

Role of cardiopulmonary exercise testing for preoperative evaluation

Volume 4 Issue 4 - 2016

Introduction

The preoperative assessment is an important tool for management of a patient in perioperative period including anesthetic management and risk stratification. The various assessment tools includes detailed patient history, physical examination, scoring systems like Lee, Goldman, Dukes activity status index and use of echocardiography and pulmonary function testing.¹ These tools provide various information but at times have limited application due to variability. The Cardiopulmonary exercise testing (CPET) has emerged an important assessment tool for assessing the functional capacity of individual it provides objective data which remains reliable and repeatable. It assess the various body systems including cardiovascular, pulmonary, hematopoietic, neuropsychological, and musculoskeletal systems to an exercise response in an integrated approach. The CPET understanding requires understanding of the physiology related to cellular function. It is known that immediate energy to the exercising muscle is obtained from stored energy within the muscle in the form of Creatine Phosphate. Once it is depleted, the aerobic metabolism of glucose provides subsequent energy to cells. Lastly muscles derive energy from anaerobic metabolism.^{2,3} The Anaerobic Threshold (AT) determines that imbalance between demand and supply of oxygen to muscles during exercise leading to anaerobic metabolism induced lactic acidosis.² For testing, patient is explained about the procedure and all these monitors are attached. Resuscitation equipments are kept ready for any eventuality. The CPET have an Treadmill or cycle ergometer which is linked to computer for controlled resistance change during patient exercise.¹ The CPET use includes recording of baseline parameters after an initial phase for 3 min patient run on the cycle ergometer without resistance. Thereafter, resistance is gradually increased at the predetermined ramp rate.¹⁻³ The pneumotachographs during the test analyses breath by breath gas volume. The gas analyzer in the system evaluates qualitative and quantitative oxygen and carbon-di-oxide levels in each breath. Thus breath-by-breath measurement of oxygen consumption (VO_2) and carbon dioxide production (VCO_2) is measured.¹ Also, 12 lead electrocardiogram, non-invasive blood pressure and pulse oximeter are used to measure respective parameters. Full monitoring continues in the recovery period for 10 minutes after cessation of exercise.¹ Once the test is conducted and data collected includes oxygen consumption (VO_2), carbon dioxide production (VCO_2), Respiratory Exchange Ratio (RER), Anaerobic Threshold (AT) and work rate in watts. Cardiovascular parameters include heart rate, 12 lead ECG with ST analysis, blood pressure, and oxygen pulse (VO_2 /HR) which approximates stroke volume. Ventilatory measurements include minute ventilation (VE), tidal volume (VT) and respiratory rate. Pulmonary gas exchange parameters are oxygen saturation, ventilator equivalents for oxygen (VE/VO_2) and carbon dioxide (VE/VCO_2).³ The CPET has found its role in assessment of patients with respiratory diseases like COPD, interstitial lung disease, chronic pulmonary vascular disease.⁴⁻⁷ A significant correlation between FEV1 and the predicted VO_2 (max % predicted) has been reported.⁶ CEPT has been used for assessment

Rakesh Garg,¹ Namita Saraswat²¹Assistant Professor, Department of Onco-Anesthesiology and Palliative Medicine, Dr BRAIRCH, All India Institute of Medical Sciences, India²Assistant Professor of Anesthesiology, PGIMER and Dr RML Hospital, India

Correspondence: Rakesh Garg, Department of Anaesthesiology, Pain and Palliative Care, Dr BRAIRCH, All India Institute of Medical Sciences, Room No. 139, 1st floor, Ansari Nagar, New Delhi-110029, India, Email aheroglu@hotmail.com

Received: February 20, 2016 | **Published:** April 05, 2016

for possible etiology of unexplained dyspnea.^{8,9} CPET parameters like VE/VCO_2 slope and VO_2 peak/kg has been reported to provide better correlation with outcome and considered as most robust predictor of survival than resting PaO_2 or desaturation below 88% during 6-MWT.⁴ The prognostic power of VO_2 in the patients with heart failure has also been emphasized where in VO_2 of <10 mL/kg/min was associated with significantly poorer predicted survival.⁴ CPET has emerged a important tool for assessment of patient for heart lung transplant, thoracic surgery and vascular surgery like aneurysm.¹⁰⁻¹⁴

Conclusion

To conclude, CPET would emerge as an important tool for integrated assessment of patient prior to a major surgery when appropriately indicated like having associated co-morbidities.

Acknowledgments

None.

Conflicts of interest

Author declare that there is no conflict of interest.

Funding

None.

References

1. American Thoracic Society, American College of Chest Physicians. ATS/ACCP statement on cardiopulmonary exercise testing. *Am J Respir Crit Care Med.* 2003;167(2):211-277.
2. Bhagwat M, Paramesh K. Cardio-pulmonary exercise testing: An objective approach to pre-operative assessment to approach to pre-operative assessment to define level of perioperative care level of perioperative care. *Indian J Anaesth.* 2010;54(4):110-115.

3. Chatterjee S, Sengupta S, Nag M, et al. Cardiopulmonary Exercise Testing: A Review of Techniques and Applications. *J Anesth Clin Res*. 2013;4:7.
4. Fell CD, Liu LX, Motika C, et al. The prognostic value of cardiopulmonary exercise testing in idiopathic pulmonary fibrosis. *Am J Respir Crit Care Med*. 2009;179(5):402–407.
5. Sun XG, Hansen JE, Oudiz RJ, et al. Exercise pathophysiology in patients with primary pulmonary hypertension. *Circulation*. 2001;104(4):429–435.
6. Ganju AA, Fuladi AB, Tayade BO, et al. Cardiopulmonary Exercise Testing in Evaluation of Patients of Chronic Obstructive Pulmonary Disease. *Indian J Chest Dis Allied Sci*. 2011;53(2):87–89.
7. Thirapatarapong W, Armstrong HF, Bartels MN. Comparison of cardiopulmonary exercise testing variables in COPD patients with and without coronary artery disease. *Heart Lung*. 2014;43(2):146–151.
8. Bhatt DV, Kocheril AG. Submaximal cardiopulmonary exercise testing for the evaluation of unexplained dyspnea. *South Med J* 2014;107(3):144–119.
9. Simons OS, Dubbelink, Yvonne F. Explaining The Unexplained: Cardiopulmonary Exercise Testing In The Saqmi Evaluation. Of Chronic Unexplained Dyspnea. *Am J Respir Crit Care Med*. 2014;189:A1788.
10. Mancini DM, Eisen H, Kussmaul W, et al. Value of peak oxygen consumption for optimal timing of cardiac transplantation in ambulatory patients with heart failure. *Circulation*. 1991;83(3):778–786.
11. Arena R, Myers J, Guazzi M. The clinical and research applications of aerobic capacity and ventilatory efficiency in heart failure: an evidence-based review. *Heart Fail Rev*. 2008;13(2):245–269.
12. Forshaw MJ, Strauss DJ, Davies AR, et al. Is cardiopulmonary exercise testing a useful test before esophagectomy? *Ann Thorac Surg*. 2008;85(1):294–249.
13. Nagamatsu Y, Shima I, Yamana H, et al. Preoperative evaluation of cardiopulmonary reserve with the use of expired gas analysis during exercise testing in patients with squamous cell carcinoma of the thoracic esophagus. *J Thorac Cardiovasc Surg*. 2001;121(6):1064–1068.
14. Bayram AS, Candan T, Gebitekin C. Preoperative maximal exercise oxygen consumption test predicts postoperative pulmonary morbidity following major lung resection. *Respirology*. 2007;12(4):505–510.