

Gebhard Wagener
Editor

Liver Anesthesiology and Critical Care Medicine

Second Edition

 Springer

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To Laurie, Ben, and Anna, who allow me to enjoy life and work, and to my parents, who contributed so much to who I am.

Foreword to the First Edition

Liver transplantation has made remarkable progress in the 48 years since the first human liver transplant, and especially in the last 30 years, since the introduction of cyclosporine made long-term survival after liver transplantation feasible.

A procedure that was initially untested and experimental became routine and is now the accepted treatment for end-stage liver disease in many parts of the world. About 6000 liver transplants are done in the United States every year, and graft and patient survival is excellent. We are able to administer transplants to children, do living related and split liver transplants, and only the shortage of organs limits the expansion of our field.

This progress is not only due to advances in immunosuppression, surgical techniques, or organ preservation but also due to improvements in anesthetic techniques. Anesthesia care initially provided by few experts in a small number of centers proliferated and is now often standardized and protocolized. Advances in anesthesiology enabled the development of surgical techniques such as caval cross-clamp or partial liver transplantation. There are few procedures in which the close cooperation of surgeon and anesthesiologist is as essential for the success of the surgery and liver (transplant) surgery would have never flourished as it did without the teamwork and partnership between anesthesiologists and surgeons.

Within the last 20 years there has been tremendous progress in clinical research of liver transplant anesthesia that aims to reduce blood transfusions, augment organ preservation, and improve overall outcome. Anesthesia for liver surgery has made a similar astounding progress and now extensive resections are conceivable that would have been impossible before. Postoperative critical care medicine as a continuation of the intraoperative care is now frequently in the hands of anesthesiologists and intensivists specialized in hepatic intensive care, reflecting the increasing knowledge in this field.

This book aims to summarize the progress in liver anesthesiology and critical care medicine of the last 20 years and serves as a guide to those who care for patients undergoing liver transplantation and liver resections. The authors are the leaders in the field of liver anesthesiology and critical care in Europe, Asia, and the United States. The foundation of this book is the increasing fund of knowledge gained through clinical research as well as through the extensive clinical experience of the authors that they share with the readers.

This textbook provides the necessary background to understand the complexity of the liver and its pathophysiology. It summarizes the elaborate logistics involved in donor and recipient matching in Europe and the United States and then describes the routine intraoperative management of liver transplant recipients and patients undergoing hepatic resections. It addresses common comorbidities and complications and how they may affect the preoperative work-up and intraoperative management. The postoperative critical care section describes the routine care after liver transplantation and resection as well as diagnosis and management of possible complications including pain management.

This book aims to summarize our current knowledge of liver anesthesiology and critical care. It will serve as a reference for those who routinely care for patients with liver disease. Those new to our exciting field will gain sufficient knowledge to successfully address many of the complex issues that may arise during liver anesthesiology and critical care medicine. To those who have extensive experience in the care of patients undergoing liver (transplant) surgery this book will serve as an authoritative reference and enable an in-depth immersion into the exciting field of hepatic anesthesiology and critical care medicine.

Pittsburgh, PA, USA

Thomas E. Starzl, MD, PhD (1926–2017)

Preface to the First Edition

Liver transplantation and liver surgery have made enormous strides in the last 20 years. It has been transformed from an often heroic operation requiring massive amounts of blood transfusions to almost routine surgery with little blood loss in spite of increasing recipient morbidity. This advancement is reflected in improved long-term mortality rates in the face of preferentially allocating more marginal organs to sicker recipients.

Many little steps and advances are responsible for this achievement, not least improvements of anesthetic techniques and postoperative care. These little steps may not be immediately obvious but were necessary to accomplish such a progress. Clinical and preclinical research in liver anesthesiology and critical care medicine in the last 10 years has thrived, and a new generation of anesthesiologists and intensive care physicians is willing to scrutinize their clinical practice using clinical research tools instead of relying only on experience. This has created a fascinating and productive interaction within the small group of anesthesiologists and intensivists who care for these severely sick patients.

This book summarizes their current knowledge by bringing together the leading experts of our subspecialty. It not only condenses a large amount of clinical research but also includes opinions and experiences when evidence is insufficient.

It is an in-depth review of the field and presents the current best knowledge. It aims to be the definitive resource of liver anesthesiology and critical care medicine. Experienced and busy practitioners will find essential information to manage complex conditions of liver disease. The novice anesthesiologist or resident will be able to use this book as a thorough and comprehensive introduction to our field and rapidly gain extensive knowledge as well as obtain practical advice for those complex and scary situations that can occur so frequently during liver transplantation.

This book provides a comprehensive review of the pathophysiology of liver disease, pharmacology, immunology, and its implications for the anesthesiologist and intensivist. Anesthesiologic and postoperative care of liver transplant recipients requires a thorough appreciation of the intricacies of liver disease and its complications. Extrahepatic manifestations of liver disease are addressed in chapters separated by organ systems. Routine management as well as common intra- and postoperative complications are described in detail to provide the knowledge required to care for these patients.

Liver transplantation is expanding internationally and a large body of work and experience originates from centers in Europe and Asia. Experts from the United States, Europe, and Asia have contributed to this book to give a global perspective of liver transplant anesthesiology.

A separate section reviews the anesthetic and postoperative management of patients undergoing liver resection. New surgical approaches have allowed us to perform more extensive and intricate resections that pose new challenges to the anesthesiologist and intensivists. Surgical techniques and their physiologic repercussions are described in detail, and management strategies for routine as well as complex cases and their possible complications are offered.

We hope this book will alleviate the apprehension often associated with caring for these sick patients and encourage many readers to engage in liver anesthesiology and critical care medicine.

New York, NY, USA

Gebhard Wagener, MD

Preface to the Second Edition

The first edition of this book was published six years ago. Since then liver anesthesiology and critical care medicine has rapidly evolved in pace with new developments in surgery and transplantation. Laparoscopic and laparoscopic-assisted liver surgery that was rarely used before is now routine in many centers and its use for living donor hepatectomies will greatly increase acceptance of liver graft donation. Anesthetic management is very different for this type of surgery, and anesthesiologists need to understand the risks and benefits of these new technologies. Left lobe living liver donation for adult recipients is now frequently used and will expand the potential donor pool and reduce the risk for morbidities for the donor. This would not have been possible without a better understanding of the regulation of liver blood flow and improved treatment for early graft dysfunction in the ICU. Pain procedures have evolved and the use of novel, ultrasound-guided regional analgesic techniques improved patient comfort and recovery.

The advent of highly successful treatment of hepatitis C with new antiviral drugs may one day reduce the number of liver transplants. However in the last six years the need for organs kept rising, resulting in lower quality grafts assigned to sicker recipients. This greatly complicates the anesthetic and critical care management of these patients.

Liver anesthesiology and critical care medicine has matured into a subspecialty in its own right with national and international societies and meetings. The anesthesiology section of the International Liver Transplant Society continues to thrive with an annual educational meeting and an extraordinarily instructive and useful educational website (<https://ilts.org/education/>). Independent subspecialty societies such as the Liver Intensive Care Group of Europe (LICAGE) and the newer Society for the Advancement of Transplant Anesthesia (SATA) in the United States meet regularly to share advances in the field, develop guidelines, and facilitate scientific progress. Many centers now offer fellowships in liver transplant anesthesiology and societies are currently developing fellowship guidelines to potentially gain approval by the Accreditation Council for Graduate Medical Education (ACGME) in the United States.

To reflect these remarkable changes in our field, all chapters in this book have been revised for this edition. We also added multiple new chapters, for example, about chronic liver disease, regulation of liver blood flow, evaluation of liver function, and evidence in liver anesthesiology. Among others the

chapter on pain underwent a major revision and now includes detailed description of regional analgesic techniques.

We hope that this book remains a useful companion for those who start in this exciting field as well for the experienced liver anesthesiologist and intensivist.

New York, NY, USA

Gebhard Wagener, MD

Acknowledgments

I sincerely thank the authors of this book for their excellent contributions. They have spent many hours of diligent and hard work creating delightful, intelligent, and insightful chapters that were a pleasure to read and edit. I would also like to thank their families for the time the authors missed with them while writing these chapters. Dr. Jean Mantz, one of the authors and a true leader in our field, died last year; I feel privileged to have known such an outstanding doctor.

This book would not have been possible without the encouragement, support, and advice of Dr. Margaret Wood who has unwaveringly supported me throughout my career and all my colleagues and friends at Columbia University Medical Center. I am immensely grateful to all of you.

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I am sincerely grateful to my colleagues, residents, students, and nurses that I have had the pleasure to work with for many years and, most importantly, to my patients, who taught me so much about disease, life, and death.

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