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HOW TO READ A CPET

Overall CPET eval:
How many watts achieved and why was exercise stopped?
(?dyspnea, ?claudication, ?chest pain, , ?any wheezing)

Review CPET data:
1. **VO2 max** ; defines normal from abnormal exercise tolerance

Next find the system/organ malfunction: pulmonary (ventilatory parameters and ABG) or non-pulmonary (HRR, O2 flow indices, EKG, HRR, BP)

2. **Anaerobic threshold (AT)** (normal=>40% predicted VO2 max)

3. **Heart Rate Reserve (HRR)** (=max HR achived-predicted max HR; pred max HR=220-age) (normally peak exercise is cardiac limited with a HRR<15)

4. EKG and BP

5. O2 FLOW INDICES:

a. **O2 Pulse** (=VO2 max/HR max in ml/beat; correlates with stroke volume)
Preferably calculate normal predicted O2 pulse or use rough rule of thumb of 12 ml/beat for men; 8 ml/beat for women)

b. **Slope of Work efficiency (ΔVO2/ΔWR)** ; check position, slope and linearity. Normals have linear relationship with a slope of 10.2 +/-1.
c. **Slope of heart rate rise (ΔHR/ΔVO2)** ; normally is linear and <50

6. VENTILATORY PARAMETERS:

a. **Breathing Reserve (BR**= MVV-VE max) ; Normally is >15 L/min
b. **Dead space (V_D/V_T)** ; normally is 1/3 of a breath at rest, decreasing to 1/5 of a breath with exercise.
c. **A-a gradient**; PaO2 and P(A-a)O2; normally PaO2 does not decrease with exercise but A-a gradient widens (PAO2 goes up.)
From Wasserman et al. Principles of Exercise Testing and Interpretation. 1994. P161:
P(A-a)O2 normals (mean +/- SD)=

Age	Rest	AT	Peak ex.
20-39	8	11	15
40-69			

Upper limit of normal (95% CI)= 28 at AT and 35 at peak exercise

d. **P(a-et)CO2** ; normally PaCo2 at rest is 2 higher than PetCO2, and decreases to a lower value than PetCO2 with exercise (normal P(a-et)CO2= -0.3 +/-2.9 at rest, -4.1+\-3.2 at peak)
e. **ABG** – metabolic acidosis is normal after AT has been reached. Respiratory acidosis at peak exercise is highly suggestive of ventilatory limitation.

13+/-7 17+/-7 19+/-9

7. Review all graphic data, and optionally review any other paramaters provided during CPET: PFT's, VT, VE/VCO2 at AT, VT/IC, RQ, RR, hemoglobin (?rare additional invasive monitoring data: Swan-Ganz cath, lactate levels, esophageal balloon data.)

Table 6 American Thoracic Society/American College of Chest Physicians: usual cardiopulmonary exercise response patterns

Measurement	Heart failure	COPD	ILD	Pulmonary vascular disease	Obesity	Deconditioned
PVo_2	↓	↓	↓	↓	↓ for actual, N for ideal weight	↓
VAT	↓	N / ↓ /indeterminate	N or ↓	↓	N	N or ↓
Peak HR	Variable, N in mild	↓, N in mild	↓	N /slightly ↓	N /slightly ↓	N /slightly ↓
O_2 Pulse	↓	N or ↓	N or ↓	↓	N	↓
VE/MVV × 100	N or ↓	↑	N or ↑	N	N or ↑	N
VE/Vco_2 at VAT	↑	↑	↑	↑	N	N
VD/VAT	↑	↑	↑	↑	N	N
Pao_2	N	Variable	↓	↓	N/may ↑	N
$P(A-a)o_2$	Usually N	Variable, usually ↑	↑	↑	May ↓	N

COPD, chronic obstructive pulmonary disease; HR, heart rate; ILD, interstitial lung disease; MVV, maximum voluntary ventilation; N, normal; $P(A-a)o_2$, alveolar–arterial difference for oxygen pressure; PVo_2, peak oxygen uptake; VAT, ventilatory anaerobic threshold; VD/VAT, ratio of physiological dead space to tidal volume; VE, minute ventilation; Vco_2, carbon dioxide output.
Adapted from ATS/ACCP Statement on Cardiopulmonary Exercise Testing.[1]