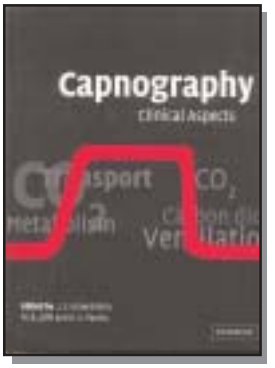
CAPNOGRAPHY: CLINICAL ASPECTS

Reviewed by Michael McPeck BS RRT FAARC

Do you have a question about capnography? If so, I have the answer – "Capnography: Clinical Aspects," a book about every aspect of carbon dioxide and its measurement of possible importance to a wide variety of healthcare practitioners, RTs included. Specifically, this book explores the contemporary understandings about the relationships between CO2 production, CO2 transport, alveolar ventilation and the non-invasive measurement of exhaled CO2 known as capnography. It delves deeply into both traditional intra-operative uses of capnography during anesthesia as well as non-operative uses during intensive care and some newer applications. The editors described their work in the preface as "more of a symposium than a textbook" and I would have to agree with them. The reader would be challenged to come up with some aspect of time-based or volumetric capnography that is not covered in this book.



The editors are an eclectic trio of CO2 nerds – and I mean that as the highest compliment. Who else could put together a book such as this? They have assembled a group of no less than 59 contributors, including themselves, to cover a wide range of capnography issues spread over 42 chapters. The book feels like a cross between a textbook and a large collection of dedicated journal articles, although each article is not in conformance to the peer-reviewed criteria of a journal. Nevertheless, each chapter is an extremely focused and in-depth treatment of its particular subject. It is a large hardbound book, 441 pages with black type on a white background with an easy-to-read font. There are a few black and white photographs, a few tables rendered as black type on light grey background, and a couple hundred figures, mostly rendered as black and white line drawings. The figures are fantastic in their diversity and detail. They include different capnograms depicting various circumstances, plus graphs showing interrelationships of various parameters that can be monitored by capnography, diagrams showing equipment setups, traditional diagrams showing physiological principles, plus a large number of tracings and waveforms depicting pathophysiology. Each chapter is referenced and it is safe to say that anything ever written about capnography can be found in this book or in its references.

It would be impossible for me to try to critique the accuracy and veracity of each chapter. There's too many of them and I am simply not that much of an expert on every aspect of capnography, although I had a great deal of experience in the late 1960s at estimating arterial carbon dioxide tension in post-operative open heart surgery patients using a non-invasive rebreathing method for CO2 equilibration. That method is all but dead now, but it is covered in the book. So instead, let's look at what the book includes and how it is laid out. That might give you a hint as to how important an acquisition it may be for specific inquires, reference or guidance.

The book is first divided into 4 major parts: Clinical Perspectives, Physiological Perspectives, Historical Perspectives, and Technological Perspectives. Given the volume of information made available by these contributors, this scheme makes sense.

The first part, Clinical Perspectives, contains 26 chapters that cover a wide range of areas including capnography in assessing ventilation; managing the airway in the prehospital setting, ICU setting and operating room. Chapters on monitoring ventilation cover circumstances such as anesthesia, mechanical ventilation, transport, neonatal monitoring, sleep, induced sedation, and during non-invasive ventilation. A section on weaning contains two contributions, one dealing with post-operative weaning and the other with optimizing mechanical ventilation. There is an interesting section on the applications of capnography in assessing the circulation. One chapter addresses capnography during CPR; others include pulmonary embolism, pulmonary blood flow monitoring and non-invasive cardiac output determination, physiological deadspace in ARDS and capnography in shock.

Part 2 addresses Physiological Perspectives with 6 chapters on CO2 pathophysiology, acid-base balance, r abnormalities and a chapter that distinguishes between time-based and volumetric capnography. Much of this is already available in pulmonary physiology and respiratory care texts, but here it is presented in context with the rest of the book which weighs heavily toward understanding the measurement of carbon dioxide in health and disease and during different altered physiological states.

The third part, Historical Perspectives, is just that: five chapters that look back and explore how capnography was conceived of, developed, applied and perfected over the years. For those of

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Falling Asleep... *Continued from page 32*

Have you been told you stop breathing during sleep? Do you experience excessive sleepiness when you should be awake? Do you wake up frequently during sleep short of breath or to urinate? Do you snore? What is your neck size? Have you been tested positive for sleep apnea? How has it been treated? Has the treatment corrected your inappropriate sleepiness?

Even a single yes to any of these simple questions should trigger a referral to a sleep specialist or to a sleep center either for testing or for follow-up to assure therapy is continuing and remains effective if answer to #7 is No.

Could a change in the H&P paperwork given out in doctor's offices and by employee health services engender an improvement in the numbers of patients who are suspected of OSA? And if not, national organizations and researchers need to find the answer. And if the answer is yes, then a way needs to be found in order to make this happen. Should agencies that certify fitness for licensing personnel in critical occupations such as the Coast Guard for boat captains or the FAA for pilots do likewise?

And the armed forces themselves? How many tragic accidents occur during military operations and training due to EDS from undiagnosed/untreated OSA? Should such critical occupational licensors/certifiers require PSGS and MWTS as part of the physical? If the answers to the first 5 questions above are Yes, then they should.

But this humble essay is not going to acquire the real estate for sleep disorders on a doctor's or other health questionnaire. But perhaps some one or more persons reading this can by making copies of this article and the vast amount of literature on this subject and give it to their congressmen and senators. All that is being accomplished is for lives to be saved. It's a start.

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us who appreciate reading the history of our modern-day conveniences, this section is delightful reading. It is especially valuable because it also contains first-hand accounts of the early development of capnography by two of the field's pioneers.

Part 4 closes the book with 5 final chapters on Technological Perspectives. While capnography is the measurement of carbon dioxide, what physical means and principles are applied to actually detect and quantify carbon dioxide gas? What are the physical properties of carbon dioxide and which of them can we exploit for its measurement? How are these means accomplished? Specifically, how does infrared absorption operate? What are the characteristics of an infrared detector and how is it embodied in a capnograph? What other methods might suffice: photoacoustic spectroscopy, colorimetry, or mass spectrometry? How do mainstream and sidestream capnography compare? Answers to these questions are the basis for these chapters.

This is an extremely comprehensive book covering a large variety of capnography related issues in depth and detail. Who, then, is this book written for? Is it the anesthesiologist predominately concerned with assessment of alveolar ventilation during surgery, the critical care physician who would like to use a non-invasive approach to monitor ventilator patients and receive an early warning of impending status change? Or maybe the respiratory therapist who, at one point, uses a form of capnography to assess the patient who has just been intubated and, at another point uses volumetric capnography to determine if a ventilator patient may attempt weaning? The book will not appeal to everyone but it would be an exceptionally valuable and comprehensive resource for the intensivist, anesthesiologist, pulmonary physiologist or therapist interested in all aspects of the field of capnography. I recommend it in particular to RT education programs as a reference.