BIOE221

- Session 2
- Vital Signs
- Biosciences Dept.
Session Objectives cont

- Understand the physiology related to the vital signs of temperature, pulse, respiration and blood pressure.
- Perform various physical examinations inclusive of:
  - General Survey
  - Vital Signs (Temperature, Pulse, Respiration, & BP)
Vital Signs

There are 4 vital signs (T,P,R,BP)

Temperature
Pulse
Respiration
Blood Pressure

Baseline observation of vital signs should be performed on all patients. Changes to the vital signs in terms of the reference ranges or qualities may indicate disease or disorder.
Temperature

Body temperature is regulated by the hypothalamus. A stable core temperature of 37.2°C is optimal for metabolism and is achieved by balancing heat production and loss.

**Heat Production**
- Metabolism
- Exercise
- Food digestion
- External factors

**Heat loss**
- Radiation
- Evaporation / sweat
- Convection
- Conduction
Sites for Taking a Temperature

The temperature can be taken via the oral, axilla, rectal or tympanic routes. In clinical routine clinical practice the most commonly used routes are”

- **Oral** – mercury in glass or digital thermometer (35.8-37.3°C)
  - Accurate and convenient – 2 minutes
  - Not after hot/cold drinks or smoking

- **Ear** – tympanic membrane thermometer
  - Measures infra-red emissions from tympanic membrane
  - 2-5 seconds
  - Safe/ quick/ good for all ages
Changes in Temperature

Hyperthermia (fever) - >37.4°C
- Pyrogens secreted by
  - Toxic bacteria - infection
  - Tissue breakdown e.g. from trauma, surgery, heart attack, cancer
- Neurological conditions that can “reset” the thermostat higher
  - e.g. stroke, cerebral oedema, brain trauma/ tumour/ surgery
- Over-exposure to heat
  - Heat exhaustion/ heat stroke

Hypothermia - <35.5°C
- Usually due to accidental prolonged exposure to cold
  - 30 -32°C → loss of consciousness
  - 28°C → heart failure / death
Pulse Rate

- As the heart contracts it pumps blood into the Aorta. This bolus of blood is known as the stroke volume, and is about 70mls in the average adult.

- The force of the stroke volume against the arterial walls creates a pulse wave, which can be felt as the pulse by palpating peripheral arteries.

- Pulse is strongest in the arteries closest to the heart, weaker in the arterioles, and disappears in the capillaries.
# Pulse Ranges & Interpretation

<table>
<thead>
<tr>
<th>AGE</th>
<th>RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neonates 0 – 1 month</td>
<td>70 – 190 bpm</td>
</tr>
<tr>
<td>Infants 1 – 11 months</td>
<td>80 – 160 bpm</td>
</tr>
<tr>
<td>Children 1 – 2 years</td>
<td>80 – 130 bpm</td>
</tr>
<tr>
<td>Children 3 – 4 years</td>
<td>80 – 120 bpm</td>
</tr>
<tr>
<td>Children 5 – 6 years</td>
<td>75 – 115 bpm</td>
</tr>
<tr>
<td>Children 7 – 9 years</td>
<td>70 – 110 bpm</td>
</tr>
<tr>
<td>Children &gt;10yrs – Adults</td>
<td>60 – 100 bpm</td>
</tr>
<tr>
<td>Well-trained athletes</td>
<td>40 – 60 bpm</td>
</tr>
<tr>
<td><strong>Tachycardia (in adults)</strong></td>
<td><strong>&gt;100 bpm</strong></td>
</tr>
<tr>
<td><strong>Bradycardia (in adults)</strong></td>
<td><strong>&lt;60 bpm</strong></td>
</tr>
</tbody>
</table>

Variables of a Pulse

- **Rate** (beats per min) – Count for 30 secs x 2 if regular

- **Rhythm** (regular or irregular)

- **Force** (stroke volume)
  - 0 = absent
  - 1+ = weak or thready
  - 2+ = normal
  - 3+ = full or bounding

- **Elasticity** (of the arterial wall)
Radial Pulse
(Jarvis 2004)

The radial pulse lies medial to the radius and lateral to the palmaris longus tendon, at the wrist.

- Locate the palmaris longus tendon which is aligned to the 3rd phalanx.
- Place the pads of 2 or 3 fingers in the groove between the radius and the palmaris longus tendon. Count the beats for 15 secs x 4 if regular, or for a full minute if irregular.
Respiration Rate

- Normal respiration is relaxed, regular, automatic and silent

- When counting respirations, do so unobtrusively as rate may change once the patient becomes aware that your counting. Observe the rise and fall of the chest.

- Count for 30 seconds (x2) or 60 seconds

- Record as respirations per minute
Respiration Rate

- 3 variables need to be observed:
  - Rate (breath /minute)
  - Rhythm (regular or irregular)
  - Effort (relaxed or forced)

- Normal range:
  - Adults: 10-20 BPM
  - Teens: 12-22 BPM
  - Neonate: 30-40 BPM
Blood Pressure (BP)

- Blood pressure is the hydrostatic pressure exerted by blood on the walls of the blood vessels during contraction of the ventricles. It is recorded as systolic / diastolic mmHg.
  - Systolic blood pressure - maximum pressure exerted on the arterial wall during left ventricular contraction
  - Diastolic blood pressure - minimum pressure exerted on the arterial wall between contractions
  - Pulse pressure - difference between systolic and diastolic and reflects the stroke volume
  - Mean arterial pressure - the pressure forcing blood into the tissues
  - Peripheral resistance the total resistance against which blood must be pumped
Blood Pressure in various blood vessels

(Tortora & Derrickson, 2009)
Control of Blood Pressure

- BP changes with daily activity/ position changes/ emotions
- Regulation mechanisms to maintain ‘normal’ blood pressure are
  - Cardiovascular centre in brain stem
    - regulates heart rate/ force of contraction of ventricles/ blood vessel diameter
  - Nervous system regulation
    - baroreceptors
    - chemoreceptors
  - Hormone regulation
    - adrenaline/ noradrenaline (↑ HR & vasoconstriction)
    - ADH & ANP
  - Autoregulation
    - local automatic adjustment of blood flow to match tissue needs
5 Factors Affecting Blood Pressure

- **Cardiac output (stroke volume x heart rate)**
  - as heart pumps more blood into blood vessels, the pressure on the vessel walls increases

- **Peripheral vascular resistance**
  - opposition to blood flow through arteries
  - increased pressure needed to push blood through constricted blood vessels

- **Circulating blood volume**
  - the greater the volume of blood in the vessels, the higher the BP

- **Blood viscosity**
  - when blood is thicker, BP will increase

- **Elasticity of arterial walls**
  - decreased elasticity increases BP
Blood Pressure Readings

Average adult BP – approx 120/80 mmHg
Varies with:

- Age
  - normally gradual rise through childhood into adulthood
- Gender
  - females lower between puberty and menopause
- Race
  - Afro-Americans - hypertension
- Diurnal rhythm
  - early morning low
  - peak late afternoon/ early evening

- Weight
  - BP rises in the obese – more blood vessels
- Exercise
  - BP increases proportionately with exercise
- Emotions
  - BP rises with fear, anger, pain
  - (SNS stimulation)
- Stress
  - continual stress can elevate BP
## BP Values and Hypertension

<table>
<thead>
<tr>
<th>Diagnostic category*</th>
<th>Systolic (mmHg)</th>
<th>Diastolic (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>&lt; 120</td>
<td>&lt; 80</td>
</tr>
<tr>
<td>High-normal</td>
<td>120–139</td>
<td>80–89</td>
</tr>
<tr>
<td>Grade 1 (mild) hypertension</td>
<td>140–159</td>
<td>90–99</td>
</tr>
<tr>
<td>Grade 2 (moderate) hypertension</td>
<td>160–179</td>
<td>100–109</td>
</tr>
<tr>
<td>Grade 3 (severe) hypertension</td>
<td>≥ 180</td>
<td>≥ 110</td>
</tr>
<tr>
<td>Isolated systolic hypertension</td>
<td>≥ 140</td>
<td>&lt; 90</td>
</tr>
<tr>
<td>Isolated systolic hypertension with widened pulse pressure</td>
<td>≥ 160</td>
<td>≤ 70</td>
</tr>
</tbody>
</table>

(National Heart Foundation of Australia, 2008)
Preparation for BP measurement

- You will need
  - Sphygmomanometer with an appropriate cuff size for the patients arm.
  - Stethoscope.
  - Quiet, relaxing atmosphere.
  - Chair / couch/ bed.
  - Client must be seated or lying – arm exposed and supported at the level of the heart with legs uncrossed.
  - Patient should be rested for at least 15 minutes before taking the blood pressure.
BRACHIAL PULSE
Located medial to the biceps tendon in the antecubital fossa. The stethoscope is placed over the point where the pulse is felt.

(Jarvis, 2004)
Relationship of BP changes to cuff pressure

Pressure in the cuff

Systolic blood pressure (first sound heard)

Diastolic blood pressure (last sound heard)

(Tortora & Derrickson, 2009)
Common errors affecting accuracy of BP Measurement

- Incorrect cuff position
- Too high inflation of cuff
- Too rapid deflation of cuff
- Erratic cuff deflation
- Pressing stethoscope on brachial artery too hard
- Defective equipment
- Noisy environment
- Hearing problems
  - White coat syndrome
- Inappropriate timing of measurement the client may be
  - Stressed e.g. rushing in at the last minute
  - Had caffeine consumption
  - Been smoking
  - Have been involved in heavy physical activity
The auscultatory gap is a brief period of time when the Korotkoff sounds cannot be heard. This will most often occur in hypertensive patients and may result in the incorrect determination of a normotensive BP result.

To avoid this:

- For all patients for whom you are not familiar with, always obtain the systolic pressure by palpation first, before obtaining the BP by auscultation.
- If you find an auscultatory gap be sure to document this in the patient's clinical notes. By doing so, you can account for the auscultatory gap in future blood pressure readings without the need for the palpatory systolic first.
Lying & Standing BP measurement

- Performed when the patient presents with a history of dizziness or fainting. Used to determine orthostatic (Postural) hypotension

  - Causes:
    - Abrupt idiopathic vasodilation
    - Postural changes following prolonged bed-rest
    - Elderly
    - Hypovolaemia (blood loss or dehydration)
    - Medications (antihypertensives)
    - Neurological conditions
Abnormalities in Blood Pressure

- Hypotension – abnormally low BP
  - In normotensive adults - < 95/60 mmHg
  - In hypertensive adults – the person’s average reading, but may be > 95/60 mmHg

- Orthostatic hypotension (postural hypotension)
  - Drop in systolic BP > 20mmHg (+/- increase in pulse of 20 bpm) with quick change to standing position

- Hypertension
  - Common, often asymptomatic disorder characterised by elevated blood pressure persistently exceeding 140/90mmHg
References

- National Health & Medical Research Council (2013). *Clinical Practice Guidelines for Management of Overweight and Obesity in Adults, Adolescents and Children in Australia*. Melbourne: NHMRC.
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