Obesity and Anaesthesia

Western General Hospital.
Friday 10\textsuperscript{th} March 2006.
Obesity: Topics

- Definition
- Incidence.
- Pathophysiology
- Pharmacokinetics.
- Anaesthesia.
- Bariatric Surgery.
Definition 1

- Body Mass Index (BMI) is generally used.
- BMI = Weight in kg / Square of Height in m.
- Ranges of BMI (definitions differ):
  - Under 20: Underweight.
  - 20 to 25: Correct weight.
  - Over 25: Overweight (WHO).
  - Over 30: Obese (WHO).
  - Over (35) 40: Severely Obese.
  - (Over 55: Super-morbidly obese).
Definition 2

- Can estimate ideal body weight (IBW) using
  - Men: 49.9kg + 0.89kg/cm above 152.4cm
  - Women: 45.4kg + 0.89kg/cm above 152.4cm
- IBW is compared with total body weight (TBW).
- Normal range is within 10% of IBW.
- Obesity defined as weight 20%, or greater, above IBW.
- Relevant when considering drug dosage.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Males</th>
<th>Females</th>
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<tbody>
<tr>
<td>16-24</td>
<td>7.3</td>
<td>7.7</td>
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<tr>
<td>25-34</td>
<td>15.5</td>
<td>19</td>
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<td>35-44</td>
<td>19.9</td>
<td>20.4</td>
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<td>45-54</td>
<td>28.8</td>
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<td>55-64</td>
<td>23</td>
<td>31.5</td>
</tr>
<tr>
<td>65-74</td>
<td>26.6</td>
<td>30.5</td>
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Why is Obesity relevant?

- Over 30,000 deaths a year in England alone.*
- Adult obesity rates have almost quadrupled in the last 25 years.*
- 22% of Britons are obese and three-quarters are overweight*.
- The number of obese children has tripled in 20 years*.
- Morbidity and Mortality associated with disease.
- Increased anaesthetic risk.

Causes of Obesity

- Excess of caloric intake over expenditure.
- Genetic predisposition. Significance.
- Diet. Dietary fat content, alcohol.
- Culture. Socioeconomic status (10% in class I, 25% in class V).
- Pathological Conditions:
  - Syndrome X.
  - Hypothyroidism.
  - Cushing's Disease, exogenous steroids.
Associated Diseases

• Relative risks of disease in the obese.
  – RR>3: NIDDM, Gall Bladder Disease, Hypertension, Hyperlipidaemia.
  – RR 2 to 3: Coronary Artery Disease, OA knee, Gout.
  – RR 1 to 2: Breast, endometrial, colon cancer. Low back pain.
Regulation of Body Weight

- **Satiety Centre**: Ventromedial Hypothalamus.
- **Feeding Centre**: Lateral Hypothalamus.
- **Central, Appetite stimulating**: Neuropeptide Y, Agouti related peptide, Melanin-concentrating hormone, Orexin A/B, Galanin, Syndecan.
- **Central, Appetite-inhibiting**: Serotonin, NE, CRH, α-MSH, Cocaine and amphetamine regulated transcript, “Mahogany”.
- **Many peripheral factors**: Nutrients, hormones (PYY, CCK), GI chemo/mechanoreceptors. Insulin, Leptin, Ghrelin.
- **β₃ adrenoreceptors**: Thermogenesis, lipolysis. Brown/white adipose cells. Relevance to long term Rx in humans.
Regulation of Body Weight

Insulin resistance

Muscle & Liver

Resistin

Endocrine

β adrenoreceptor

oestrogen

GH

α adrenoreceptor

Adipocyte

Leptin

Gastrointestinal tract

CCK

PYY

Hypothalamus

Neuropeptide Y +

Serotonin -
	norepinephrine -

Ghrelin

Anaesthesia 60 1009
Pathophysiology

- Increase in lean and total body mass, disproportionate increase in fat.
- Increased CO and Oxygen consumption.
- Respiratory compromise.
- GI changes, aspiration risk.
- Changes in immune function and coagulation: a “smoldering inflammatory state”.
Cardiovascular Pathophysiology

- Increased CO and Oxygen consumption.
- “Obesity Cardiomyopathy”. Increased stroke volume; further increases in CO met by inc HR.
- Atrial arrhythmias.
- High incidence of IHD, HT, sudden death.
- Aortocaval Compression.
- Increased risk of thromboembolism.
Respiratory Pathophysiology

- Increased metabolic demand.
- Worsening of spirometric parameters; FRC, Expiratory Reserve Vol., TLC.
- Closing Capacity encroaches on tidal volume. Less severe with PEEP/ CPAP/ Epidural Anaesthesia.
- Increased work of breathing, up to *4 in supine position.
- High frequency of post-op resp complications.
- High incidence of OSA, apiration, ...
Obstructive Sleep Apnoea

- 4% of the population, higher in the obese.
- Physical collapse of the pharyngeal airway during sleep; inhalation against a partially occluded airway.
- OSA: Five episodes/h during sleep of obstructive apnoea (10s). Desaturations.
- Other Sy's: Daytime sleepiness, Fatigue, depression, headaches, impotence, enuresis.
- Associations: Hypertension, Stroke, IHD, Cardiac Arrhythmias, Pulmonary HT, Cor Pulmonale.
Other Pathophysiology

- GI: high incidence of reflux disease and hiatus hernia.
- Increased renal blood flow and GFR.
- Impaired Glucose Tolerance.
- Increased inflammatory mediators. TNF$\alpha$, IL-6, elevated CRP.
- Thrombogenic state.
Pharmacokinetics

- High proportion of fat, though lean body weight is also increased.
- Consider fat solubility, Volume of distribution.
- Consider clearance.
- Thiopentone/ Propofol: use TBW.
- Benzodiazepines: load on TBW, maintain on IBW.
- Muscle relaxants: Use IBW.
- Sevo/ Des relatively insoluble, so more flexible.
Assessment

- BMI
- Airway
- RS co-morbidity. Symptoms of OSA?
- CVS co-morbidity.
- Vascular Access.
- Plan technique.
- Prepare/ warn theatre.
- Site epidurals the day before?
Regional Techniques

- Spinal/ Epidural/ CSE.
- Potential for much less disturbance of respiratory function.
- Technical difficulties.
- USS and X-Ray assisted catheter placement.
- May need to decrease drug dose by 20 to 25%.
Day Case
- Obesity is no longer a contra-indication. No BMI cut-off (AAGBI, 2005). Judgement, local protocol.

Pre-medication
- Sedative pre-medication is best avoided.
- Acid aspiration prophylaxis in morbidly obese even if asymptomatic.
- Thrombo-embolism prophylaxis.
- Antibiotic Prophylaxis.
Conduct of Anaesthesia 2

• Positioning
  – Large/ multiple tables.
  – Anaesthetise on the table, in theatre.
  – Pressure sore prevention.
  – IVC compression: lateral tilt/ lateral decubitus.
  – Sufficient staff and equipment for safe transfer and movement.
Conduct of Anaesthesia 3

- IV Access. Ultrasound guidance, CVC.
- Usual monitoring standards apply.
- NIBP vs invasive BP. Cuff Size.
- Choice of induction drugs and dosage.
- Airway management
  - RSI.
  - Awake fibre-optic techniques.
  - pre-oxygenate using PEEP?
- Multiple Anaesthetists.
Conduct of Anaesthesia 4

- Drugs during maintenance phase.
- PEEP.
- Reverse Trendelenberg.
- Extubation.
  - Awake.
  - Sit at 45 degrees.
  - CPAP?
- Judicious opioids, other analgesics, regional.
- HDU/ ICU
Bariatric Surgery

- Surgery to promote weight loss.
- Prospect of successful long term weight loss.
- Increasing frequency.
- Considered when BMI > 40 or BMI > 35 with severe associated disease (e.g. OSA).
- Surgery may aim to
  - Restrict gastric capacity.
  - Introduce an element of malabsorption.
- Associated mortality.
Figure 1. Estimated Number of Bariatric Operations Performed in the United States, 1992–2003.
Data are from the American Society for Bariatric Surgery.
Vertical Banded Gastroplasty

- Restrictive Surgery.
- 80% lose some weight, 30% reach normal weight.
- 40 to 63% loss of excess weight over three years.
- Nausea, heartburn, pain.
- <= 1% mortality.
Gastric Bypass

- Second commonest surgery after VBG.
- Restriction: Stomach pouch.
- Malabsorption: Bypass between stomach and ileum or jejunum.
- Improved weight loss but dumping, malabsorption.
Gastric Banding

- Restrictive.
- Less complex surgery. Laparoscopic.
- Adjustable versions exist.
- Long term results awaited.
- Reflux.
Bariatric Surgery: Pros and Cons

- Best chance of long term weight loss. Most regain some weight.
- Frequent improvement in obesity-related medical conditions.
- Enhanced quality of life.
- Up to 10%: Infection, bleeding, Resp complic'ns, Thromboembolism, Splenic/ gut injury, Gallstones.
- 10 to 20%: Further surgery (e.g. hernia).
- Malabsorption, nutritional deficiency.
- Death: 0.17%.
Conclusions

- Obesity is increasingly prevalent.
- Anaesthesia carries increased risk when BMI is greater than 30.
- Consequences of obesity and associated comorbidities present anaesthetic challenges. CVS, RS, GIS systems are affected.
- Planning is required to meet anaesthetic challenges.
- Bariatric Surgery increasingly performed in US...
End.