

# Obesity and Anaesthesia

Western General Hospital.  
Friday 10<sup>th</sup> March 2006.

# Obesity: Topics



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

# Definition 1

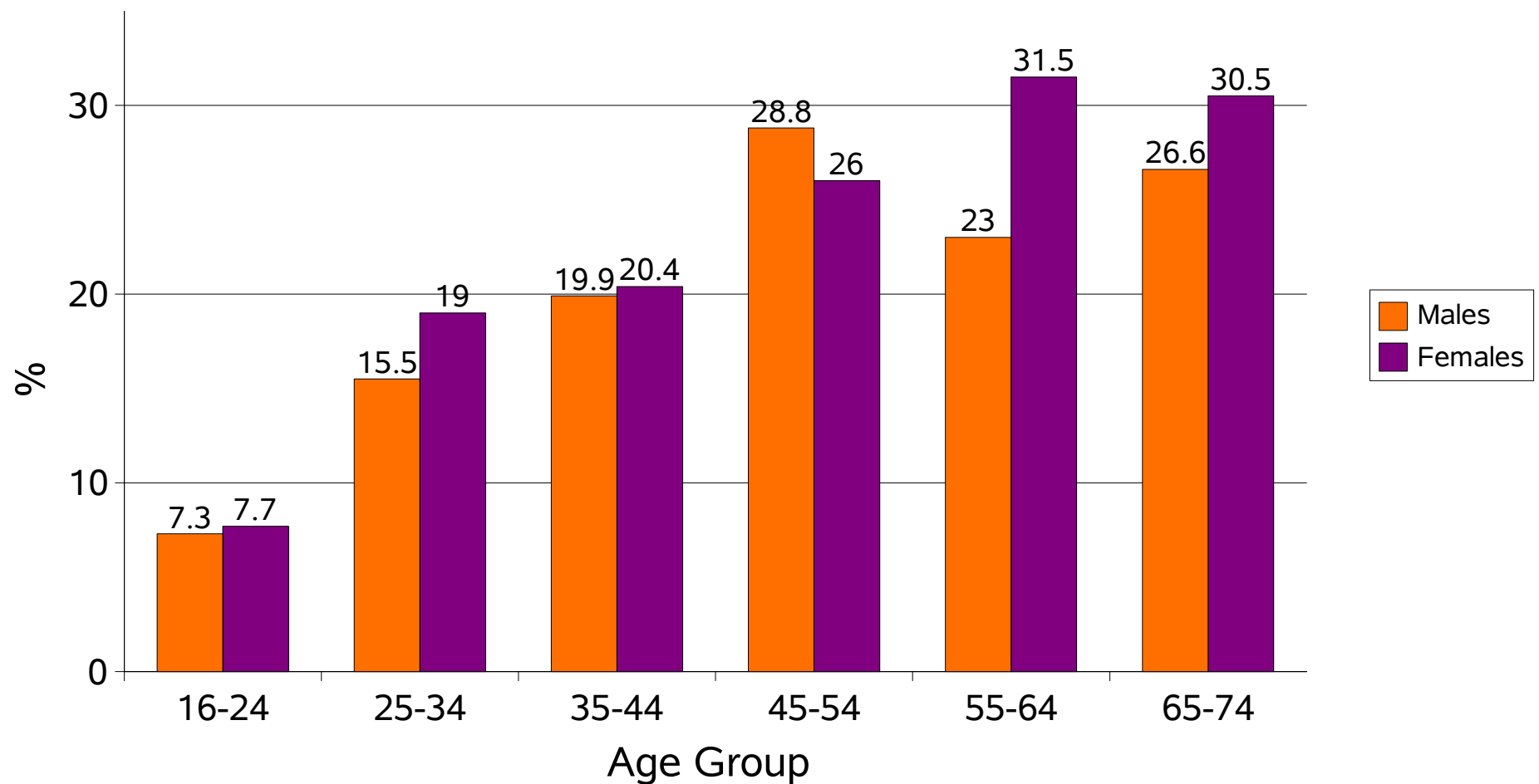
- Body Mass Index (BMI) is generally used.
- $BMI = \text{Weight in kg} / \text{Square of Height in m.}$
- Ranges of BMI (definitions differ):
  - Under 20: Underweight.
  - 20 to 25: Correct weight.
  - Over 25: Overweight (WHO).
  - Over 30: Obese (WHO).
  - Over (35) 40: Severely Obese.
  - (Over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

# Definition 2

- Can estimate ideal body weight (IBW) using
  - Men:  $49.9\text{kg} + 0.89\text{kg/cm}$  above 152.4cm
  - Women:  $45.4\text{kg} + 0.89\text{kg/cm}$  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.

# Prevalence

Scottish population with BMI over 30, 1998.



# 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.

\* <http://www.bbc.co.uk/science/hottopics/obesity/index.shtml>

# 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

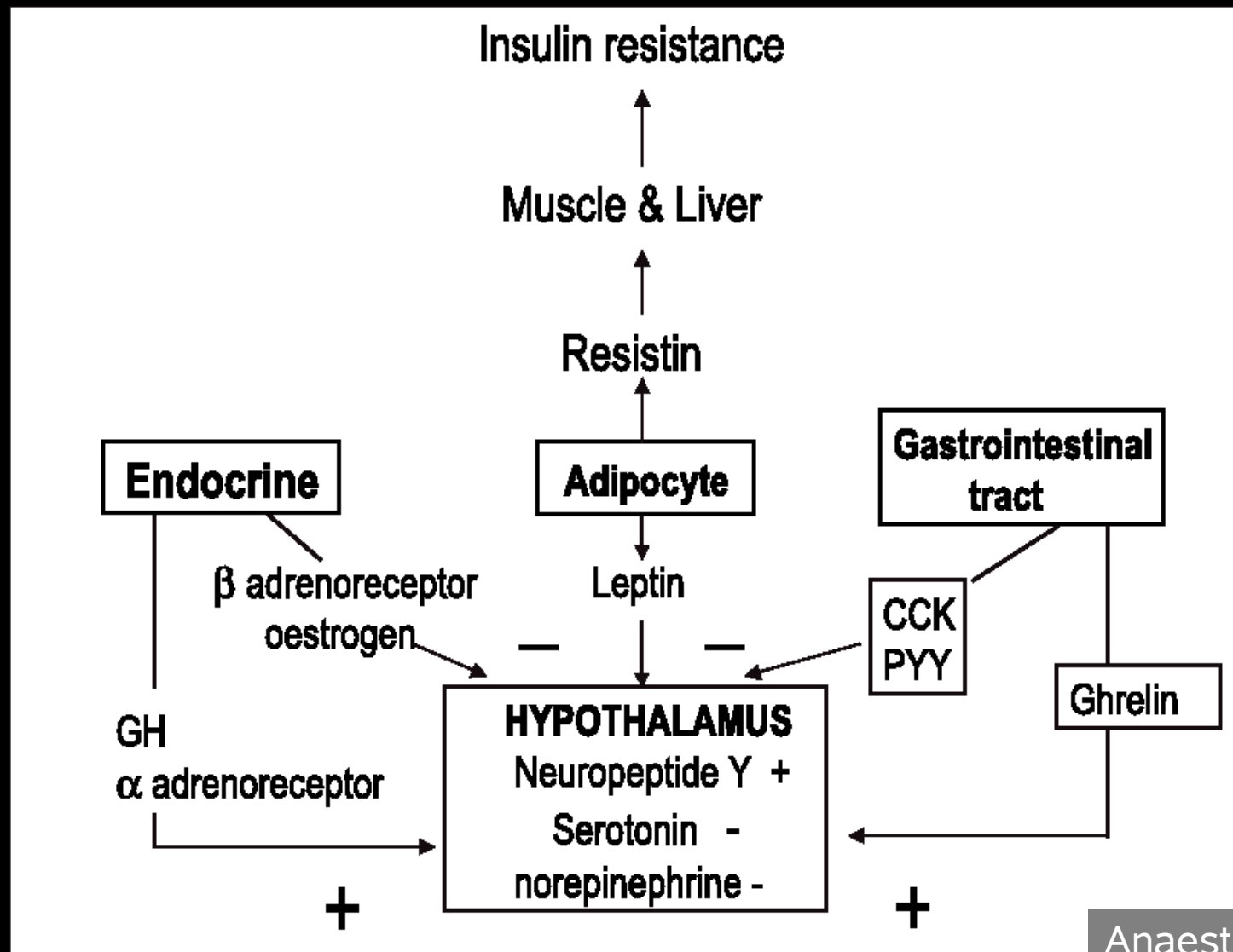
- Relative risks of disease in the obese.
  - RR > 3: NIDDM, Gall Bladder Disease, Hypertension, Hyperlipidaemia.
  - RR 2 to 3: Coronary Artery Disease, OA knee, Gout.
  - RR 1 to 2: Breast, endometrial, colon cancer. Low back pain.



# 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,  $\alpha$ -MSH, Cocaine and amphetamine regulated transcript, “Mahogany”.
- **Many peripheral factors:** Nutrients, hormones (PYY, CCK), GI chemo/ mechanoreceptors. Insulin, **Leptin**, Ghrelin.
- **$\beta_3$  adrenoreceptors.** Thermogenesis, lipolysis. Brown/ white adipose cells ?relevance to long term Rx in humans.

# Regulation of Body Weight



# 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.  $\text{TNF}\alpha$ , 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%.

# Conduct of Anaesthesia 1

- 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.

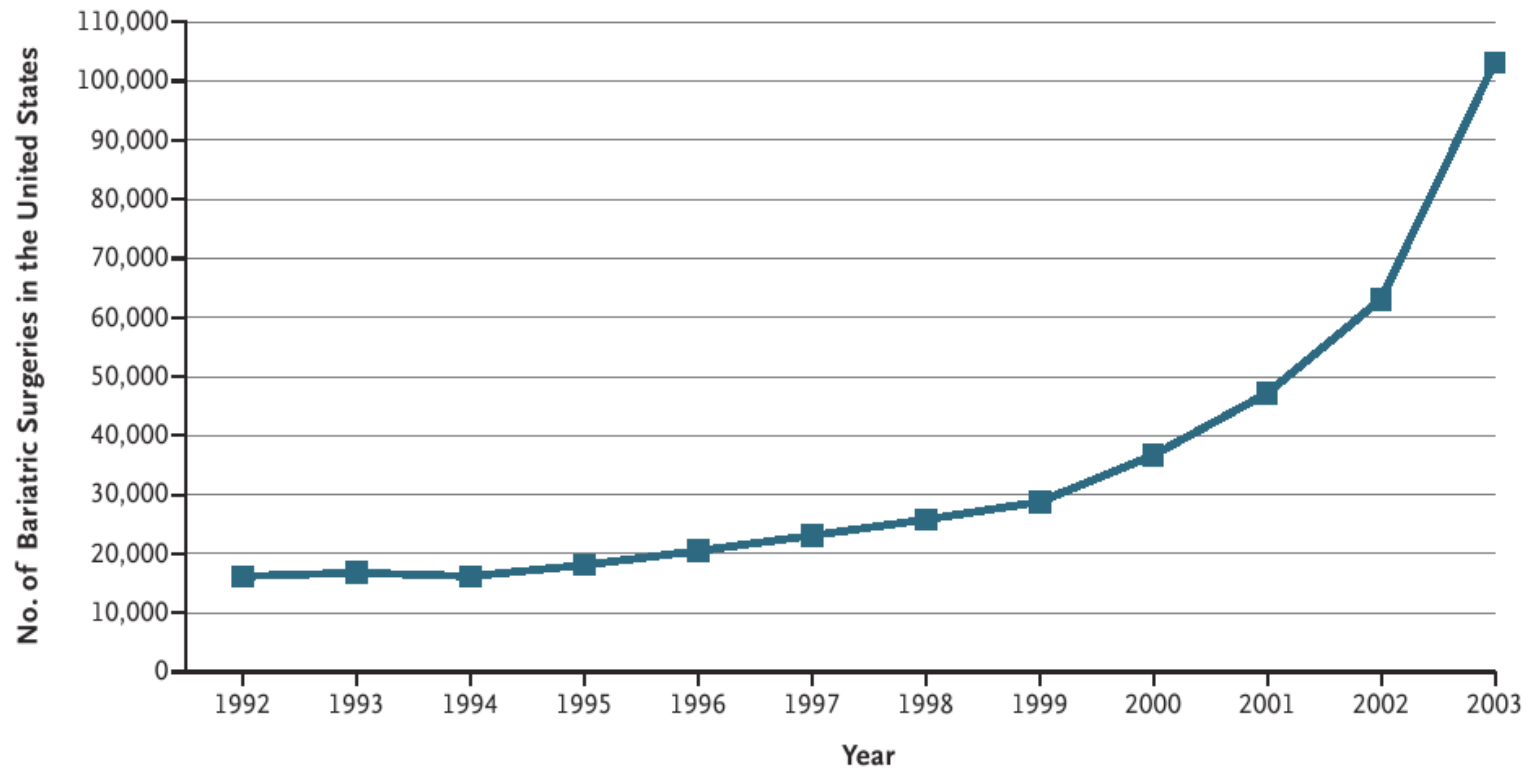
# Conduct of Anaesthesia 4

- 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.

# Bariatric Surgery

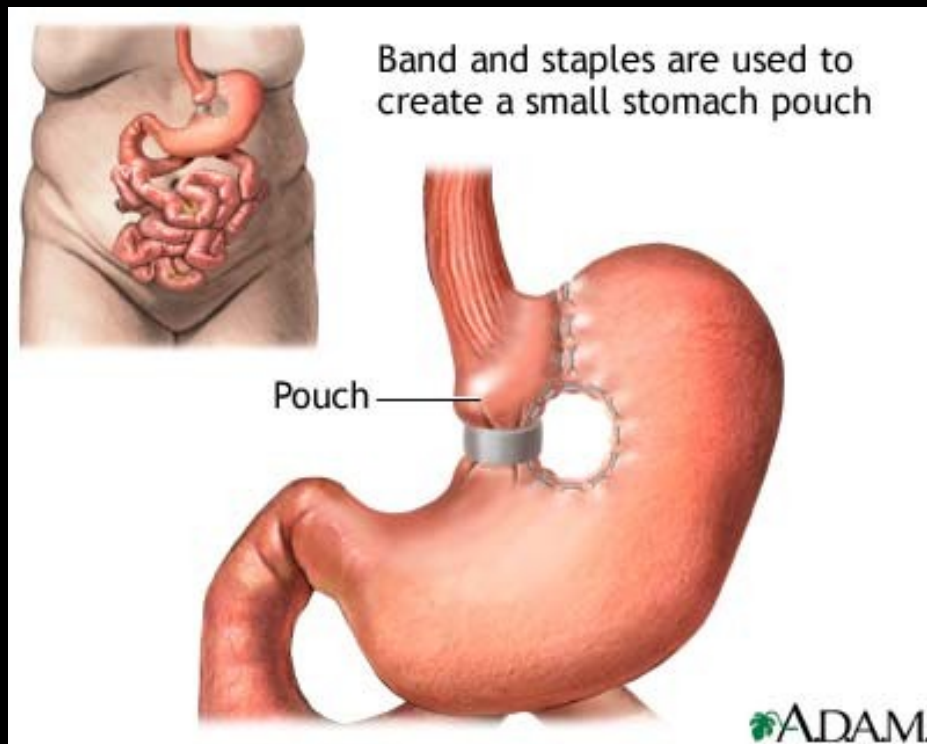


**Figure 1.** Estimated Number of Bariatric Operations Performed in the United States, 1992–2003.

Data are from the American Society for Bariatric Surgery.

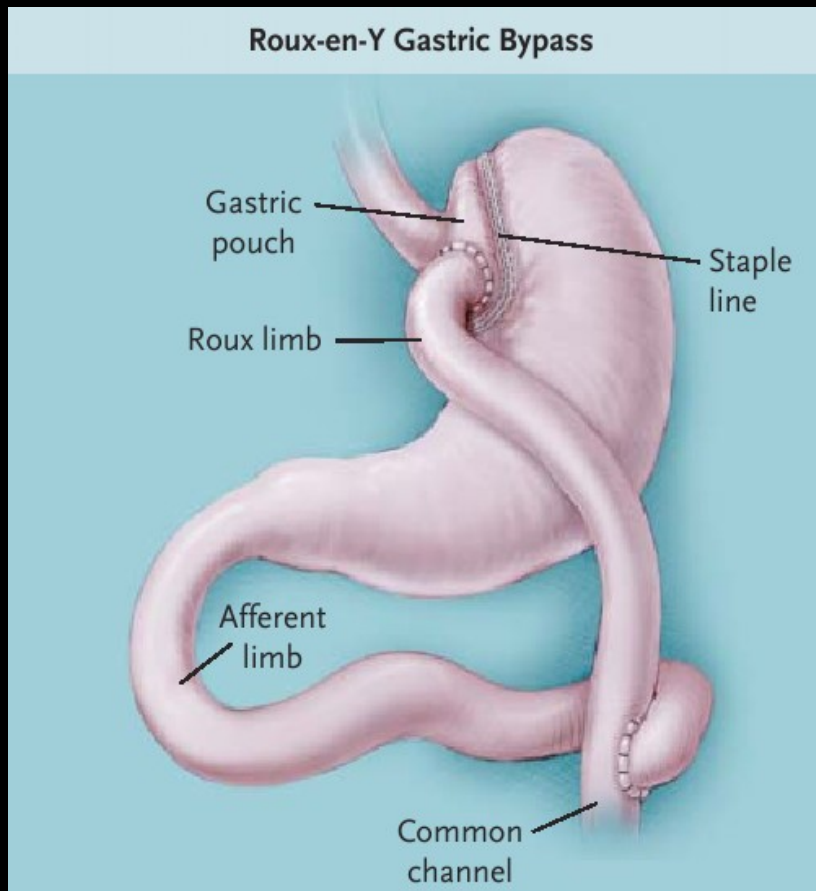


# Vertical Banded Gastroplasty



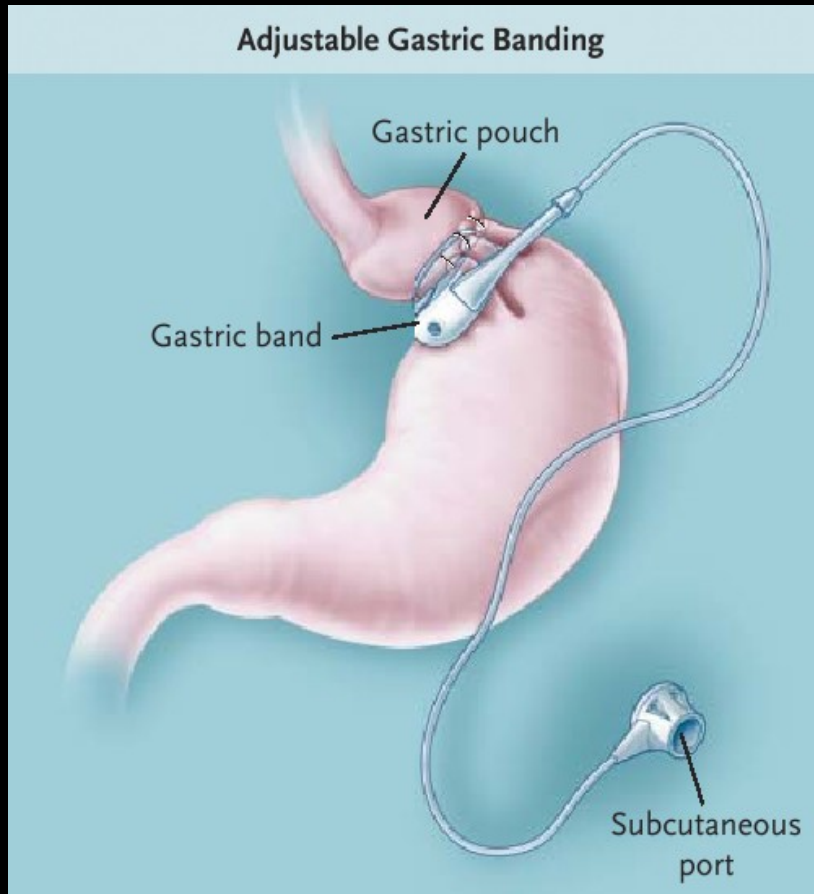
- Restrictive Surgery.
- 80% lose some weight, 30% reach normal weight.
- 40 to 63% loss of excess weight over three years.
- Nausea, heartburn, pain.
- $\leq 1\%$  mortality.

# 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.

