Improved performance on cardiopulmonary exercise testing following DDDR pacemaker adjustment: a case report

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Editor’s key points

- Cardiopulmonary exercise testing is increasingly being used to direct perioperative management of patients undergoing non-cardiac surgery.
- This report highlights the importance of carefully considering pacemaker settings to optimize exercise potential of the patient.

We report a case of improved cardiopulmonary exercise (CPX) test outcomes measured 48 h after initial CPX testing and immediately after alterations were made to the settings of a dual chamber, dual sensing pacemaker with exercise detection. The changes allowed successful abdominal surgery to be completed.

Keywords: exercise test; pacemaker, artificial; postoperative complications

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Introduction

The value of subjecting elective non-cardiac surgery patients to routine cardiopulmonary exercise (CPX) testing is not proven but currently vigorously debated in the anaesthetic literature.1–5 The CPX measurements are used to guide perioperative management directed at more intensive monitoring and support to ameliorate adverse outcomes.1–6 The modification of CPX variables by the manipulation of patient physiology has not been well documented. Changing VVI pacemakers from fixed rate to rate-variable (VVI-Act) has been documented to increase oxygen uptake (VO2) at anaerobic threshold (AT) and peak VO2.7 We report a case of improved CPX test outcomes achieved 48 h after initial CPX testing and immediately after alterations were made to the patient’s pacemaker settings. The change in exercise testing allowed successful abdominal surgery to be undertaken.

Case report

An 81-yr-old patient was referred for anaesthetic assessment prior to proposed large bowel resection. The assessment included CPX testing, as previously described, after a formal history and examination were completed.2 The relevant medical history included hypertension, Type 2 diabetes mellitus requiring insulin, myocardial infarction with angiography and coronary artery bypass grafting 15 yr previously with an anterior STEMI 14 yr ago. He was an ex-smoker of 15 yr with a 40 pack-year history of smoking. His symptoms included exertional dyspnoea limited to 10 m walking but no orthopnoea, paroxysmal nocturnal dyspnoea, chest pain, syncope, or palpitations. Daily medications included aspirin 100 mg, irbesartan 150 mg, hydrochlorothiazide 12.5 mg, amlodipine 5 mg, bisoprolol 1.25 mg, pravastatin 40 mg, traserim nitro 5 mg per 24 h and insulin 40 units in two doses daily.

There were no basal crepitations or wheeze and heart sounds were normal. An electrocardiograph (ECG) showed a dual chamber paced rhythm of 60 bpm. Laboratory investigations indicated normal electrolytes with a raised serum creatinine 136 μmol litre−1. The patient had a mild anaemia; haemoglobin 105 g litre−1.

A dual chamber pacemaker (Medtronic, Adapta ADDR01) had been implanted 4 yr previously for symptomatic third degree AV block. The pacemaker was programmed in DDDR mode (dual chamber sensing; dual chamber pacing; dual chamber inhibition and stimulation of pacing with movement detection), lower rate 60 bpm, upper sensor and tracking rate at 120 bpm.

CPX testing to maximal exertion was carried out on an electronically braked cycle ergometer (CardiO 2; Medical Graphics Corporation, St Paul, MN, USA). Oxygen uptake (VO2) and carbon dioxide (VCO2) output was measured using a breath-by-breath analyser (CPX/D system; Medical Graphics Corporation, St Paul, MN, USA).2

The following parameters were recorded during the exercise test: ECG, workload, oxygen delivery at AT and peak oxygen delivery. All aspects of performance improved with an increase in VO2 and workload at all stages of testing. These changes are given in Table 1.

The pacemaker was reprogrammed prior to the second CPX test. The lower rate was changed to 80 bpm and various other changes made to increase the sensitivity of the pacemaker to detect movement and translate this into a more aggressive increase in heart rate (HR).

The patient underwent resection of a low rectal carcinoma with a Hartmann’s procedure 9 days after CPX testing with...
postoperative monitoring in a High Dependency Unit bed overnight. He was discharged from hospital 12 days later.

**Discussion**

This patient presented for anaesthetic assessment prior to major bowel surgery. The initial CPX test indicated that the patient was not fit for major abdominal surgery. However, the initial slow HR with minimal response to exercise alerted the anaesthetist conducting the CPX test to the possibility of improving the pacemaker settings. The cardiologist responsible for inserting the patient’s pacemaker agreed to optimize the pacemaker settings and to increase the sensitivity of the device to detect exercise. The CPX test completed after adjustment of the pacemaker settings shows increases in all aspects of the CPX test particularly exercise time, workload, VO2 at AT, peak VO2, and HR (see Table 1). The only values that decreased presumably related to the increase in HR observed in the second CPX test were the oxygen delivery per heart beat (VO2/HR) observed in the second CPX after pacemaker adjustment.

There are various mechanisms employed by pacemakers to detect increased metabolic demand and then alter the pacing rate accordingly. This is called rate responsive pacing. The most common is a piezoelectric sensor, also known as an accelerometer. This device detects movement and vibration and translates the signal into an increase in pacing rate. This will tend to give an inadequate response when metabolic demand increases in the absence of movement such as could occur riding a stationary bike or during surgery. In this case, a dual chamber pacemaker with exercise detection modality via an accelerometer was adjusted to sensitively detect exercise and increase HR accordingly.

The two sequential tests indicate that CPX testing can document improvements in physiological measurements related to improving pacemaker activity. This confirms the earlier work of Benditt and colleagues, who demonstrated improved physiological responses to exercise testing after adjustment of a VVI pacemaker. Furthermore, the case illustrates the value of close cooperation between perioperative physicians or anaesthesiologists and cardiologists in ensuring the optimal preparation of patients for major surgery.

We have demonstrated that adjustment of a dual chamber pacemaker to sensitively and reliably detect exercise will improve physiological measurements during CPX testing. Such adjustment increased the physiological parameters to the extent that the risk of open abdominal surgery was acceptable. The patient subsequently underwent uncomplicated major bowel surgery.

**Authors’ contributions**

Data collection and analysis was by C.W., M.C., and S.B.; pacemaker analysis and adjustment was by D.R.; manuscript preparation was by M.C., D.R., and S.B.; manuscript review and correction was by D.R., M.C., and S.B.; figures were prepared by M.C.

**References**


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