

## The emerging role of cardiopulmonary exercise testing and cardiac rehabilitation in dilated cardiomyopathy: A mini review

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### Abstract

Cardiovascular mortality is a major health burden worldwide and the number of patients with cardiac diseases is increasing. Dilated cardiomyopathy (DCM) is the most frequent cause for patient visits in cardiac care units and emergency departments. It is commonly misdiagnosed as ischaemic cardiac disease. Middle- and low-income countries rely on pharmacological management as the only treatment option. Most of the patients cannot afford heart transplants or advanced treatment strategies. Most health professionals also do not prescribe cardiac rehabilitation for DCM patients in their routine clinical practice. There is evidence that supervised cardiac rehabilitation is safe and beneficial for DCM patients. In addition to medications, cardiopulmonary exercise testing (CPET) and supervised cardiac rehabilitation, can provide more benefits to the affected population of cardiomyopathies. CPET and cardiac rehabilitation are still novel concepts in countries like Pakistan. The present review aims to provide clinicians with an overview of an evidence-based and innovative perspective. This perspective emphasizes the utilization of the additional benefits of cardiac rehabilitation in the holistic management of DCM patients and the prevention of chronic heart failure.

**Keywords:** Cardiac Rehabilitation, Cardiopulmonary exercise testing, CPET, DCM, Exercise, Idiopathic Dilated Cardiomyopathy, Risk stratification.

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### Introduction

The increased burden of cardiovascular diseases on Pakistani healthcare system highlights the need for preventive measures to improve the quality of life in patients with cardiomyopathy. Cardiovascular diseases are major health burden in Pakistan and the number of cardiac patients are increasing day by day.<sup>1</sup> Dilated cardiomyopathy (DCM) is one of the most common cause

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of arrhythmia, heart failure and sudden cardiac death. It is a frequent reason for patients' visits to cardiac care units and emergency departments.<sup>2</sup>

### What is dilated cardiomyopathy (DCM)?

Dilated cardiomyopathy (DCM) refers to dilatation of heart chambers with poor contraction of the ventricles leading to systolic dysfunction and heart failure. There is an increase in end diastolic (EDV) and end systolic volume (ESV) with hypo-kinesis in left ventricle that results in an increase in residual volumes, very poor ejection fraction which ultimately cause increased left ventricle end-diastolic pressure (LVEDP). The most common symptom of DCM includes dyspnoea, palpitations, chest pain, and pedal oedema, distention in the abdomen, fatigue, and syncope. Various patients may present with multiple complaints. Among these, dyspnoea on exertion is the most common symptom, DCM is presented as one of the neglected cardiac diseases in Pakistan. It may also be misdiagnosed and overlooked because the treatment options remain unsatisfactory. It is a frequent cardiac problem but commonly misdiagnosed as coronary artery disease.<sup>3</sup>

### Cardiopulmonary exercise testing (CPET)

When compared to the standard exercise testing, Cardiopulmonary Exercise testing (CPET) provides more accurate and precise measurement of aerobic capacity, reasons for breathlessness on exertion as well as the prognosis in patients with systolic dysfunction. In order to confirm the presence or to determine the severity of the ischaemia, exercise stress testing is commonly prescribed. It gives information regarding exertional symptoms, systolic and diastolic blood pressure responses as well as fluctuations in heart rate and the predicted aerobic capacity. However, the direct measurement of respiratory gas exchange with exercise can also be measured which is known as cardiopulmonary exercise testing (CPET).<sup>4</sup> Recently, ventilatory abnormalities related with exercise have gained attention of the researchers and resulted in another scientific debate and innovation in this perspective. If DCM patients are stable and maximal medical treatment is instituted than peak VO<sub>2</sub> alone, measured through CPET, is a strong predictor of outcome in DCM. Thus, supporting the importance of using CPET as



**Figure:** A cardiologist examining a patient who is undergoing a cardiac stress test. (Cited from <https://www.pexels.com/photo/a-cardiologist-examining-a-patient-undergoing-cardiac-stress-test-8460228/> on 6-12-2023).

a clinical tool in the management of chronic heart failure caused by DCM.<sup>5</sup>

The prognostic value of cardiopulmonary exercise testing was studied in a large cohort of 381 patients with idiopathic DCM.<sup>6</sup> Alterations in the mechanical properties of myocardium were investigated in patients with dilated cardiomyopathy both at rest and during the same session of CPET. Resting global longitudinal strain (GLS), longitudinal strain rate at systole (LSRS) and diastole (LSRD) were impaired in DCM. This is because the first anatomical components that are affected in DCM are the longitudinal fibers in the sub-endocardium. Therefore, longitudinal strain is detected early and may be detected even at sub-clinical stages. These parameters improved with peak exercise.<sup>7</sup>

CPET is a valuable tool for the measurement of exercise capacity in children who develop heart failure due to idiopathic DCM. They show similar cardiac abnormalities as observed in adults with the same clinical characteristics. Gas exchange analysis during exercise testing is relevant clinically as it can easily identify the children with heart failure.<sup>8</sup> CPET is also very useful for the evaluation of functional aerobic capacity and exercise tolerance for DCM patients who are candidates for heart transplant.<sup>9</sup>

### **The role of cardiac rehabilitation in dilated cardiomyopathy:**

Many different protocols of CPET are utilized for functional assessment depending on the purpose of the test and the capacity of the patient. In patients with heart failure, both treadmill as well as bicycle protocols can be used. Although CPET provides an excellent assessment in DCM patients it is contraindicated in patients who have

hypertrophic cardiomyopathy. The interpretation of CPET can be a difficult task, however peak VO<sub>2</sub> derived from it is alone a very strong and independent variable for predicting the prognosis of DCM patients.<sup>10</sup>

The benefits and the side-effects of home-based exercise training in patients with ischaemic and dilated cardiomyopathy have been studied. Patients with idiopathic dilated cardiomyopathy had a significant improvement in peak aerobic capacity, exercise time and a reduction in end diastolic and end systolic dimensions on echocardiography. However, patients with DCM reported some complications like fluid retention and exercise induced tachycardia. It was proposed that DCM patients can also benefit from an exercise programme but they should be monitored very closely to prevent undesirable effects.<sup>11</sup>

A systematic review and meta-analysis also supported the findings that physical functioning and quality of life show improvements with exercise as compared to usual plan of care in heart failure due to DCM. The improvements are clinically significant because they were independent of demographics, severity of the disease, length and location of the intervention plan.<sup>12</sup>

In order to test the prognostic power of CPET, repeating CPET during the follow-up patients of DCM were also reported in which it was proposed that 1-year repetition of CPET in DCM patients could easily identify the high-risk patients.<sup>13</sup>

Exercise training in idiopathic dilated cardiomyopathy decreases the biventricular oxidative metabolism as well as improves the forward work efficiency. This desirable energy-sparing effect of DCM makes it a suitable option as a concomitant option for both the prevention and treatment purposes.<sup>14</sup> Supervised exercise training programme did not pose any threats to the patients.<sup>2</sup> Exercise training with lower limb ergometers were very effective in improving the left ventricular dimensions as well as ejection fraction of patients with DCM. A randomized controlled trial was conducted in Pakistan on the effects of exercise training on functional capacity of patients with DCM. With 2 months of exercise training on bicycle (3times/week) reported statistically significant improvements in all the parameters of functional capacity except time duration. The most probable reason is the activation of the passive heart in these patients which results in the favorable outcomes.<sup>15</sup>

### **Conclusion**

The review focusses on health promotion, significance of appropriate interventions for cardiopulmonary exercise

testing and appropriate exercise prescription for idiopathic dilated cardiomyopathy. The current review provides the general and practical aspects with regards to CPET for the understanding of health care professionals. It also updates the clinicians on the indications and utilization of cardiac rehabilitation as a non-pharmacological management choice for patients with DCM in their clinical settings to prevent complications of chronic heart failure.

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## References

- Zubair F, Nawaz SK, Nawaz A, Nangyal H, Amjad N, Khan MS. Prevalence of cardiovascular diseases in Punjab, Pakistan: a cross-sectional study. *J Public Health*. 2018;26:523-9.
- Murad S, Siddiqi FA, Tariq MI, Butt MW. Effects of Cardiovascular Conditioning Exercises on Quality of Life in Patients with Dilated Cardiomyopathy in Pakistan. *Journal of Ayub Medical College Abbottabad*. JAMC 2019;31(4 Sup):651-5.
- Ali M, Faruqi AM. Dilated Cardiomyopathy Experience in Pakistan. *Pakistan Heart Journal*. PHJ. 1984;17: 27-34.
- Milani RV, Lavie CJ, Mehra MR, Ventura HO, editors. Understanding the basics of cardiopulmonary exercise testing. *Mayo Clin Proc*. 2006;81:1603-11
- Corrà U, Mezzani A, Bosimini E, Giannuzzi P. Cardiopulmonary Exercise Testing and Prognosis in Chronic Heart Failure\*: A Prognosticating Algorithm for the Individual Patient. *Chest*. 2004;126:942-50.
- Sinagra G, Iorio A, Merlo M, Cannatà A, Stolfo D, Zambon E, et al. Prognostic value of cardiopulmonary exercise testing in Idiopathic Dilated Cardiomyopathy. *Int J Cardiol*. 2016;223:596-603.
- Triantafyllidi H, Birmpa D, Ikonomidis I, Benas D, Makavos G, Cokkinos DV, et al. Peak exercise myocardial deformation indices during cardiopulmonary exercise testing are associated with exercise capacity and ventilatory efficiency in patients with dilated cardiomyopathy. *Hellenic J Cardiol*. 2023;70:28-35.
- Guimarães GV, Bellotti G, Mocelin AO, Camargo PR, Bocchi EA. Cardiopulmonary exercise testing in children with heart failure secondary to idiopathic dilated cardiomyopathy. *Chest*. 2001;120:816-24.
- Ong KC, Benedicto JP, Chan AH, Tan YS, Ong YY. Cardiopulmonary exercise testing in heart transplant candidates. *Ann Acad Med Singap*. 2000;29:442-6.
- Albouaini K, Egred M, Alahmar A, Wright DJ. Cardiopulmonary exercise testing and its application. *Postgrad Med J*. 2007;83:675-82.
- Webb-Peplow KM, Chua TP, Harrington D, Henein MY, Gibson DG, Coats AJS. Different response of patients with idiopathic and ischaemic dilated cardiomyopathy to exercise training. *Internat J Cardiol*. 2000;74:215-24.
- Palmer K, Bowles K-A, Paton M, Jepson M, Lane R. Chronic Heart Failure and Exercise Rehabilitation: A Systematic Review and Meta-Analysis. *Arch. Phys. Med. Rehabil*. 2018;99:2570-82.
- Baracchini N, Zaffalon D, Merlo M, Baschino S, Barbati G, Pezzuto B, et al. Prognostic value of cardiopulmonary exercise testing repetition during follow-up of clinically stable patients with severe dilated cardiomyopathy. A preliminary study. *Internat J Cardiol*. 2023;131252.
- Stolen KQ, Kempainen J, Ukkonen H, Kalliokoski KK, Luotolahti M, Lehtikainen P, et al. Exercise training improves biventricular oxidative metabolism and left ventricular efficiency in patients with dilated cardiomyopathy. *J American Coll of Cardiol*. 2003;41:460-7.
- Waseem M, Tariq MI, Yaqoob N, Murad S, Amjad I. Effect of lower cycle ergometer on functional capacity of patients with dilated cardiomyopathy. *Rawal Med J*. 2019;44:465-468.