has served as a model to be emulated. The surgical time-out evolved from the checklist methodology, which mandates information transfer among cabin crew. Although the isolated OR time-out serves an important purpose, a neurosurgical procedure can easily take longer than many airline flights. Information transfer remains integral to all phases of the flight/case. We may want to look at the principles of cockpit resource management for inspiration. These include, but are not limited to, team management, situational awareness, assertion and advocacy, stress and fatigue management, error reduction, and leadership strategies.

We remain indebted to Drs. Cottrell and Newfield for their continued efforts at advancing our interrelated disciplines.

Steven Giannotta, MD

PREFACE

It is in the true spirit of cooperation, consultation, and collaboration among neuroanesthesiologists, neurosurgeons, neurointensivists, neurointerventionalists, neuropathologists, neuroradiologists, and neurologists that this fifth edition of the *Handbook of Neuroanesthesia* is offered as a concise and easily accessible compendium of neuroanesthesia and neurocritical care.

The chapters in this Fifth Edition have not only been updated but now most feature clinically relevant illustrative cases along with summaries and chapter highlights. Several new chapters have been added including one on information technology that serves as a reader's guide to online medical resources and search modalities. Other additions include such topics as Parkinson's disease and deep brain stimulation, intraoperative imaging modalities, and the prevention of postoperative neuropathies and visual loss.

The advances in neuroanesthesia and neurocritical care over the past few years can be attributed to the intellectual curiosity, creativity, energy, and determination of the physicians who have worked tirelessly to improve the care of neurosurgical patients. We acknowledge the anesthesiologists who have devoted their careers to advancing the safe and enlightened practice of neuroanesthesia through teaching, research, and clinical care, especially those who have so generously contributed to this volume.

In the midst of our preparation of the Fifth Edition of the *Handbook of Neuroanesthesia*, we were greatly saddened by the passing of Anne Minaidis who had shepherded the first four editions to completion with us. Our gratitude to Christine Waters is boundless for the way in which she stepped right into a foreign landscape, quickly familiarized herself with what had been done thus far, and then worked with the authors, editors, and publisher to see the process of writing and editing through to its conclusion. No detail escaped her notice, no e-mail went unanswered, and no author went uncontacted. We are in her debt for the thorough, professional, and good-humored way in which she approached the work.

In addition, we owe a debt of gratitude to our neurosurgical colleague, Dr. Steven Giannota, who wrote the Foreword to the fifth edition. His recognition of the need for interdisciplinary cooperation, clearly illustrated in his chapter entitled: "Anesthesia and Neurosurgery: A Communication Paradigm," underlines the importance of good communication and teamwork in the operating room, neurointerventional suite, and neurosurgical intensive care unit.

The blending of specialties for a systems-based approach toward total patient care is a goal to which we must all aspire.

Philippa Newfield, MD
James E. Cottrell, MD, FRCA

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To our neuroanesthesiology fellows, in the clinical and research areas, who have added to our knowledge that has contributed to better patient care. Also, thanks to Ira Kass, PhD, who heads our neuroscience efforts in the laboratory and patiently guides our research fellows through.

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1 Physiology and Metabolism of the Brain and Spinal Cord

Yunfang Joan Hou and Ira S. Kass

Illustrative Clinical Case

Ms. Z is a 35-year-old healthy female without a history of hypertension. She was skiing and fell and bumped her head on a patch of ice. She was initially dazed but recovered quickly and felt fine; she continued skiing for an hour. When she went to the lodge for lunch, a headache developed and she took two Advil; this made her feel better. She mentioned her headache to a friend who convinced her to go to the first aid station in the lodge. Her blood pressure was elevated (180/100 mm Hg) and she complained about being tired; the nurse in the aid station recommended she be immediately transported to the hospital. In the ambulance she became increasingly confused and drowsy, her blood pressure reached 240/130 mm Hg, and her heart rate was 48 bpm. The ambulance radioed in for a neurosurgeon and anesthesiologist to be present on arrival of the patient. The patient deteriorated rapidly and was unconscious on arrival in the emergency room (ER). An immediate CT scan indicated a large epidural hematoma. The patient was sent immediately to the operating room for a craniotomy with evacuation of the hematoma.

The bleeding into the epidural space initially used up compliance and displaced volume from other compartments; thus, this increase in volume did not initially increase intracranial pressure (ICP). Once this compliance was exhausted, a small additional increase in volume caused a large increase in ICP. Since cerebral perfusion pressure (CPP) is equal to mean arterial pressure (MAP) minus ICP, blood flow to the brain is reduced. When cerebral blood flow (CBF) is reduced to ischemic levels, there is a strong sympathetic response (Cushing reflex) to increase blood pressure (with a compensatory decrease in heart rate) to maintain cerebral perfusion. This can compensate only up to a certain point beyond which CPP will fall further and lead to severe cerebral ischemia, coma, or even death if ICP is uncontrolled. The increased ICP from the expanding hematoma can also cause herniation of the brain, which can lead to rapid neurologic deterioration or death.

Chapter Highlights

- Neurons maintain a membrane potential that is mainly influenced by the concentration difference of potassium (K) and sodium (Na) inside and outside of the neuron and the conductance of the membrane to