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Intro -- Preface -- Acknowledgments -- Contributors -- 1 Exercise Testing and Interpretation -- WHAT IS CARDIOPULMONARY EXERCISE TESTING? -- CELL RESPIRATION AND BIOENERGETICS -- NORMAL COUPLING OF EXTERNAL TO CELLULAR RESPIRATION -- WHY MEASURE GAS EXCHANGE TO EVALUATE CARDIORESPIRATORY FUNCTION AND CELLULAR RESPIRATION? -- CARDIAC STRESS TESTS AND PULMONARY STRESS TESTS -- PATTERNS OF CHANGE IN EXTERNAL RESPIRATION ( $\text{VO}_2$  AND  $\text{VCO}_2$ ) AS RELATED TO FUNCTION, FITNESS, AND DISEASE -- FACTORS LIMITING EXERCISE -- Fatigue -- Dyspnea -- Pain -- EVIDENCE OF SYSTEMIC DYSFUNCTION UNIQUELY REVEALED BY INTEGRATIVE CARDIOPULMONARY EXERCISE TESTING -- Diagnosis of Exercise Intolerance, Especially Exertional Dyspnea and Myocardial Ischemia -- Cardiopulmonary Exercise Testing and Prognosis in Patients With Known Disorders -- Cardiopulmonary Exercise Testing and Preoperative Assessment -- SUMMARY -- 2 Physiology of Exercise -- SKELETAL MUSCLE: MECHANICAL PROPERTIES AND FIBER TYPES -- BIOENERGETICS -- Sources of High-Energy Phosphate and Cellular Respiration -- Phosphocreatine Breakdown -- Substrate Utilization -- Carbohydrates -- Lipids -- Amino Acids -- OXYGEN COST OF WORK --  $\text{VO}_2$  Steady State and Work Efficiency --  $\text{VO}_2$  Nonsteady State -- ARTERIAL LACTATE INCREASE -- Arterial Lactate Increase as a Function of Work Rate -- Arterial Lactate Increase as a Function of Time -- Mechanisms of Arterial Lactate Increase -- Increasing Glycolytic Flux and Exercise Intensity -- Sequential Recruitment of Type II Muscle Fibers -- Pyruvate Dehydrogenase Activity -- Change in Cytosolic Redox State Limiting Mitochondrial Proton Shuttles -- Lactate Production and Clearance -- Oxygen Supply and Critical Capillary  $\text{PO}_2$  -- pH Change and Oxyhemoglobin Dissociation Above the Anaerobic Threshold -- BUFFERING THE EXERCISE-INDUCED LACTIC ACIDOSIS. CARDIOVASCULAR RESPONSES TO EXERCISE -- Cardiac Output -- Oxygen Pulse -- Distribution of Peripheral Blood Flow -- Arterial  $\text{PO}_2$  -- Oxyhemoglobin Dissociation -- Hemoglobin Concentration -- Arterial Oxygen Content -- GAS EXCHANGE KINETICS -- Oxygen Uptake Kinetics -- Moderate Exercise -- Supra-AT Exercise -- Mean Response Time -- Oxygen Deficit -- Oxygen Debt -- Carbon Dioxide Output Kinetics -- Moderate Exercise -- Supra-AT Exercise -- Power-Duration Curve and Critical Power -- VENTILATORY RESPONSES TO EXERCISE -- Arterial and Venous  $\text{PCO}_2$  and Carbon Dioxide Content -- Ventilatory Determinants -- Carbon Dioxide and  $\text{H}^+$  Elimination -- Alveolar Ventilation -- Dead Space Ventilation -- Total (or Expired) Ventilation -- Breathing Pattern -- Ventilatory Control -- Moderate Exercise -- Supra-AT Exercise -- SUMMARY -- 3 Measurements During Integrative Cardiopulmonary Exercise Testing -- measurements -- Electrocardiographic Changes With Exercise -- Maximal and Peak Oxygen Uptake -- Oxygen Uptake and Work Rate -- Normal Subjects -- Upward Displacement of  $\text{VO}_2$  as a Function of Work Rate in Obesity -- Slope of  $\text{VO}_2$  as a Function of Work Rate ( $\text{VO}_2/\text{WR}$ ) -- Linearity of  $\text{VO}_2$  as a Function of Work Rate -- Can  $\text{VO}_2$  or METs Be Predicted From the Work Rate? -- Cardiac Output and Stroke Volume -- Cardiac Output Measurement -- Indirect Fick Method Using  $\text{VCO}_2$  and Estimated  $\text{CVCO}_2$  -- Direct Fick Method -- Noninvasive Cardiac Output and Stroke Volume by the Fick Principle -- Oxygen Pulse and Stroke Volume -- Anaerobic (Lactate, Lactic Acidosis) Threshold -- Methods of Measurement -- V-Slope Method -- Ventilatory Equivalent Method -- Improving Estimation of the Anaerobic Threshold -- False Positives -- Heart Rate-Oxygen Uptake Relationship and Heart Rate Reserve --

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## Sommario/riassunto

Selected as a Doody's Core Title for 2025! Thoroughly revised and updated for today's clinicians, Wasserman & Whipp's Principles of Exercise Testing and Interpretation, Sixth Edition, provides a comprehensive, practical overview of cardiopulmonary exercise testing (CPET) ideally suited for pulmonologists, cardiologists, anesthesiologists, and others with an interest in clinical exercise testing. Written by authors who are uniquely positioned to convey relevant aspects of research and apply them to clinical contexts, this volume offers in-depth coverage of essential information for conducting CPET, or for utilizing data from this discipline in clinical practice or research. Clearly defines terminology throughout and focuses on the core elements of CPET that are common to all users, ensuring that content is easily accessible to clinicians from a wide variety of backgrounds. Reviews the central aspects of exercise physiology and metabolism important for understanding measurements used in CPET. Identifies core procedures and measurements for conducting tests and laboratory quality control. Outlines systematic, step-by-step approaches to the interpretation of exercise data, including the scientific and technical basis of the methods and analyses. Includes a new chapter on approach to data and interpretation - focused on practical approaches to viewing, summarizing, and reporting results of a test. Illustrates normal and abnormal results of exercise tests through discussion of dozens of actual case presentations. Draws on the extensive experience and

expertise of authors from the fields of pulmonary medicine and physiology with experience in research and clinical studies related to cardiology, metabolism, sports medicine, and other areas. Enrich Your Ebook Reading Experience Read directly on your preferred device(s), such as computer, tablet, or smartphone. Easily convert to audiobook, powering your content with natural language text-to-speech.

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