Role of Cardiopulmonary Exercise Testing for Preoperative Evaluation

Mini Review
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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 [1]. 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-dioxide levels in each breath. Thus breath-by-breath measurement of oxygen consumption (VO2) and carbon dioxide production (VCO2) 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 (VO2), carbon dioxide production (VCO2), 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 (VO2 /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/VO2) and carbon dioxide (VE/VCO2) [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 VO2 (max % predicted) has been reported [6]. CEPT has been used for assessment for possible etiology of unexplained dyspnea [8,9]. CPET parameters like VE/VCO2 slope and VO2 peak/kg has been reported to provide better correlation with outcome and considered as most robust predictor of survival than resting PaO2 or desaturation below 88% during 6-MWT [4]. The prognostic power of VO2 in the patients with heart failure has also been emphasized where in VO2 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.

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