When to Ask for An Exercise Test and What to Do With The Results

John Blakey
Senior Lecturer in Airways Disease, LSTM
Honorary Consultant, Aintree University Hospital
Hello
my name is

John
What?
Measure inspired and expired gas concentrations and volumes

12 lead ECG

Predetermined amount of work
Rest
Unloaded cycling

Load (watts)

Time (minutes)
Why?
Why is this person short of breath?

Which of the known pathologies is the most limiting?

How bad is the objective impairment?

That thing I did last time….did it work?

Are they fit for the procedure?
When?
Dear Doctor,

mean age at referral = 46

Please could you see this 52 year old lady with difficult asthma. She also has diabetes and hypertension.

Medication
Seretide 250 2p bd
Salbutamol 100mcg prn
Amlodipine 10mg od
Aspirin 75mg od
Uniphyllin 200mg od
Prednisolone 10mg od

more than a third had no clear reason for referral

¾ with chronic treated comorbidity

33% at Step 5

Sincerely,

Dr Spock
History
Examination
Simple tests
Exercise test
Question 1

How confident are you in interpreting cardio-pulmonary exercise tests?

1. Not confident
2. I’m happy with the basics
3. Quite confident; I could have a good go at reporting them
4. I am a CPET ninja. Your talk is beneath me, Blakey
Question 2

How many times have you requested a CPET in the last year?

1. Not at all
2. Once or twice
3. Several times
4. I request and report them as part of my regular job
How?
DON'T PANIC
“Discussed at X-ray meeting. Probable LIP.”
Time (minutes) vs. Load (watts) graph showing:
- Rest period from 0 to 2 minutes.
- Unloaded cycling from 2 to 11 minutes, starting at 100 watts and increasing linearly to 200 watts at 11 minutes.
Look at $\text{VO}_2\text{max}$ first

• Best overall measure of fitness
  – Ventilation
  – Diffusion
  – Circulation / oxygen delivery
  – Oxygen extraction in muscles

• All aspects of system need to be functioning normally
  – Including motivation
Look at VO₂ max first
Look at VO$_2$max first

A few people have a very high VO2. Cyclists are at an advantage.
If the VO2max is lower than expected, look at the heart rate

Heart is working really hard

Could be a cardiovascular thing

Heart not working so hard

Could be a lung thing
Heart Disease

Low VO2max

At or near maximum HR

Rapid early rise in heart rate or chronotropic insufficiency

Low oxygen pulse +/- early plateau

 +/- ECG changes
What we measure as uptake here (VO2)
“Oxygen Pulse”

What we measure as uptake here (VO2)...

...must be the same as the uptake here (blood flow times arteriovenous oxygen concentration difference)
"Oxygen Pulse"

\[ VO_2 = Qc \times (C_{(a-v)O_2}) \]
"Oxygen Pulse"

\[ \text{VO}_2 = \text{HR} \times \text{SV} \times (C_{(a-v)}\text{O}_2) \]
“Oxygen Pulse”

So...

\[ \frac{VO_2}{HR} = SV \times (C_{(a-v)O_2}) \]
“Oxygen Pulse”

So...

$VO_2/HR \propto SV$
Pulmonary Vascular Disease

Low VO2max

At or near maximum HR

Rapid early rise in heart rate

Low oxygen pulse

Desaturation

Low AT
Aerobic metabolism

1. Glucose
2. Pyruvate
3. AcetylCoA

- Krebs Cycle
- Electron transport chain

Cytoplasm
Mitochondrion
Aerobic metabolism

Glucose → Pyruvate → AcetylCoA

Cytoplasm

Mitochondrion

Krebs Cycle → Electron transport chain

2 ATP
34 ATP
Aerobic metabolism

Oxygen -> Glucose -> Pyruvate -> AcetylCoA

Cytoplasm

Mitochondrion

Krebs Cycle

Electron transport chain
Anaerobic metabolism

Glucose → Pyruvate → AcetylCoA

Krebs Cycle
Electron transport chain

Oxygen

Cytoplasm
Mitochondrion

2 ATP
Anaerobic metabolism

- Glucose
- Pyruvate
- AcetylCoA
- Lactic acid

Krebs Cycle

Electron transport chain

Cytoplasm
Mitochondrion
Anaerobic metabolism

Glucose → Pyruvate → Lactic acid

Cytoplasm

Plasma
Anaerobic metabolism

Glucose → Pyruvate → Lactic acid

Lactic acid → Lactate → H+
Anaerobic metabolism

Glucose $\rightarrow$ Pyruvate $\rightarrow$ Lactic acid

Lactate $\rightarrow$ H+

Cytoplasm

Plasma

$H^+_{(aq)} + HCO_3^-_{(aq)} \rightleftharpoons H_2CO_3_{(aq)} \rightleftharpoons H_2O_{(l)} + CO_2_{(g)}$
During Exercise

VO2 vs. VO2 Scatter Plot
During Exercise

![Graph showing VO2 and VCO2 during exercise with a trend line and data points.](image-url)
During Exercise

![Graph showing the relationship between VO2 and VCO2 during exercise. The graph includes a scatter plot with a trend line and an elliptical region highlighting a specific area.]
Looking at it another way...
<table>
<thead>
<tr>
<th>AT/VO$_2$max</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-80%</td>
<td>Athletic</td>
</tr>
<tr>
<td>50-60%</td>
<td>Normal</td>
</tr>
<tr>
<td>40-50%</td>
<td>Deconditioned / early disease</td>
</tr>
<tr>
<td>&lt;40%</td>
<td>Disease</td>
</tr>
</tbody>
</table>
Submaximal Effort

- Low VO2max
- Not at maximum HR
- Not at maximum ventilation
- No RCP
Dysfunctional Breathing

Usually low VO2max

Usually not at maximum HR

Chaotic or stereotyped ventilation

Variable RER
RER during exercise

Goes above 1 as CO2 is generated by anaerobic metabolism.
RER during exercise

- Goes above 1 as CO2 is generated by anaerobic metabolism
- …or earlier if CO2 is blown off during hyperventilation
Dysfunctional Breathing

[Graphs and charts showing various parameters such as VE, HR, VO2, VO2/WR, VE/VCO2, R-R interval, and PETCO2 over time.]
You may pick up...

- ILO

- exercise-induced asthma

...but more sensitive tests exist
Cathy suggested we discuss this case to Team.
Summary

• Consider ordering earlier

• Look at more results to improve your pattern recognition skills

• Avoid over-interpretation
12:00 am