

# *Book Review*

## **Understanding Acid-Base**

Benjamin Abelow, M.D. Baltimore,  
Philadelphia, London, Paris,  
Bangkok, Buenos Aires, Hong Kong,  
Munich, Sydney, Tokyo, Wroclaw:  
Williams & Wilkins; 1998. 333 pp,  
index and appendix. \$24.95. ISBN  
0-0683-18272-2

**MARCH 1999    NUMBER 2    VOLUME 66:134-135**

Teaching the fundamentals of acid-base is not an inconsequential component of medical education, and mastering concepts is not a trivial exercise. Yet, for the most part, the essentials of this crucial subject are fragmented within Biochemistry and Physiology, as well as in Pediatrics, Medicine, Intensive Care and various clinical subspecialties where the student, house officer, practitioner and specialist will be challenged by actual patients in whom an acid-base derangement represents a major, if not, life-threatening disorder. Dr. Abelow, Lecturer in Medicine at Yale University School of Medicine, has undertaken to integrate the many segments to facilitate a clearer understanding of the core aspects by the reader-student.

The book is divided into an introductory review of the fundamentals and five sections entitled Chemistry, Physiology, Pathophysiology, Diagnosis, and Treatment, each of which is further subdivided into brief chapters. An appendix addressing, in brief, twelve topics of special interest is intended to move the reader "one level deeper." An annotated bibliography and an index conclude the book.

The book is well written and achieves its stated objective of making the subject of acid-base readily understandable to a very broad audience. The author clearly states, at the very beginning of the first chapter entitled "Review of Fundamentals," that this section is directed toward first year medical students. Many readers might find this introduction to the elementary concepts overly simplistic and, as the author suggests, might elect not to spend any time on it except as a refresher. This option might be taken by many with respect to the material on buffers through to the discussion of bicarbonate as a buffer system. The author's intent in including this material is to assure that all readers have been suitably prepared to address the information and to digest the concepts to be presented subsequently. A notable and worthy approach is the inclusion of a self-assessment quiz at the end of this section. The reader's performance in answering the questions should be decisive with respect to investing the time, or not, to read the introductory material. I might add that each subsequent section has its own well-thought-out and constructed self-assessment quiz which I found

to be a useful evaluation of how well the material has been presented by the author and grasped by the reader.

The second section is devoted to various aspects of acid-base physiology such as regulation of arterial  $\text{PCO}_2$ , renal bicarbonate reabsorption and regeneration, and acid production and excretion. All of these topics are of crucial importance and are handled by the author with style and dispatch. Clearly, the text is devoted to how two major organs, the lungs and kidneys, modulate acid-base regulation. In the case of the lungs, the basic concepts of alveolar ventilation and diffusion are presented succinctly to assure that the reader has no doubt about how the partial pressure of  $\text{CO}_2$  ( $\text{PCO}_2$ ) is regulated. With respect to the kidneys, a brief review of the nephron sets the stage for a well-illustrated discussion of hydrogen ion secretion and bicarbonate reabsorption which occur in the various segments of the nephron. There is also a brief mention of the “proton pump” in the distal tubule. Following this material, the text turns to a discussion of acidification of body fluids. Most textbooks addressing the subject of acid-base do not provide much insight into the inseparable relationship between energy and acid-base metabolism. This is not to say that a full exposition of the subject should be provided in texts dealing with acid-base, but surely some details would help the reader realize that any gaps in his or her knowledge base with respect to the relationships between tissue oxygen consumption and  $\text{CO}_2$  production, and aerobic and anaerobic ATP synthesis and proton production, must be closed. Integrating this component directly into the text would be well worth the effort by the author, who has been so successful in handling all of the other material. I am sure that the reader would come to value and appreciate Dr. Abelow’s insight and style in presenting this material as well. What the author has done, however, is to exemplify, graphically and in narrative form, how the outcomes of metabolizing several different kinds of substrates impact on acid-base. The reader will find this discussion to be easily comprehensible. Continuing this approach, the text goes on to briefly mention the consequences of anaerobic metabolism of glucose to lactic acid, and the incomplete oxidation of triglycerides. A short discussion of protein metabolism highlights the different roles played by various amino acids in acid-base balance. A brief discussion, but a most useful and very essential one, describes the contributions of the various parts of the GI tract to the acid-base story. Herein, the author captures the essence of how the different segments work and how they are distinctly different.

Within this section on Physiology, there are two brief chapters and a concluding overview which deal, first, with acid excretion or bicarbonate regeneration, and then an integrated view of renal bicarbonate handling. Again, the text is amply illustrated with several easy to understand figures.

The third section is entitled “Pathophysiology.” Here lies the essence of what has gone on before. The reader is introduced to the language and precise meaning of each of the terms generally used in describing the clinical status of patients with acid-base disorders. The brevity of the presentation does not short-change the reader, and may even represent a strength. The text addresses the three main body compartments involved in buffering and their relative importance. Mechanisms of compensation are clearly illustrated. However, I am concerned with the explanation offered with

respect to the compensatory sequences for metabolic derangements of acid-base, in that only a passing mention is made of the existence of the blood-brain barrier. The respiratory center, functioning as a central chemoreceptor, is certainly responsive to  $\text{PCO}_2$ ,  $\text{H}^+$  and  $\text{HCO}_3^-$ , but the blood-brain barrier plays an important role in determining the composition of the cerebrospinal fluid and the brain's interstitial fluid, which differ uniquely from the extracellular and interstitial fluids of other organs and tissues. This information is so fundamental that the author's footnote is hardly adequate. But the subsequent discussion of metabolic acidosis and alkalosis is as illuminating as it is concise. The same can be said of the presentations on respiratory acidosis and alkalosis. The reader will welcome these presentation of the concepts as well as specific factual information. However, I was unable to find any mention of alveolar capillary block. Despite a section entitled "The work of breathing," the reader is not exposed to a definition of "work," how it is measured, and the clinical consequences when more of it is required in the several conditions elaborated upon by the author. The function and role of the elastic tissue in the lung are not mentioned, although the reader is informed, and correctly so, about the highly elastic lung being stiff and non-compliant. But the book is not intended as an exposition of pulmonary physiology. The mention of the blood gas composition of a mountaineer at the top of Mount Everest is titillating and it would have been helpful if the appropriate reference had been provided for those inquisitive enough to explore human adaptability to such extreme conditions.

The fourth section is devoted to "Diagnosis" and is divided into five chapters. The initial section deals with the need for the clinician to have a high index of suspicion of the acid-base derangement just from the history and physical examination as a basis for ordering the appropriate laboratory tests. A number of conditions are enumerated which are potential causes of acid-base disturbances. The utility of knowing the concentrations of electrolytes in venous blood, and the gases in arterial blood, is thoughtfully detailed along with nomograms. Similarly, some additional tests and their limitations are also enumerated. The reader is challenged to integrate these data into a knowledge base which can be recalled, but if this appears insurmountable, the author suggests that the reader may want to photocopy, for ready reference, a nicely laid out one-page table entitled "Typical Laboratory Presentations of Common Acid-Base Disturbances."

The final section of the book is devoted to "Treatment." The author does provide numerous details which are beyond the scope of this review. In some instances, the reader might have wished more specifics regarding, for example, the suggested rate of intravenous administration of potassium when indicated, as well as other modalities.

The final part of the book is an "Appendix" which consists of topics A-L. Herein, the author provides the reader with more information on renal ammonium handling, anion gap, osmolar gap, and renal tubular acidosis amongst others. The final topic is a description, and in many ways an endorsement, of the use of local or topical anesthesia prior to arteriopuncture. The author does not address the use of capillary blood from a finger stick to determine blood gas concentrations, or the use of an "arterialized" venous sample obtained by immersing an arm in a water bath at  $40^\circ\text{C}$  for five minutes or so. Either approach could avoid the risk and discomfort of an arterial puncture, even

Abelow- book review

with a fine needle.

In summary, I think the author has achieved the stated objectives he set out to accomplish. I can recommend the book to medical students and house officers who want to broaden their horizons with a firmer grasp of the road map, with its many highways and byways, into acid-base and surrounding territories.

Sherman Kupfer, M.D.  
Mount Sinai School of Medicine