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Edited by Michael G. Irwin , Gordon T. C. Wong , Shuk Wan Lam
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Taking on TIVA

Debunking Myths and Dispelling Misunderstandings

Edited by

Michael G. Irwin

University of Hong Kong

Gordon T. C. Wong

University of Hong Kong

Shuk Wan Lam

University of Hong Kong



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Contents

List of Contributors vii

Foreword ix

Introduction: Power to the People: the Rationale of a Practical Text x

-
- | | |
|--|--|
| <p>1 Why Bother? The Advantages of TIVA 1
Michael G. Irwin and Gordon T. C. Wong</p> <p>2 You Say ‘PK’ and I Say ‘No Way!’; You Say ‘Keo’ and I Say ‘Time to Go!’: Pharmacokinetics for TIVA 5
Frank Engbers and Michael G. Irwin</p> <p>3 TCI and TIVA: What a Good Idea! 14
Michael G. Irwin and Gavin N. C. Kenny</p> <p>4 Milk of Amnesia: Propofol for TIVA 22
Kane O. Pryor and Paul S. Myles</p> <p>5 A Catwalk with a Difference: What Distinguishes TIVA Models? 31
Lim Thiam Aun</p> <p>6 Let’s Get Started: The Know-Hows and No-Hows of Setting Up TIVA 40
Michael G. Irwin and Gordon T. C. Wong</p> <p>7 Let’s Get Pumped! The Nitty Gritty of TIVA Syringe Pumps 46
Nigel J. Huggins</p> <p>8 ‘But I’m Used to MAC!’: How Do I Get the Dose Right with TIVA? 52
Nicholas Peter Sutcliffe and Michael G. Irwin</p> <p>9 Be Aware, Unaware and Confusion Everywhere: TIVA and Awareness 63
Pablo Martinez-Vazquez, Claus Lindner, Umberto Melia, Jaideep J. Pandit and Erik Weber Jensen</p> | <p>10 Do You Want Fries with That? The Role and Effects of Adjuvant Medications in TIVA 73
Vivian Man Ying Yuen</p> <p>11 Intra- and Post-operative Analgesia for TIVA 80
Talmage Egan, Byron Bankhead and Greg Smith</p> <p>12 Wakey Wakey! Smooth Recovery from TIVA 95
Peter J. van der Mast and Anthony R. Absalom</p> <p>13 Under Pressure: TIVA in Emergency Surgery 106
Anup Biswas, Gordon T. C. Wong and Michael G. Irwin</p> <p>14 Ankle Biters: How to Use TIVA in Children 111
Brian Anderson and James Houghton</p> <p>15 Old Timers: How to Use TIVA in the Elderly 124
Fernando Neira-Reina, J. Luisa Ortega-García and Luis Miguel Torres</p> <p>16 Big Can Be Beautiful! How to Use TIVA in the Obese 132
Luis Ignacio Cortínez and Brian Anderson</p> <p>17 A Bun in the Oven: How to Use TIVA in Obstetrics 139
Pamela Flood and Jessica Ansari</p> |
|--|--|

Contents

- | | | | | | |
|----|--|-----|----|---|-----|
| 18 | Saving the Whales by Taking on TIVA: The Environmental Impact of TIVA | 146 | 20 | Skiing Off-Piste and Other Assorted Goodies: Advanced TIVA | 162 |
| | Vincent K. F. Kong | | | Gordon T. C. Wong and Michael G. Irwin | |
| 19 | TIVA Drugs for Sedation | 154 | | | |
| | Stefan Schraag | | | | |

Index 170

Contributors

Anthony R. Absalom, MBChB, FRCA, MD
 Department of Anesthesiology, University of Groningen, The Netherlands

Brian Anderson, MBChB, PhD, Dip Obstet, FANZCA, FCICM
 Department of Anaesthesiology, University of Auckland, New Zealand

Jessica Ansari, MD
 Department of Anesthesiology, Stanford University Medical Center, CA, USA

Byron Bankhead, MD
 Acute Pain Service, University of Utah, UT, USA

Anup Biswas, MBBS, FRCA
 Department of Obstetric/Adult Anesthesiology, Sidra Women's and Children's University Medical and Research Center, Doha, Qatar

Luis Ignacio Cortínez, MD
 Department of Anesthesiology, Clinical Hospital Catholic University, Santiago, Chile

Talmage Egan, MD
 Department of Anesthesiology, University of Utah, UT, USA

Frank Engbers, MD, FRCA
 Leiden University Medical Centre, The Netherlands

Pamela Flood, MD, MA
 Perioperative and Pain Medicine (OB), Stanford University Medical Center, CA, USA

James Houghton, BSc, MBChB, FANZCA
 Department of Paediatric Anaesthesia, Starship Children's Hospital, Auckland, New Zealand

Nigel J. Huggins, FRCA
 Department of Neuro-Anaesthesia, Queen Elizabeth Hospital Birmingham, UK

Michael G. Irwin, MBChB, MD, FRCA, FCAI, FANZCA, FHKCA, FHKAM
 Department of Anaesthesiology, University of Hong Kong, Hong Kong

Erik Weber Jensen, PhD
 R&D Department Quantum Medical/Fresenius Kabi and Automatic Control and Informatic (ESAI) Department, Centre for Biomedical Research (CREB) UPC-Barcelonatech, Systems Pharmacology Effect Control and Modeling (SPEC-M) Research Group, Anesthesiology Department, Hospital Clinic de Barcelona, Spain

Gavin N. C. Kenny, MSc, MBChB, MD
 Glasgow University Department of Anaesthesia, Glasgow, UK

Vincent K. F. Kong, MBBS, MSc, PGDipEcho, FANZCA, FHKCA, FHKAM
 Department of Anaesthesiology, Gleneagles Hospital Hong Kong, Hong Kong

Claus Lindner, PhD
 R&D Department, Quantum Medical/Fresenius Kabi, Barcelona, Spain

Pablo Martinez-Vazquez, MSc, PhD
 R&D Department, Quantum Medical/Fresenius Kabi, Barcelona, Spain
 German Primate Center, Department of Cognitive Neuroscience, Goettingen, Germany

Umberto Melia, PhD
 R&D Department, Quantum Medical/Fresenius Kabi, Barcelona, Spain

Paul S. Myles, MBBS, MPH, MD, DSc, FCAI, FANZCA, FRCA
 Department of Anaesthesia and Perioperative Medicine, Alfred Hospital and Monash University, Melbourne, VIC, Australia

List of Contributors

Fernando Neira-Reina, PhD, MD

Department of Anaesthesia, Cádiz University,
 Andalusia, Spain

J. Luisa Ortega-García, PhD, MD

Department of Anaesthesia, Cádiz University,
 Andalusia, Spain

**Jaideep J. Pandit, MA, BM, DPhil, FRCA, FFPMRCA,
 DM**

Nuffield Department of Anaesthetics, Oxford
 University Hospitals Foundation Trust, Oxford, UK

Kane O. Pryor, MD

Clinical Anesthesia, and Academic Affairs, Weill
 Cornell Medicine, New York, NY, USA

Stefan Schraag, MD, PhD, FRCA, FFICM

Department of Anaesthesia, Golden Jubilee National
 Hospital, Clydebank, Glasgow, UK

Greg Smith, MD

University of Utah, UT, USA

Nicholas Peter Sutcliffe, MD, FRCA

Deputy Chairman, Information and Technology,
 Department of Anesthesiology, ICU and

Perioperative Medicine, Hamad Medical
 Corporation, Doha, Qatar

Lim Thiam Aun, MBBS, MD, FRCA, FFARCSI, FMM

Department of Anaesthesiology, Faculty of Medicine
 and Health Sciences, University Putra, Malaysia

Luis Miguel Torres, MD, PhD

Department of Anesthesia, University of Cádiz, Spain

Peter J. van der Mast, MD

Department of Anesthesiology, Ommelander
 Hospital Group, Scheemda, The Netherlands

**Gordon T. C. Wong, MBBS, BSc, MD, FANZCA,
 FHKCA, FHKAM**

Department of Anaesthesiology, Hong Kong
 University, Hong Kong

**Vivian Man Ying Yuen, MBBS, MD, FHKCA, FHKAM,
 FANZCA**

Department of Anaesthesiology and Perioperative
 Medicine, Hong Kong Children's Hospital and Queen
 Mary Hospital, Hong Kong University, Hong Kong

Foreword

Having been personally convinced, in 1990, of the merit of the technique of target-controlled infusion (TCI) by path-finding experts in Germany, Holland, Belgium, France, Switzerland, the UK and the USA, it took a further couple of years before ICI Pharmaceuticals Division (now Zeneca) agreed to begin the development of what became the 'Diprifusor' TCI system for the administration of propofol. I became involved in the organisation of the clinical validation of this system with the Marsh pharmacokinetic (PK) model and took part in many discussions with infusion pump manufacturers, and drug and device regulatory authorities, before its approval in most countries of the world from 1996 onwards – one significant exception being our failure to gain approval in the USA.

As cheaper generic propofol began to appear, in 2002, there was a demand for 'open' TCI systems, which did not require an electronically tagged presentation to confirm the presence and concentration of propofol. These systems provided a choice of PK model for propofol and allowed control of blood or effect-site concentrations, the latter being achieved in some cases with a choice of keo values. The introduction of Diprifusor TCI systems had been accompanied by an extensive programme of lectures and demonstrations and Gavin Kenny travelled the world with missionary zeal to describe and advocate the use of this system. With the arrival of the open systems, drug delivery with the different models, particularly at induction of anaesthesia, can be quite different. While different models and modes of administration provide opportunities for studies by enthusiasts, in my view they also make the TCI technique appear more complex to less experienced anaesthetists.

I was disappointed to read that more than 20 years after the introduction of propofol TCI, with its benefits of rapid, clear-headed recovery and a low frequency of post-operative emetic events, the NAP5 activity survey on awareness found that propofol TIVA was used in only 8% of general anaesthetics in the UK.

Michael Irwin, Professor of Anaesthesia at Hong Kong University, gained experience of total intravenous anaesthesia (TIVA) and TCI with Gavin Kenny during his training in Glasgow Royal Infirmary. In Hong Kong, he and his colleagues have continued to study and publish on TIVA techniques and in a recent large survey of anaesthetists, the results of which are summarised in this book, have identified the barriers considered to be important by infrequent and frequent TIVA users. A prominent finding was that many of the factors considered to be barriers by infrequent users were not considered to be significant barriers once more experience had been gained.

The aim of the present book is to present a practical approach to TIVA to encourage those with little experience of the technique to begin to use TIVA in healthy patients or in patients desiring sedation during procedures conducted with regional anaesthesia. In this way experience can be gained in titrating the target concentration to achieve the depth of anaesthesia or sedation desired – taking on more complex cases where TIVA may be required. With open TCI pumps, new users can use a saline-filled syringe to play with the pump, inputting different targets and patient characteristics, and observing the amounts of drug given at induction and the changing infusion rate over time. Becoming familiar with setting up a pump and the appropriate infusion sets before using it on a patient should help to reduce the clinical set-up time.

The authors have gathered an international collection of experts in each of the areas covered and many practical approaches for example patients are provided. Instructed to write in a clear and easily readable style, I believe the authors and editors have accomplished their objective. With the approach adopted in this book, I am confident that more infrequent users of TIVA will be encouraged to join the TIVA train.

Iain Glen, BVMS, PhD, MRCVS, DVA, FRCA

Introduction: Power to the People: the Rationale of a Practical Text

No one throws a new-born baby onto the street with the advice ‘take care of yourself kid’. On the other hand, they wouldn’t use Plato’s *The Republic* for their child’s bedtime reading. You nurture children and give them the knowledge and confidence to explore the world. We appreciate that anaesthetists are probably the most knowledgeable and experienced clinicians in pharmacology (applied pharmacology is what we do!) but many have not been properly trained in the use of TIVA. Whatever you think about TIVA, it is essential for us to be able to use this important modality (see Chapter 1). A useful analogy is that you can drive a car without knowing exactly how the engine works. Most anaesthetists using inhalational agents will not be able to tell you the saturated vapour pressure or oil:gas solubility, although they should know the minimum alveolar concentration (MAC) and have a rough idea of the relative blood:gas solubility and the basic workings of a vaporiser.

We believe therefore that there is a need for a practical book that enables anaesthetists to begin propofol-based TIVA safely and with confidence. It complements more detailed textbooks and review articles and is intended more as a guidebook than a definitive text.

TIVA is not complicated. The PK models that are used for stable drug delivery are, of course, complex but modern infusion pumps take care of this for us. In fact, these TCI pumps can be thought of as ‘vaporisers’ for TIVA. Most inhalational agents have both analgesic and anaesthetic properties but with TIVA we control anaesthesia/consciousness with one drug (propofol) and analgesia with another (a titratable opioid such as remifentanyl). This is an important distinction but one that may also have advantages now that there is increasing concern over the adverse effects of excessively deep

anaesthesia. It also means that we need to change our way of thinking about anaesthesia when using TIVA as inhalation and intravenous (IV) skills are not directly transferable.

As well as pharmacokinetics (what the body does to the drug) and pharmacodynamics (what the drug does to the body) we also have pharmacogenetics. We are all different (fortunately!) and the same applies to our hypnotic and analgesic requirements. With inhalational drugs there is MAC. This is a statistical concept introduced more than 50 years ago and is the concentration of a vapour in the lungs that is needed to prevent movement in 50% of subjects in response to a surgical (pain) stimulus. By definition it will be either too high or too low for most patients. We have a similar concept with propofol (effective concentration 50 or EC₅₀), which can guide us to the average dose requirement for loss of consciousness. However, with TIVA it is much easier to titrate the effect-site concentration of propofol to individual requirements (clinical response) as we start and maintain anaesthesia with the same drugs rather than guessing as, essentially, happens with MAC.

We have a geographically diverse collection of authors who have helped us to present the most important topics in TIVA in a clear and easily readable style. Our vision is to empower readers to start or continue using this technique. Ideally this should be in young, healthy patients undergoing relatively straightforward surgery without the use of muscle relaxants. As your experience grows so then can your range of TIVA practice. Eventually, like us, you will use it for everything!

Michael G. Irwin