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CARDIOPULMONARY EXERCISE TESTING: A COMPREHENSIVE REVIEW OF PROTOCOLS, CLINICAL APPLICATIONS, AND LIMITATIONS

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Abstract: Cardiopulmonary exercise testing (CPET) is a vital tool for evaluating symptoms, disease severity, prognosis, and therapeutic responses in patients with cardiopulmonary diseases. By assessing the integrated function of cardiovascular, pulmonary, musculoskeletal, nervous, and hematological systems during exertion, CPET provides objective data that complement resting diagnostics. This review outlines key CPET variables, protocols, and clinical indications, emphasizing its role in diagnosing unexplained dyspnea, guiding exercise prescriptions, and managing heart failure. Limitations, including sex-based differences and the impact of obesity, are also discussed.

Introduction: Symptoms of cardiopulmonary diseases often manifest during physical activity, making CPET a unique diagnostic modality. Unlike resting evaluations (e.g., echocardiography, spirometry), CPET captures dynamic physiological responses, offering insights into oxygen transport and utilization. This review synthesizes evidence on CPET's utility in diverse populations, from athletes to patients with heart failure, and highlights gaps in current standards.

Methods: A narrative review was conducted using peer-reviewed literature on CPET protocols, clinical applications, and limitations. Data sources included PubMed, NEJM Evidence, and consensus guidelines. Key themes were organized into sections on protocols, functional assessment, and special populations.

Results: 1. CPET Protocols Modalities: Treadmill testing is preferred for simulating daily activities, while cycle ergometry suits patients with gait limitations. VO\(_2\) max values are 5–11% lower on ergometers due to reduced muscle engagement. Protocols: The Bruce protocol's variable increments may obscure results. Alternatives like the modified Astrand (2% grade increase/2 min) or Ellestad (speed-focused) protocols yield comparable VO\(_2\) max but differ in secondary parameters (e.g., heart rate). VO\(_2\) Max Criteria: Indirect markers (plateau in VO\(_2\), RER >1.1, maximal HR, RPE) are commonly used, though repeating tests at higher workloads remains the gold standard.

2**. Clinical Applications**: Functional Assessment: CPET distinguishes cardiac, pulmonary, and peripheral limitations in unexplained dyspnea. Exercise Prescription: Ventilatory threshold defines sustainable exercise intensity. Heart Failure: HFrEF: VO\(_2\) peak ≤14 mL/kg/min (≤12 mL/kg/min on beta-blockers) indicates transplant referral. V\(_E\)/VCO\(_2\) slope >34 predicts hospitalization risk. HFpEF: CPET diagnoses early-stage disease via abnormal PCWP during exercise, though peripheral limitations (e.g., reduced skeletal muscle perfusion) often contribute.

3. **Limitations**: Sex Differences: VO\(_2\) max norms, derived predominantly from men, underestimate women's capacity due to lower muscle mass and hemoglobin. Obesity: Scaling VO\(_2\) to total body mass penalizes obese individuals; fat-free mass adjustments

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may better reflect fitness. Medications: Beta-blockers reduce VO\(_2\) max, necessitating reliance on alternative metrics. Peripheral Factors: Endothelial dysfunction, reduced capillary density, or orthopedic injuries may limit exercise capacity independently of cardiopulmonary function.

Discussion: CPET's integrative approach enhances diagnostic precision and personalized care. However, standardization challenges persist, particularly for women, obese patients, and those with congenital heart disease. Future research should address: Sex-specific VO\(_2\) max criteria. The prognostic value of fat-free mass-adjusted metrics. CPET's role in emerging HFpEF phenotypes.

Conclusion: CPET is indispensable for evaluating exercise intolerance and guiding therapeutic decisions. Its multivariate data capture systemic interactions often missed by static tests, though methodological refinements are needed to optimize equity and accuracy.

References:

1. Herrmann SD, Willis EA, Ainsworth BE, et al. 2024 adult compendium of physical activities: a third update of the energy costs of human activities. J Sport Health Sci 2024;13:6-12. DOI: 10.1016/j.jshs.2023.10.010.
2. Miyamura M, Honda Y. Oxygen intake and cardiac output during maximal treadmill and bicycle exercise. J Appl Physiol 1972;32:185-188. DOI: 10.1152/jappl.1972.32.2.-b185.
3. Bruce RA, Blackmon JR, Jones JW, Strait G. Exercising testing in adult normal subjects and cardiac patients. Pediatrics 1963;32:742-756. DOI: 10.1542/peds.32.4.742.
4. Pollock ML, Bohannon RL, Cooper KH, et al. A comparative analysis of four protocols for maximal treadmill stress testing. Am Heart J 1976;92:39-46. DOI: 10.1016/S0002-8703(76)80401-2.

5. Ellestad MH, Allen W, Wan MC, Kemp GL. Maximal treadmill stress testing for cardiovascular evaluation. Circulation 1969;39:517-522. DOI: 10.1161/01.CIR.39.4.517

6. Saydaxmedov, Z. I., & Mahmudov, U. I. (2023). CLINICAL AND FUNCTIONAL STATUS OF THE CARDIOVASCULAR SYSTEM IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE WITH COVID-19. SCIENTIFIC ASPECTS AND TRENDS IN THE FIELD OF SCIENTIFIC RESEARCH, 2(16), 44-47.

7. Qurbonbek o'g'li, D. S. (2023). TREATMENT OF THE PATIENT WITH COPD AND CARDIOVASCULAR DISORDERS. Scientific Impulse, 1(8), 553-564.

8. Qurbonbek o'g'li, D. S. (2023). THE RELATIONSHIP BETWEEN CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD) AND CARDIOVASCULAR DISEASE (CVD). PEDAGOG, 6(12), 85-96.

ISSN: 2692-5206
AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES

9. Ilhomjon ogli, M. U., Ibrohimjon ogli, S. Z., & Qurbonbek ogli, D. S. (2024). CLINICS AND RESULTS OF TREATMENT OF PATIENTS WITH CORONAVIRUS INFECTION COMPLICATED BY INTERSTITIAL PNEUMONIA IN THE FERGHANA REGION. MODELS AND METHODS FOR INCREASING THE EFFICIENCY OF INNOVATIVE RESEARCH, 3(30), 21-26.

10. Авезов, Д. К., Турсунова, Л. Д., Назарова, Н. О., & Хайитов, Х. А. (2021). КЛИНИКО-ФУНКЦИОНАЛЬНЫЙ СТАТУС СЕРДЕЧНО-СОСУДИСТОЙ СИСТЕМЫ У ПАЦИЕНТОВ С ХРОНИЧЕСКОЙ ОБСТРУКТИВНОЙ БОЛЕЗНЬЮ ЛЕГКИХ С COVID-19. Интернаука, (20-2), 15-16.

11. Saydaxmedov, Z. I., & Mahmudov, U. I. (2024). DIABETES MELLITUS AND COVID-19; A BIDIRECTIONAL INTERPLAY. FORMATION OF PSYCHOLOGY AND PEDAGOGY AS INTERDISCIPLINARY SCIENCES, 2(25), 130-136.

12. Saydaxmedov, Z. I., & Mahmudov, U. I. (2023). Dynamics Of Glycemic Variability In Patients With Type 2 Diabetes Mellitus During Deprescribing Therapy Depending On The Presence Of Severe Comorbid Pathology. Innovative Developments And Research In Education, 2(24), 243-249.