Pulmonary Physiology for Clinicians

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A Focused Guide

Springer

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ISBN 978-3-032-24302-7 ISBN 978-3-032-24303-4 (eBook)
https://doi.org/10.1007/978-3-032-24303-4

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

This book is dedicated to my mentor, Dr. Dudley F. Rochester who was intensely devoted both to the study of pulmonary physiology and to its clinical teaching. His empathy, sincerity, and humility were unique among his peers.

Marc Lavietes, MD

I dedicate this book to my students, whose inquisitiveness renews my passion for pulmonary physiology.

Andrew Berman, MD

Preface

Pulmonary function testing is an important component of several determinations used to evaluate respiratory health. Others include history, physical examination, serological and skin testing, and imaging studies. Clinicians and epidemiologists rely on pulmonary function testing both to confirm diagnoses and to evaluate the functional status of patients and study subjects. Medical and graduate school programs offer comprehensive sections on pulmonary physiology early in their curricula as do basic physiology textbooks. Later, clinical courses and texts describe the pathophysiology of lung diseases. Their descriptions include the pulmonary function test results associated with each clinical condition. However, they offer little or no accompanying discussion of the physiological principles underlying those results. Therefore, many students do not grasp the relationships between basic physiology and the clinical application of their test results. Given a lack of understanding of underlying physiological principles, physicians often miss some of the clinical implications available to them from the interpretation of these results. It seems that while students readily understand the function of other organs, the understanding of lung physiology is sometimes enigmatic.

The goal of this book is: to integrate the interpretation of pulmonary function test results with both their physiological basis and their clinical implications. This book picks and chooses those basic concepts that are necessary to understand and interpret clin-

ical lung function test results. To this end, many fundamental physiological concepts presented in other texts are omitted here. For one clear example: the description of the physicochemistry of hemoglobin. Basic texts all present graphs showing three variables: oxygen tension (*x*-axis), hemoglobin saturation (*y*-axis), and a third variable, either pH or temperature, represented as a continuous line or curve on the graph. This information is critical for the understanding of how oxygen first affixes to hemoglobin in the lung and is later released for uptake by the tissues. It is however not helpful for the interpretation of pulmonary function tests. On the other hand, material not found elsewhere is presented here because of its importance for the interpretation of test results. For example, we describe at length the protocols for the performance of each test. Knowledge of these protocols and procedures is important for both the technician performing the test and the clinician interpreting them. The technician, in order to achieve successful technician-patient coordination, must understand the principles governing the instructions given to the test subject. The clinician must also be familiar with test procedures. For example, when interpreting the data describing lung volume, the clinician must know that a gas dilution technique may underestimate the true lung volume of an emphysematous patent whereas plethysmography will provide more accurate data.

There are four components of a standard pulmonary function testing session. Each of the first four chapters here is devoted to one component. These include: one, evaluation of the static properties of the respiratory system; two, its dynamic properties; three, the propensity for gas to diffuse across the alveolar-pulmonary capillary membrane; and lastly the properties of the lung allowing for the matching of ventilation with perfusion (V/Q). The property of V/Q matching is quantified with surrogate measures: arterial blood gas determination in some laboratories; less invasive procedures such as measurements of oxygen saturation and end tidal pCO_2 in others. This book is then presented in sections corresponding to the laboratory protocol for lung function testing. Each section will follow the identical format: a brief commentary

on the origin and evolution of the test to be described along with a detailed account of how the test is performed and the results interpreted. This is followed by comments on the clinical implications of test results and finally a review of the physiological principles governing the interpretation of each test.

Newark, NJ, USA Marc Lavietes

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