34th Annual BACCN Conference
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Moral Courage: Meeting the Challenges of a Contemporary Healthcare System

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The ABC of Obesity in Critical Care

Dr. Louise Stayt
Aim

• The aim of this workshop is to explore the impact of obesity on airway, breathing and circulation and discuss the clinical implications and management.
Learning Outcomes

• By the end of the session the delegate will be able to:
  – Discuss the extent of obesity in the UK
  – Define and classify obesity
  – Define and discuss Metabolic Syndrome and its pathophysiology
  – Discuss the physiological and clinical implications of obesity on the airway, breathing and cardiovascular system
  – Discuss the clinical management of the obese patient in critical care
Globesity

13% of adults are obese (BMI >30)

Global obesity has tripled since 1975

39% of adults are overweight (BMI > 25-29)

13% of adults are obese (BMI >30)

(World Health Organisation 2019)
Definition of Obesity

- “Overweight and obesity are defined as "abnormal or excessive fat accumulation that presents a risk to health". (WHO 2019)
## Classification of Obesity

<table>
<thead>
<tr>
<th>BMI classification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt; 18.5</td>
</tr>
<tr>
<td>Normal range</td>
<td>18.5 - 24.9</td>
</tr>
<tr>
<td>Overweight</td>
<td>≥ 25.0</td>
</tr>
<tr>
<td>Preobese</td>
<td>25.0 - 29.9</td>
</tr>
<tr>
<td>Obese</td>
<td>≥ 30.0</td>
</tr>
<tr>
<td>Obese class I</td>
<td>30.0 - 34.9</td>
</tr>
<tr>
<td>Obese class II</td>
<td>35.0 - 39.9</td>
</tr>
<tr>
<td>Obese class III</td>
<td>≥ 40.0</td>
</tr>
</tbody>
</table>

(WHO 2019)
# Obesity Statistics UK, 2019

## BMI Category by Gender

<table>
<thead>
<tr>
<th>Category</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>37%</td>
<td>31%</td>
</tr>
<tr>
<td>Overweight</td>
<td>31%</td>
<td>40%</td>
</tr>
<tr>
<td>Obese</td>
<td>30%</td>
<td>27%</td>
</tr>
</tbody>
</table>

## BMI Category by Age

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Obese</th>
<th>Overweight</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>16-24</td>
<td>15%</td>
<td>23%</td>
<td>57%</td>
</tr>
<tr>
<td>25-34</td>
<td>22%</td>
<td>34%</td>
<td>41%</td>
</tr>
<tr>
<td>35-44</td>
<td>29%</td>
<td>37%</td>
<td>33%</td>
</tr>
<tr>
<td>45-54</td>
<td>36%</td>
<td>36%</td>
<td>27%</td>
</tr>
<tr>
<td>55-64</td>
<td>34%</td>
<td>39%</td>
<td>27%</td>
</tr>
<tr>
<td>65-74</td>
<td>33%</td>
<td>43%</td>
<td>24%</td>
</tr>
<tr>
<td>75+</td>
<td>31%</td>
<td>41%</td>
<td>27%</td>
</tr>
</tbody>
</table>

( Commons Library, 2019 )
Pathophysiology of Obesity

I’m lovin’ it
Metabolic Syndrome

• Presence of diabetes mellitus/ impaired glucose tolerance/ insulin resistance
• And two of the following:
  – Hypertension
  – Dyslipidaemia
  – Abdominal Visceral Fat
  – Microalbuminuria
Abdominal Visceral Fat

- AVF secretes hormones and inflammatory peptides:
  - Adipocytokines (Adipokines)
Adipokines are cell signalling proteins secreted by adipose tissues.
Adipokines

- Insulin Resistance
- Atherosclerosis
- Hypertension
- LVH
- Angiotensinogen
- Plasminogen Activator Inhibitor-1
- Leptin
- Hypercoagulation
- Interleukin-6
- Tumour Necrosis Factor α
- Resistin
- Altered Cardiac Contractility
- Cardiomyocyte hypertrophy
- Insulin resistance
- Atherosclerosis
- Insulin Resistance
- Atherosclerosis
Clinical Manifestations

- Hypertension
- Cardiomyopathy- Left Ventricular Hypertrophy
- Atherosclerosis- Increased MI and CHD
- Insulin resistance- Diabetes Mellitus
- Hypercoagulation- Increased VTE
Obesity in Critical Care

• 26% of patients in critical care are obese (Shashatya et al. 2015)
• Controversy over impact of obesity on ICU associated complications and mortality
• Obesity increases risk of respiratory and cardiovascular complications associated with critical illness (Bell et al. 2017; Bradley et al. 2016)
• Obesity associated with increased mortality but only in the presence of co-morbidity (Abhyankar et al. 2012)

• Significantly increases nurses work load (Carrara et al. 2015) 😊
Airway: Physiological changes

- Increased facial fat
- Increased parapharangeal fat
- Reduced thyromental distance

(Brusco et al. 2015)
• What are the clinical implication of these changes?

• How might we manage them?
Airway: Clinical Implications

- Obstructive Sleep Apnoea
- Compromise mask fit for oxygen and NIV
- Increased grade of intubation (Lundstrom et al. 2009; De Jong et al. 2015)
- Increased susceptibility to hypoxia (Juvin et al. 2003)
- Reduced safe apnoea time (Shashaty et al. 2014)
Clinical Management of Airway

- Difficult Airway Risk Assessment
- Pre-oxygenation prior to intubation with CPAP of 10cm H$_2$O
- 30º Reverse Trendelenberg
- Fibreoptic at the ready?

(Juvin et al. 2003; Simpson et al. 2012; Clayton et al. 2017)
Breathing: Pathophysiology

- Excess metabolically active adipose tissue
  - Increased CO$_2$ production
  - Increased O$_2$ consumption
- Reduced lung compliance
- Diaphragm shift cephalad
- Reduced functional residual capacity (FRC) and expiratory reserve volume (ERV)
• What are the clinical implication of these changes?

• How might we manage them?
Breathing: Clinical Implications

- ↑Work of breathing
- ↑ Closing capacity
- ↑ Atelectasis
- ↑ Risk of ventilator induced injury
- ↑ Risk of ARDS
- ↓Respiratory muscle endurance
- Hypercarbia
- Bronchoconstriction- expiratory flow limitation
- Obesity Hypoventilation Syndrome
- Obstructive Sleep Apnoea

(Brusco et al. 2015; Shashaty et al. 2014; Lederer et al. 2011)
Clinical Management of Breathing

• No evidence based consensus of optimal mechanical ventilation strategy
• Careful consideration of $V_T$ and PEEP in mechanical ventilation (Pfeilsticker et al. 2017; Koutsoukou et al. 2004)
• Apply recruitment manoeuvres (Clayton et al. 2017)
Cardiovascular: Pathophysiology

- Neovascularisation
- $\uparrow$ blood volume
- $\uparrow$ CO ($\uparrow$ stroke volume)
- LV hypertrophy
- Right sided failure
- ECG abnormalities
- $\uparrow$ Sympathetic activity
- Atherosclerosis
• What are the clinical implication of these changes?

• How might we manage them?
Cardiovascular: Clinical Implications

- Reduced reserve capacity of the cardiovascular system
- Increased instability of cardiovascular system
- Increased risk of cardiovascular events
- Increase risk of VTE
- Increased pulmonary vascular resistance
- Underestimated fluid resuscitation volumes

(Winfield et al. 2010; Chahal et al. 2012; Brusco et al. 2015; Shashaty et al. 2014)
Clinical Management of Cardiovascular

• No consensus of fluid management strategy for the obese
• Need to develop fluid resuscitation protocol to account for BMI associated changes in blood volume (Winfield et al. 2010)
  • NICE?
  • Sepsis guidelines?
  • VTE prophylaxis
Obesity Paradox

• Some evidence demonstrates a trend for better survival in overweight/obese patients with critical illness, trauma or undergoing surgery (Pan et al 2017; Kramer 2019; Chowdury et al 2018)

• Hedge our bets?
Thank you!

- Enjoy you Dinner!
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