

term is not true. Arterial oxygen desaturation can occur in high-level aerobic athletes, even at sea level, and is normal in healthy people at high altitude. I also quibble with another statement on the first page, where the authors say that desaturation in patients with pneumonia and pulmonary vascular disease occurs because of a diffusion limitation secondary to alveolar capillary thickening. Careful studies of gas exchange, utilizing the multiple inert gas elimination technique (MIGET), have shown that there is not diffusion limitation at low altitude in these patients, but areas of shunt or low ventilation-perfusion relationship.

On page 130 the authors state that a maximum cardiac output is 20 L/min. That is a low estimate of even most normal healthy individuals. They also state that diastolic blood pressure rises during exercise. In healthy individuals there is actually a widening of the pulse pressure, with either no change in the diastolic blood pressure or sometimes even a slight drop. On page 133, in the section on "heart rate reserve," they talk about the failure of heart rate to rise and don't include the possibility of certain medications such as β blockers, which may blunt the chronotropic response. Also, in the discussion of the lactate threshold the authors refer to "anaerobic metabolism," which is an archaic term nowadays. On page 134 the authors say that lactic acidosis becomes intolerable, which has been shown not to be true in subjects who had lactate infusion of the exercising muscle. The limitation and intolerance to exercise is secondary to other factors, usually inadequate perfusion of exercising muscles and or respiratory muscle fatigue.

These last points are relatively minor but need to be clarified in light of the precision of the physiologic points they are trying to make. All in all, however, I enjoyed perusing this handy and quite portable little volume.

Unlike some of the Greeks of old, who bore "gifts" to Troy, or the Delphic oracles, whose obfuscation of their prophecies made interpretation difficult, this fine volume, which begins with a Socratic quotation, is as clear as the ancient Greek scholars and will provide clarity to many students, physicians, and technicians of pulmonary medicine.

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Principles of Exercise Testing and Interpretation: Including Pathophysiology and Clinical Applications, 4th Edition.

Karlman Wasserman MD PhD, James E. Hansen MD, Darryl Y Sue MD, William Stringer MD, Brian J Whipp PhD DSc. Philadelphia: Lippincott, Williams & Wilkins. 2005. Hard cover, 585 pages, \$89.95.

Karlman Wasserman et al have released another edition of what is generally viewed as one of the standard textbooks of exercise physiology. The book comprehensively examines the fundamental principles underlying exercise testing and the means by which such tests should be conducted and interpreted, so it should be a fixture in the office of any exercise physiologist or pulmonologist running an exercise laboratory.

This new edition has 10 chapters. The first 3 chapters are devoted to developing the physiologic principles that underlie exercise performance and provide the basis for understanding exercise testing. Chapter 1 provides a broad, but brief, overview of exercise testing. Chapter 2 examines various fundamental aspects of exercise physiology, including the anaerobic threshold, control of breathing, and lactate physiology, among other topics. Chapter 3, which describes changes in acid-base status and blood gases during exercise, is an entirely new chapter, with subjects not covered in the previous editions. In Chapter 4 the editors describe the basics of exercise testing by laying out the measurements that can be made during an exercise test and their now familiar 9-panel graphical array of data derived from the testing process.

Chapter 5 then examines the pathophysiologic basis by which various disease states, including pulmonary vascular disease, ventilatory disorders, cardiomyopathies, and muscle disorders, produce exercise limitation. Chapter 6 covers the pure nuts-and-bolts issues of exercise testing by describing the equipment necessary to perform the tests, how to prepare the patient and the exercise laboratory prior to the test, and how to perform the test. Chapters 7 and 8 are devoted to test interpretation, with the former providing a discussion of normal values in exercise testing and the latter developing the textbook's well-known flowchart approach to determining the cause of exercise limitation in a given patient. After discussing the clinical applications of exercise testing in Chapter 9, the authors conclude the book with the 10th chapter and its large

array of case presentations that provide illustrative examples of exercise studies in normal subjects and a wide variety of clinical disorders.

At 585 pages, including appendixes and index, the 4th edition is slightly longer than the previous edition. The editors updated the chapter on clinical applications of pulmonary function testing (Chapter 9) by adding a discussion of end-tidal oxygen and carbon dioxide measurements, as well as a new section on cardiopulmonary exercise testing for prognostic evaluation and treatment planning in cardiomyopathy patients being considered for heart transplantation, pulmonary hypertension patients being evaluated for lung transplantation, and chronic obstructive pulmonary disease patients being considered for lung-volume-reduction surgery. This section on prognostic evaluation is a particularly useful addition to the new edition. As the indications for heart and lung transplantation expand, and as new, expensive therapies such as intravenous prostacyclin or endothelin antagonists become available to treat difficult disorders such as pulmonary hypertension, it is useful to understand the role that cardiopulmonary exercise testing can play in guiding decisions about the management of these problems. Finally, 2 new cases focusing on the impact of β -adrenergic blockade on exercise performance have been added to the 10th chapter and its collection of case presentations.

Aside from those changes, the 4th edition is not markedly different than the previous edition. With the exception of very minor textual changes scattered throughout the book, the written and graphical materials are essentially the same as in the prior edition, as are the references. Given the minimal changes in the current edition, it is hard to recommend that an owner of the 3rd edition purchase the new edition, as the additions to the updated version are not enough to justify the purchase. As well, the fact that the text has not changed substantially is somewhat problematic from another standpoint. Prior editions have been known for being accessible only to people with a strong background in exercise physiology and pulmonary medicine; the new edition's failure to substantially change the text did nothing to improve the accessibility of the book to a wider array of readers.

The book has several positive attributes. One of its greatest strengths is the manner in which Wasserman et al describe the com-

plex physiology that underlies exercise performance and the pathophysiology of disorders that limit exercise. Put simply, after a methodical reading of the first 5 chapters of the book, and perhaps a second or even third review of the material, the reader should have a solid understanding of the fundamental principles of the field. Adequate time must be devoted to these chapters, however, as the material is complicated and cannot be fully understood through a cursory reading.

A second noteworthy feature is the long chapter of case presentations (Chapter 10), which provides examples of exercise tests in a wide array of patients, including normals and those with various pulmonary, cardiac, and other diseases. The chapter contains 85 cases, including 2 cases that were not present in the 3rd edition. Each case presentation includes well-organized tabular and graphical presentation of data from the patient's exercise test, as well as a very concise body of text discussing the clinical background of the case, the exercise findings, and the interpretation of the data. The textual material in this section is considerably easier to follow than that in earlier chapters. To the editors' credit, they do not present only cases with "clean" data from cooperative patients, but, instead, present cases that give a sense of the wide range of data quality from exercise testing. This large number of cases provides a great resource for any practitioner just beginning to develop exercise-test interpretation skills. In considering this large number of cases, however, it is important for the training practitioner to remember that the cases are illustrative examples of exercise performance in various disease states and do not reflect the sole pattern of exercise performance that will be seen in each of these diseases.

From the organization of the book—in particular the manner in which the editors discuss fundamental principles of exercise physiology, then seek to develop an understanding of all aspects of exercise testing, from setting up a laboratory to running a test to interpreting the data—one might surmise that their goal was to write a book that can be used by someone just starting out in the field or seeking to start a testing laboratory. But the text cannot serve that role. The editors do provide a very thorough understanding of the principles underlying exercise performance in health and disease, but their written material is extremely dense and requires substantial prior understanding of physiologic principles to fully grasp the

material. Consider the following example of text from Chapter 2, in which the authors discuss changes in arterial lactate as a function of work rate.

To determine the best-fit mathematical model describing the \dot{V}_{O_2} [oxygen consumption] at which lactate starts to increase, we tested both continuous-exponential and threshold models. The purpose of this model testing was to better understand the physiologic events that accompany the development of the highly reproducible lactic acidosis engendered by heavy exercise.

Several sentences later, they continue:

Because lactate increases steeply with little increase in \dot{V}_{O_2} as $\dot{V}_{O_{2max}}$ is approached, the data examined to address the question of model behavior for lactate increase are restricted to the region of interest, from resting lactate to that below an arterial lactate of 4.5 mmol/L.

Throughout the book, and in the first 5 chapters in particular, the text is loaded with similarly dense, sophisticated discussions, so substantial portions of the text are accessible only to those with a preexisting high degree of understanding of exercise physiology. People with more rudimentary understanding, such as an exercise laboratory technologist or pulmonary fellow in the early stages of training, will struggle to grasp large portions of the text unless he or she is willing and able to devote large amounts of time to a slow, careful reading of the text.

My final concern is about an aspect of the text that is not unique to the 4th edition but, instead, has been a constant feature of each edition of this book: the flowchart approach. Wasserman et al use detailed algorithms for the interpretation of exercise tests. These algorithms are laid out and discussed in detail in Chapter 8 of the current edition. At each step in the algorithm, the test interpreter is required to answer a specific question, such as "Is the peak \dot{V}_{O_2} normal or low?" or "Is the anaerobic threshold determined?" The answers to the question at each step shunts the test interpreter down a particular pathway, toward more questions that eventually yield a diagnosis of the patient's exercise limitation. Although systematic in

its approach, this method is potentially misleading. A wrong decision at any branch point in the algorithm sends the interpreter down the wrong pathway, toward an erroneous diagnosis.

To illustrate this point, consider the following scenario. A major decision in the flowchart is whether the anaerobic threshold can be determined. The anaerobic threshold is typically present in cardiovascular limitation to exercise but absent in many ventilatory disorders, such as chronic obstructive pulmonary disease. However, with the growing use of β -blockade in the management of cardiomyopathy, at my institution we have started to see many cases in which it is difficult to identify a clear anaerobic threshold in patients with known cardiomyopathy who are on high levels of β -blocker medications. The risk in strictly applying a flowchart approach to diagnosis of exercise limitation is that one may misclassify the source of exercise limitation in such patients by making a mistake at the anaerobic threshold step in the flowchart. Rather than adhering to a strict flowchart approach that relies on decisions in discrete steps, I think it is more appropriate to look at exercise test interpretation as the simultaneous weighing of multiple factors. For example, the patient with ventilatory limitation would generally be identified by the absence of a clear anaerobic threshold, a limited ventilatory reserve, and a rising end-tidal carbon dioxide at maximum exercise, whereas the patient with cardiac limitation would be identified by factors such as an adequate ventilatory reserve, the presence of an anaerobic threshold, a plateau in the oxygen pulse, and a stable oxygen saturation throughout exercise. In that approach the absence of one particular factor or difficulty identifying a particular item does not necessarily preclude a particular diagnosis, as it might in the flowchart approach of Wasserman et al.

In summary, this text provides a thorough, detailed overview of cardiopulmonary exercise testing, from the underlying principles of exercise physiology to the techniques for conducting and interpreting such tests and incorporating the results into clinical practice. It is a standard text in the field, which should be on the bookshelf of any experienced exercise physiologist or pulmonologist running an exercise laboratory. The minor changes relative to the 3rd edition do not warrant the purchase of the new edition if your book shelf is already populated by

the previous edition, nor should this book be relied on by people new to the field of exercise physiology, who might be overwhelmed by the dense nature of the material and who would benefit from a more easily understood text that focuses on the essentials of exercise physiology.

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Atlas of Chest Sonography. Gebhard Mathis MD and Klaus Dieter Lessnau MD, editors. Berlin: Springer-Verlag. 2003. Hard cover, illustrated 179 pages, \$99.

Chest sonography is tricky because the ultrasound beam is almost completely reflected by the thoracic bones, and it is almost fully obliterated by the gas-filled lung. Given those limitations, chest sonography has been viewed as being of little importance for the clinical assessment of thoracic or pulmonary disease. The value was largely seen as for assessment of pleural effusion, where sonography was used as a diagnostic tool and as a guide for punctures to install drainage systems.

The **Atlas of Chest Sonography**, edited by Mathis and Lessnau, shows us with impressive pictures how much we have underestimated the technique by reducing its use only to assessment of pleural effusions. The ultrasound technique, and especially chest sonography, has dramatically improved over the last 15 years; numerous papers on its value in various clinical settings have been published and promoted our knowledge and interest in this noninvasive technique, which is, to our knowledge today, virtually free of adverse effects. It is the merit of the **Atlas** that it comprehensively summarizes all modern applications of chest sonography, which is particularly important because the widespread availability of ultrasound makes it necessary to further spread the physician's knowledge on this technique. The **Atlas** fulfills this task with its broad variety of excellent pictures, each of which is accompanied by a short description and history of the patient. With this clinical approach, the **Atlas** primarily addresses physicians who might conduct chest sonography or who should at least be able to interpret sonography results.

The **Atlas** is divided into 10 chapters, beginning with some introductory remarks on the indications and the technical and investigational aspects. This chapter, written by Beckh, is definitively not intended to cover all technical aspects of ultrasound and its reflection, but it focuses on the requirements and the investigation of the chest, thereby serving as a good "teaser" to learn more about the technique.

The next chapters are divided according to the various anatomical structures assessable with ultrasound: the chest wall (written by Bitschnau and Mathis); the pleura (by Reuss); consolidations of the peripheral lung, subdivided into inflammatory processes (by Mathis), neoplastic conditions (by Beckh), vascular diseases (by Mathis), atelectasis formation (by Görg), and congenital pulmonary sequestration (by Mathis); and the mediastinum, subdivided into the transthoracic views (by Blank) and transesophageal views (by Annema, Veselic, and Rabe). All the chapters are full of high-quality pictures of virtually all clinical conditions that might be seen via chest sonography. All the pictures are accompanied by a short text that describes the patient's medical condition and history, thereby putting the ultrasound investigation and the obtained picture in a strictly clinical perspective. This approach facilitates easy understanding for the clinician, helping us to better understand the sensitivity and specificity of the method embedded in a clinical context. I have honestly not found any relevant ultrasound picture that is not shown in the **Atlas**, and I have to admit that most of the pictures shown are of a clarity and quality far above my clinical average. Therefore, the **Atlas** is not only a high quality teaching tool but also a motivation for experienced users to improve their skills to the level shown in the **Atlas**. The pictures have clear legends and arrows pointing to the important structures explained in the legends.

In Chapter 6 Herth and Becker describe the technique of endobronchial sonography, which is interesting to read, although the tool might be restricted to the pulmonologist. However, it gives an interesting impression of the technique and the results attainable with it. Again, the pictures are the merit of the chapter, being accompanied by short clinical notes. In Chapter 7, Görg describes the ultrasound assessment of the white hemithorax, due either to liquid or solid masses. This comprehensive clinical

chapter is really a "must read" for every physician involved in chest sonography.

It is a special merit of the **Atlas** that it mentions artifacts and pitfalls (in Chapter 8, written by Schuler). Every investigator knows about these difficulties in ultrasonic investigations, and therefore the chapter is highly appreciated by clinicians to systematically learn about the possible limits of this technique. Again, the clarity and quality of the pictures makes the chapter a valuable teaching and learning tool.

In Chapter 9, Blank points out some aspects of interventional chest sonography. The chapter helps to understand possibilities and to judge what can be done in specialized centers by experienced users. The last chapter, by Beckh, describes the role of ultrasonic investigations in a clinical pathway to examine frequent clinical conditions in chest medicine, such as chest pain, pleural disease, and pneumonia. Here it becomes evident how ultrasound results might be used to promote and direct additional and complementary investigations in various clinical settings.

The **Atlas** was originally published in 2001, edited by Mathis, in German. In 2003 Lessnau became co-editor of the English translation. In Germany and the English-speaking countries during those years, "real-time sonography" came into use as a point-of-care investigation throughout the hospital, and that practice will definitely continue. Thus, sonography is an issue not only for the radiologist or pulmonologist, but for every physician involved in treating chest disease. In my intensive care department, chest sonography is performed by surgeons, internists, and anesthesiologists, and it is being taught to every resident and fellow staying with us. We use the **Atlas** as an excellent teaching and learning tool for the beginner and as a reference book for the more experienced user. I highly recommend it to every physician involved in interdisciplinary workups of chest patients. I fully agree with Lessnau, who writes in the preface to the English edition, "The time is certainly well invested."

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