

Why use Cardiopulmonary exercise testing for surgical patients?

Major surgery can invoke significant physiological stress resulting in increased global oxygen consumption. Prolonged open surgery can more than double oxygen consumption, with complications possibly raising demand further. Patients unable to sustain increased oxygen demand, can develop oxygen debt and 'functional heart failure' where kidneys, lungs and healing may be compromised.

What is Cardiopulmonary exercise testing (CPET)?

CPET can be useful as an **objective measure** that aims to test how patients cope with raised oxygen demand. It stresses the cardiovascular and respiratory systems, hence is a multisystem examination, able to differentiate a myriad of causes for exercise intolerance. The patient cycles and resistance (or work done) is increased until they cannot continue. Expired gases, ECG, BP and SpO₂ are all measured and recorded throughout the test.

Who is the test most useful for?

1. Major Surgery:
 - a. major open intraabdominal surgery (e.g. cystectomy)
 - b. Major open vascular surgery (e.g. AAA surgery)
 - c. Major intrathoracic surgery (e.g. oesophagectomy)
2. Unexplained breathlessness to differentiate cardiac or respiratory cause
3. Intermediate-risk surgery, where exercise stress testing may help to determine patient suitability for invasive or non-invasive treatment options (e.g. patient frailty)

Who is the test not useful for?

Patients for low-risk surgery or if contraindications exist (see Respiratory Investigation form)

Practicalities at JHH:

If doubt exists about usefulness of test, please contact perioperative anaesthetic consultant in clinic. Alternatively, it can be discussed with Dr Healey (SD 67441) or Dr Eissa (SD 66695).

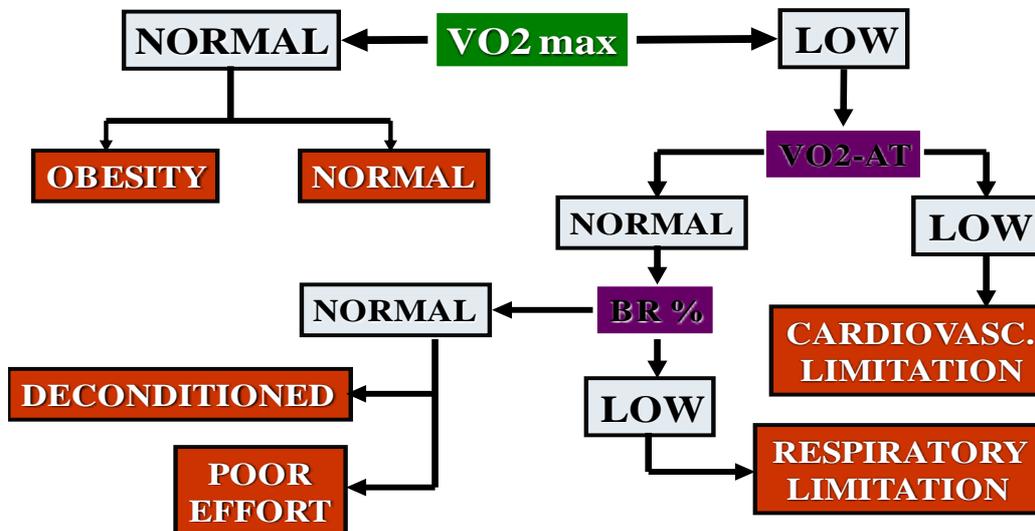
Complete a respiratory investigation form, ensuring no contraindications (as per back of referral form). Tests are performed every Wednesday through John Brannan (Respiratory Scientist). Contact via e-mail (john.brannan@health.nsw.gov.au) or speed dial 64472.

A formal report will always be produced by the respiratory team. Senior perioperative clinic staff (as listed above) may also be able to help with how this influences surgical risk and if optimisation of the patient is possible (see over). Further discussion can also occur at Perioperative special Interest Group meetings (PIG) or the CPET MDT once a month.

Important information test provides:

- Breathing reserve (BR%): difference between predicted & actual maximum ventilation
- VO₂ Peak/Max: oxygen consumption at peak exercise (when patient stops)
- Anaerobic Threshold (AT): oxygen consumption when lactate enters blood
- VE/VCO₂: Measures efficiency of gas exchange which can fall in cardiorespiratory diseases
- Oxygen Pulse: surrogate for cardiac stroke volume (VO₂/ heart rate)

Basic interpretation of findings



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CPET Parameters & Perioperative Risk

Low Risk Category	AT>11mls/Kg/min Peak VO2 >15mls/Kg/min VE/VCO2 @ AT <33	-Likely lower risk of mortality or complications if all 3 present -Further testing unlikely to assist -But optimisation may still be possible
Caution	AT 9-11mls/Kg/min VE/VCO2 @ AT 33-40	-Risk profile depends on surgery type -Perioperative staff can advise: -If further testing is required -If optimisation possible/ necessary
High Risk category	AT <9mls/Kg/min Peak VO2 <14mls/kg/min VE/VCO2 @ AT >40	-Definite higher risk group for major surgery if any of these present -MDT meeting would be advisable to discuss patient options, further testing and optimisation

CPET measurements in ISOLATION are not currently validated as a way of directing care to non-operative means

References or Further reading

1. Anaesthesia Tutorial of the week 217. Cardiopulmonary exercise testing. Drury & Carlisle. <https://www.wfsahq.org/resources/anaesthesia-tutorial-of-the-week>
2. *Introduction to Cardiopulmonary Exercise Testing*. Robertson, Luks & Glennly. Springer 2013
3. Moran J, Wilson F, Guinan E, McCormick P, Hussey J, Moriarty J. Role of cardiopulmonary exercise testing as a risk-assessment method in patients undergoing intra-abdominal surgery: a systematic review. *Br J Anaesth.* 2016 Feb;116(2):177-91.