HRV – Relevant Conditions

Group 31
Topics Covered

COPD
- Introduction and brief summary
- Significant physiological parameters
- Importance of ECG and PaCO2
- Available technologies for remote monitoring

Sepsis
- Introduction and brief summary
- Parameters monitored
- Invasive vs. non-invasive monitoring
Chronic Obstructive Pulmonary Disease

- 4th most frequent cause of death worldwide
- No definitive cure
- Characterized by **V/Q mismatch**

- Large airways, bronchioles, and lung tissue affected
- Increased release of enzyme elastase
- Destroyed alveolar walls, decrease gas exchange SA
- Air trapping in the lung
- Impaired regional ventilation causes a V/Q mismatch
Remote monitoring COPD

- Continuous monitoring during normal daily activities
- Continuous monitoring during home treatment of mild exacerbations
- Monitoring oxygen therapy
- Monitoring exercise
Significant Physiological Parameters

1. PaCO2
2. PaO2
3. ECG
4. Spirometry
5. Respiration rate
6. Body temperature
7. Blood pressure
8. Weight
Why monitor PaCO2?

- Long term oxygen therapy (LTOT)
- Increase perfusion in poorly ventilated lung areas
- Hypercapnia
- Respiratory failure
How to monitor PaCO₂?

**Problem:**
- Gold standard: ABG
  - Invasive, painful, time-consuming and discrete
- PaO₂ can be derived from by pulse oximetry
- In contrast, PaCO₂ measured from PetCO₂
- BUT this is not a reliable estimate for COPD patients!

**Solution:**
- Transcutaneous monitoring (PtcCO₂)
  - Painless, noninvasive, continuous, minimal disturbance, self-manageable
  - Expensive (device usually shared among patients)
  - 2-min lag for changes in PaCO₂ to be seen in PtcCO₂
Existing Devices & Technologies

SenTec monitor

TCM5 FLEX

V-Sign™

OxiVenT™

Imperial College
London
COPD and Related Cardiac Diseases

- Cardiac failure is the main cause of death for COPD patients
- Arrhythmias and cardiac arrest (observe HR)
- Hypertension, coronary artery disease, breakdown of pulmonary capillaries
- Hypoxemia results in hypoxic pulmonary vasoconstriction
Why monitor ECG?

• Cardiovascular diseases – *most frequent comorbidity* with COPD
• ECG changes can help identify these various cardiovascular diseases
• Provides HR and RR intervals
• Some medications like corticosteroids cause hypertension
ECG Changes

• P wave axis farther right than +75 degrees
• Right ventricular hypertrophy
• Late R wave progression in precordial leads
• Low voltage
• Abnormal Q waves in the inferior or anterior leads
• Acute right bundle branch block
• Changes in corrected QT interval
• Due to: Tachycardia, arrhythmias, AF
Example: Multifocal Atrial Tachycardia

- Rapid irregular rhythm > 100bpm
- At least 3 distinct P wave morphologies
- Associated with *increased mortality in COPD patients*
**Patch ECG (PECG)**

**Benefits:**
- Small and wireless
- Functions even during sleep and taking a shower
- Sends life-threatening events and alarms to clinicians
- Useful for remote monitoring
- Can obtain HR, heart rate corrected QT interval and estimate RR

**Problems:**
- Only 1 lead
- Approximated RR interval is less accurate for elderly
- High cumulative consumer costs
- Data processing time varies depending on company
Existing Devices & Technologies

- Savvy ECG senzor
- ZIO® XT Patch
- SEEQ™ MCT patch device by Medtronic, Inc.
Sepsis
**Sepsis**

- Chemical imbalance during immune response
- Infection of internal organ(s)
- More common in:
  - Pregnant women
  - Children and elderly
- Sepsis → severe sepsis → septic shock
Recognising Sepsis

When it comes to sepsis, remember IT’S ABOUT TIME™. Watch for:

- **T** - Temperature: higher or lower than normal
- **I** - Infection: may have signs and symptoms of an infection
- **M** - Mental Decline: confused, sleepy, difficult to rouse
- **E** - Extremely Ill: severe pain, discomfort, shortness of breath

If you experience a combination of these symptoms: seek urgent medical care, call 911, or go to the hospital with an advocate. Ask: “Could it be sepsis?”

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Recognising Sepsis

**THE SEPSIS SIX**
1. Give O2 to keep SATS above 94%
2. Take blood cultures
3. Give IV antibiotics
4. Give a fluid challenge
5. Measure lactate
6. Measure urine output

**SEPSIS IN ADULTS IS A SERIOUS CONDITION**
that can initially look like flu, gastroenteritis or a chest infection. Sepsis affects more than 250,000 people every year in the UK.

**JUST ASK “COULD IT BE SEPSIS?”**
IT’S A SIMPLE QUESTION, BUT IT COULD SAVE A LIFE.

**ANY ADULT WHO HAS:**
- Sore or boils
- Nausea or vomiting
- Difficulty breathing
- Fever or chills
- Confusion or disorientation

**ANY CHILD WHO:**
- Is breathing very fast
- Has a ‘fit’ or convulsion
- Looks mottled, bluish or pale
- Has a rash that does not fade when you press it
- Is very lethargic or difficult to wake
- Feels abnormally cold to touch

**ANY CHILD UNDER 5 WHO:**
- Is not feeding
- Is vomiting repeatedly
- Hasn’t had a wee or wet nappy in 12 hours

**JUST ASK “COULD IT BE SEPSIS?”**
IT’S A SIMPLE QUESTION, BUT IT COULD SAVE A LIFE.

**MIGHT HAVE SEPSIS**
Call 999 and ask ‘could it be sepsis?’

**JUST ASK “COULD IT BE SEPSIS?”**
IT’S A SIMPLE QUESTION, BUT IT COULD SAVE A LIFE.

**KNOW YOUR SEPSIS SIX.**
1. Give high-flow oxygen
2. Take blood cultures
3. Give IV antibiotics
4. Give a fluid challenge
5. Measure lactate
6. Measure urine output

BY DOING THESE SIX SIMPLE THINGS IN THE FIRST HOUR, YOU CAN DOUBLE YOUR PATIENT’S CHANCE OF SURVIVAL.
Management of Sepsis

Clinical Pathway for Initial Management of Patients With Sepsis

- Decision made to treat patient for sepsis
  - Activate sepsis protocol:
    - 30 mL/kg IV crystalloid fluid bolus (Class II)
    - Serum lactate (Class I)
    - Blood cultures 2 (Class I)
    - IV antibiotics < 1 hour if possible (Class II)
    - Laboratory testing to assess organ function (Class III)
    - Cardiac monitoring
    - Pulse oximetry
    - Monitor fluid balance

- Assess response to treatment:
  - Mental status (Glasgow coma scale score)
  - Skin (mottling, color, temperature)
  - Organ function (e.g., signs and laboratory results) (Class III)

- Fluid responsive? (IVC < 50%, straight-leg raise negative, hypotension recovers after initial fluid bolus) (Class III)

- MAP ≥ 65 mm Hg?
  - Urine output > 0.5 mL/kg/hr?
    - Yes: Consider additional IV fluid bolus if clinical signs of hypovolemia (Class II)
    - No: Consider IV fluid bolus; assess renal function and cause of oliguria and address (Class III)

- Lactate < 2 mmol/L, or lactate clearance ≥ 10%?
  - Yes: Consider additional IV fluid bolus if clinical signs of hypovolemia (Class II)
  - No: Consider IV fluid bolus; assess renal function and cause of oliguria and address (Class III)

- Remeasure lactate:
  - Lactate < 2 mmol/L, or lactate clearance ≥ 10%? (Class III)

- Shock requiring vaspressors > 4 hr and mechanical ventilation:
  - Consider hydrocortisone 200 mg/day IV to shorten duration of shock and mechanical ventilation (Class I)

- Consider ICU admission (Class II)

- Disposition based on clinician judgment, hemodynamic stability, and response to treatment

- Vaspressors required for MAP ≥ 55 mm Hg?
  - Yes: Consider mechanical ventilation in respiratory distress, anaglucia, sedation
  - No: Increase oxygen delivery

- Increase oxygen delivery:
  - Increase cardiac output, improve oxygenation, achieve MAP ≥ 65 mm Hg (Class III)

- Initiate source identification and control:
  - Establish early source control, evaluate for bowel ischemia, necrotizing soft-tissue infection, abscess, empyema, occult sources of infection (consider radiologic studies) (Class III)
  - Consider alternate causes of lactate: Liver/renal disease; DKA, metformin, beta-aggristors (Class III)
  - Complete physical examination
    - Identify potential missed source of infection; reassess perfusion and response to treatment (Class II)

- Remeasure hemodynamics:
  - Adequate MAP ≥ 65 mm Hg: POCUS to assess cardiac function and IVC; consider isotropes and additional IV fluid bolus when indicated (Class III)

Abbreviations: DKA, diabetic ketoacidosis; ICU, intensive care unit; IV, intravenous; IVC, inferior vena cava; MAP, mean arterial pressure; POCUS, point-of-care ultrasonography; IV, intravenous.
Significant Physiological Parameters

- Lactate: >2mmol/L
- ECG: HR, BP
- SpO2, RR: >25 breaths/min
- **MAP**: >65 mmHg
- Urine output: none in >18h
MAP Monitoring: Invasive

• Arterial cannula and saline tubing: conduction to transducer

Figure 1. Components of an arterial monitoring system.

Figure 2. Invasive blood pressure monitoring (boxed). The waveforms are usually colour coded (red for the arterial trace) and the monitor displays the systolic/diastolic BP, with the mean arterial BP in brackets below.
MAP Monitoring: Non-Invasive

- Comfort vs efficiency/accuracy — **trade-off**
- MAP = DP + 1/3(SP − DP) = DP + 1/3(PP)
Questions