HRV Project

Background Research

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Thurs 5th Nov 2020
Contents

1. Physiological systems
2. Heart rate variability (HRV)
3. Cardiorespiratory monitoring
4. Electrocardiogram (ECG)
Physiological systems

Respiratory

Cardiovascular

Transport of substances (nutrients in, waste out)

Measured: RR / breaths per minute
Physiological systems

Blood pressure control
- Force driving blood flow

Thermoregulation
- Body operates at specific temperature range
- Conduction, convection, radiation, evaporation
- Vasoconstriction vs vasodilatation

Maintenance at specific values
Heart Rate Variability (HRV)

**Underlying Physiology**

- **Hypothalamus**
  - Receives information and processes it.
  - Includes info from hormones, senses, nerves etc.

- **Autonomous Nervous System**
  - Sympathetic and Parasympathetic Nervous Systems

**Response**

- Heart rate either goes up or down.
- BP changes accordingly.
- Temperature matches response.
Heart Rate Variability (HRV)

Measurements and Reference Range

1. RR intervals
2. Difference between consecutive RR intervals.
3. Mean

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Gender</th>
<th>ln(RMSSD)</th>
<th>HRV Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-25</td>
<td>Male (337)</td>
<td>4.46 ± 0.55</td>
<td>68.68 ± 8.52</td>
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<tr>
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<td>Female (89)</td>
<td>4.23 ± 0.65</td>
<td>65.09 ± 9.99</td>
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<td>25-35</td>
<td>Male (1936)</td>
<td>4.19 ± 0.63</td>
<td>64.48 ± 9.69</td>
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<td>Female (327)</td>
<td>4.02 ± 0.69</td>
<td>61.83 ± 10.59</td>
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<td>35-45</td>
<td>Male (3099)</td>
<td>3.92 ± 0.64</td>
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<td>3.82 ± 0.68</td>
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<td>3.46 ± 0.72</td>
<td>53.27 ± 11.07</td>
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<td>65-75</td>
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<td>3.42 ± 0.83</td>
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<td>Female (26)</td>
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<td>49.35 ± 11.10</td>
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<td>75+</td>
<td>Male (35)</td>
<td>3.50 ± 0.98</td>
<td>53.88 ± 15.09</td>
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<td>Female (2)</td>
<td>3.24 ± 1.09</td>
<td>49.85 ± 16.79</td>
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</table>
Heart Rate Variability (HRV)

Significance

- Stress
- Physical Activity & Fitness
- Breathing
- Hormones

Stress
Physical Activity & Fitness
Breathing
Hormones
Why is Cardiorespiratory (CR) Monitoring important?

- Avoid more life-threatening conditions that may be present (arrhythmia).
- Portable cardiac monitoring allows physicians to monitor patients while patient is at home in real-time (in house CCM).
These start-ups emerged as a consequence of the current pandemic as patients with heart conditions are particularly vulnerable to COVID-19.
Importance of CR Monitoring in the ICU

Most basic monitors show:

In critical care, daily monitoring is essential.

Interest: Temperature monitoring

Different body sites, different temperature

Recommended in ICU: Urinary, esophageal or nasopharyngeal
Function and relationship with respiratory and CV system

- Used in ambulances, emergency departments, ITU, neonatal ICU, etc. [1]
- Monitoring of patient state or condition [1]
- Identification/Diagnosis of underlying diseases such as arrhythmia, apnea and hypoxemia
- Direct the decision of appropriate treatment [2]
- Monitoring foetal heart and respiratory conditions during gestation and labour using Doppler ultrasound technology [1]
- Monitoring the condition or assessing the cardiorespiratory ability of athletes during training
- Warning medical staff of abnormalities in patient condition (e.g. parameters outside normal set values) through an alarm [2]
Companies making cardiorespiratory monitors [1,2]:

- Abbott
- GE Healthcare
- Hill-Rom
- Medtronic
- Philips Healthcare
- St. Jude Medical
- Boston Scientific
- Edwards Lifesciences
- Johnson & Johnson
- Getinge
- Terumo
- W.L.Gore & Associates
- Lepu Medical Technology

Types of Cardiorespiratory Monitors:

1. Bedside Monitors
2. Insertable Cardiac Monitor (ICM)
3. Wearable Cardiac Monitors (e.g. for sports): Apple Watch, Garmin, Fitbit, Samsung, etc.
4. Diagnostic ECG
5. Ambulatory Monitors
Features and Examples of Cardiorespiratory Monitors

**Parts**: monitor or screen, cables, electrode patches, pressure transducers, pulmonary artery catheter, arterial blood saturation probe, blood pressure cuff, printer, alarms [1] and sometimes defibrillators [2]

**Displays and records** the electrical and pressure waveforms and parameters of the cardiorespiratory system of the patient such as heart rate, ECG, cardiovascular pressures, cardiac output, blood temperature and oxygen saturation levels [1]

Confirm Rx ICM (Abbott) [2]  
CARESCAPE ONE Monitor (GE Healthcare) [3]
ECG: Clinical Importance

- Identify arrhythmias (irregular heartbeats)
- Determine overall health of heart before procedures (e.g. surgery)
- Determine health of heart after treatment for conditions such as a heart attack (myocardial infarction), or endocarditis (inflammation or infection of one or more heart valves)
- Used to get a baseline tracing of heart function during a physical exam to compare in with future ECGs
Health care professionals look for different features in an ECG which can indicate different issues. Differences in amplitude, frequency and shape are looked at.

**Examples include:**
- Changes in shape of P wave - mitral or pulmonary stenosis
- Changes in the interval between P and R wave – first degree atrioventricular block or pre-excitation
- Wide QRS complexes (>0.12s) - bundle branch block, hyperkalaemia, aberrant ventricular conduction.
- Loss of R wave amplitude – myocardial infarction

![Normal and abnormal R-wave progression](image.png)
ECG: Variations in Heart Rate

- Tachycardia
- Atrial Fibrillation
- Bradycardia
- And many more...
Thanks for listening!

Questions?