Anesthesia for Bariatric Surgery: What the occasional anesthesiologist should know

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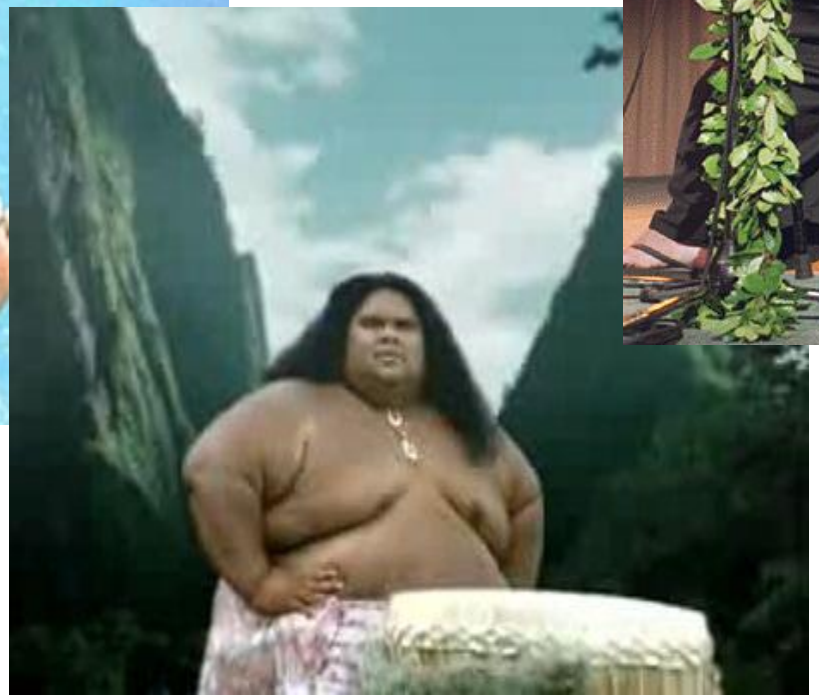
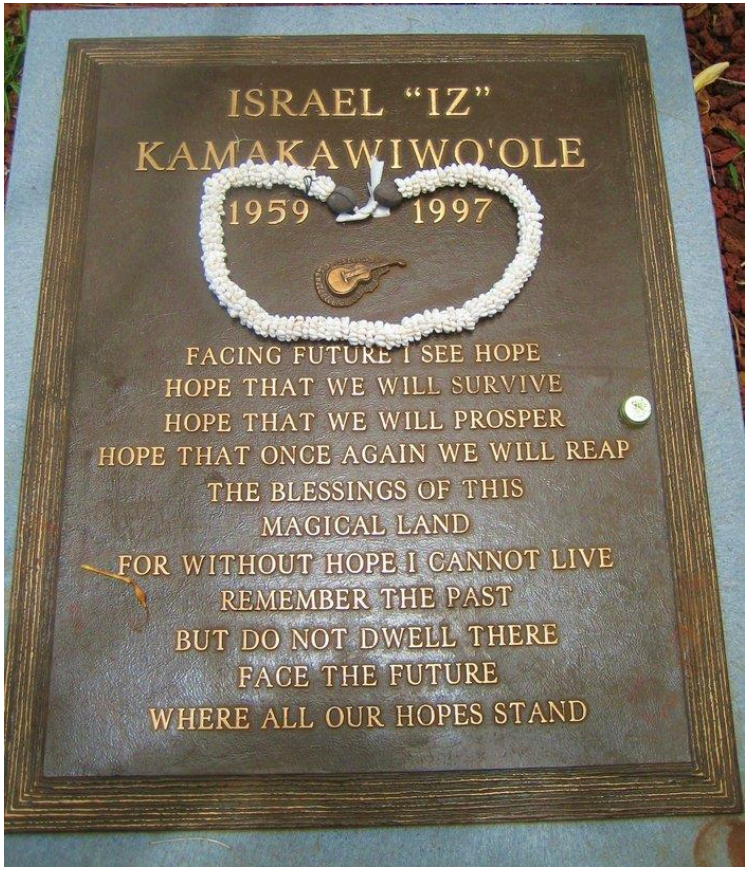
Who am I?



Unfortunately…



…he died at age 37 due to his obesity!

Introduction

- Bariatric ➔ GREEK word : *baros* = weight and *iatrics* = medical treatment

- Greatest health challenge in western countries

- UK: 23% men, 25 % women *

- USA: 200 million people are overweight**

**Rennie KL, Jebb SA. Prevalence of obesity in Great Britain. Obes Rev 2005; 6: 11-2*
*** Baskin MI et al: Prevalence of obesity in the United States. Obes Rev 6:5-7, 2005*

Definition

- **Excess of body fat**
- **Intake > Expenditure**
- **Genetic, behavioral, cultural and socioeconomic factors**
- **Reduces quality of life and life expectancy**
- **Increased healthcare services demands (> 100 billion dollars)**

$$BMI = \frac{\text{weight (lb)} * 703}{\text{height}^2\ (\text{in}^2)}$$

OR

$$BMI = \frac{\text{weight (kg)}}{\text{height}^2\ (\text{m}^2)}$$ (metric)

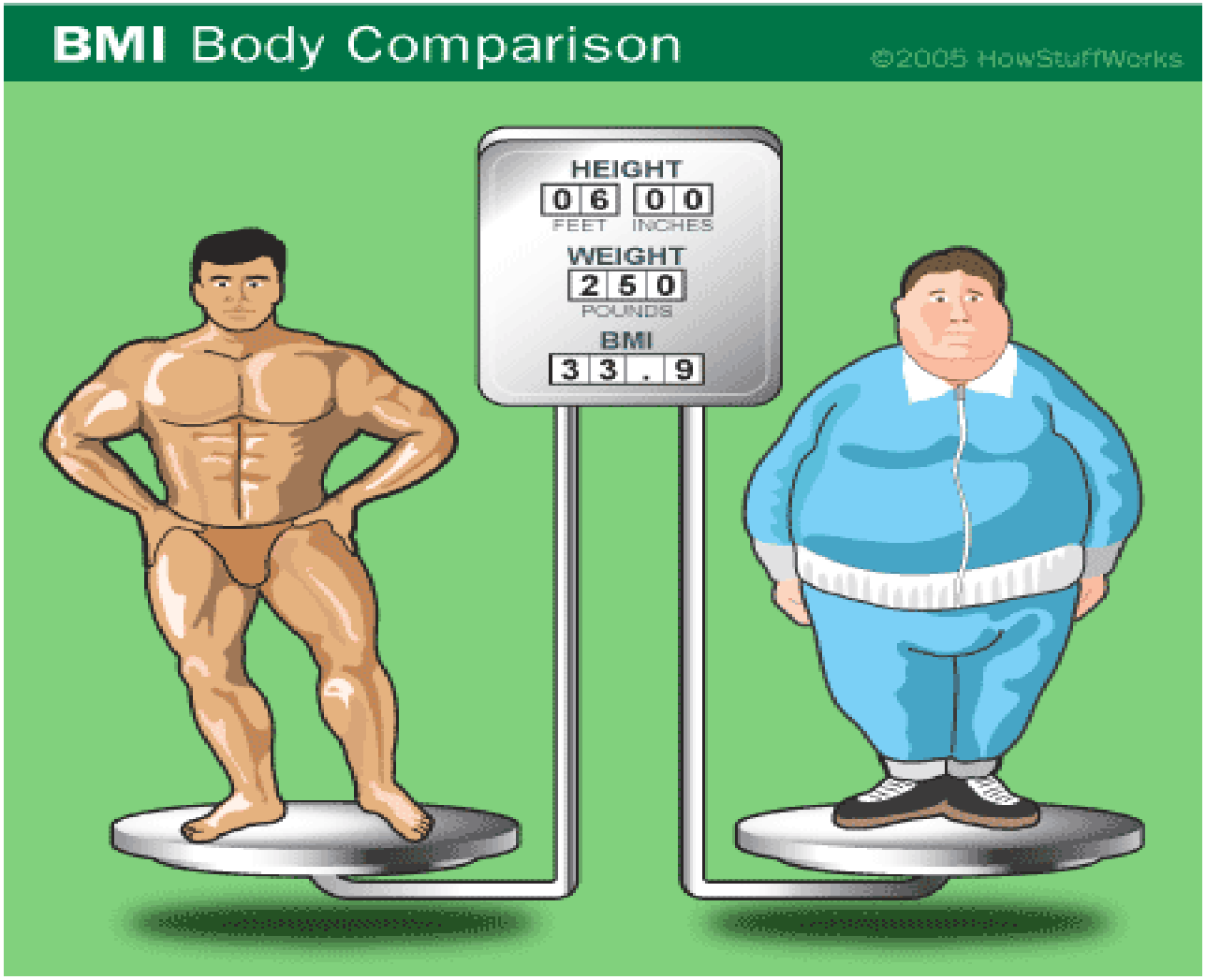
Body Mass Index	Definition
less than 18.5	underweight
18.5–24.9	normal
25.0–29.9	overweight
30.0–34.9	Class i Obesity
35.0–39.9	Class ii Obesity
more than 40.0	Class iii Obesity

The Class iii definition has been refined by the medical profession as follows.

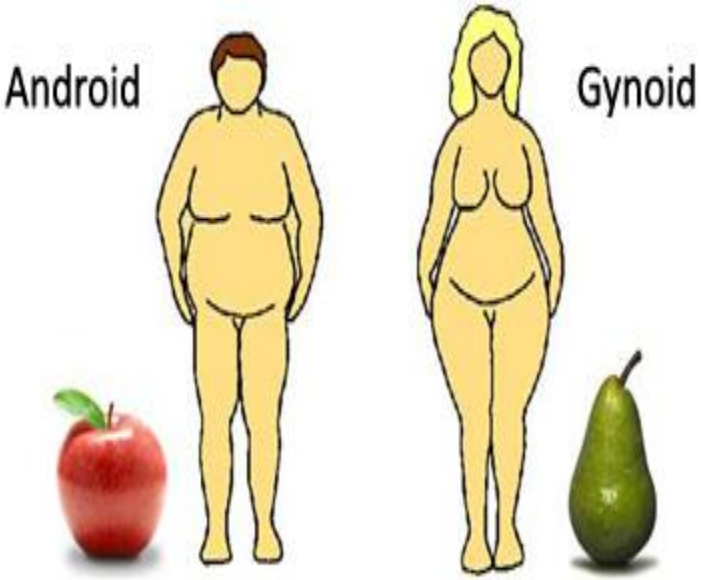
Body Mass Index	Definition
over 40	severe obesity
40.0–49.9	morbid obesity
over 50	super obesity

Limitations of BMI

- Not a direct measure of adiposity
- No account of fat distribution
- No account of duration of obesity
- Inaccurate at extremes of height
- Inaccurate with extremes of lean body mass (athletes, elderly)


BMI Body Comparison
©2005 HowStuffWorks
HEIGHT
06 00
FEET INCHES
WEIGHT
250
POUNDS
BMI
33.9


"Apple" vs. "Pear"
Above the waist
Below the waist
A.D.A.M.


Android
Gynoid

Some definitions…

- **IBW = Ideal Body Weight (kg)** = height (cm) – X

Where X = 100 in males and 105 in females

- **PBW = predictive body weight (kg):**

Males → PBW = 50 + 0.91(height in cm -152.4)

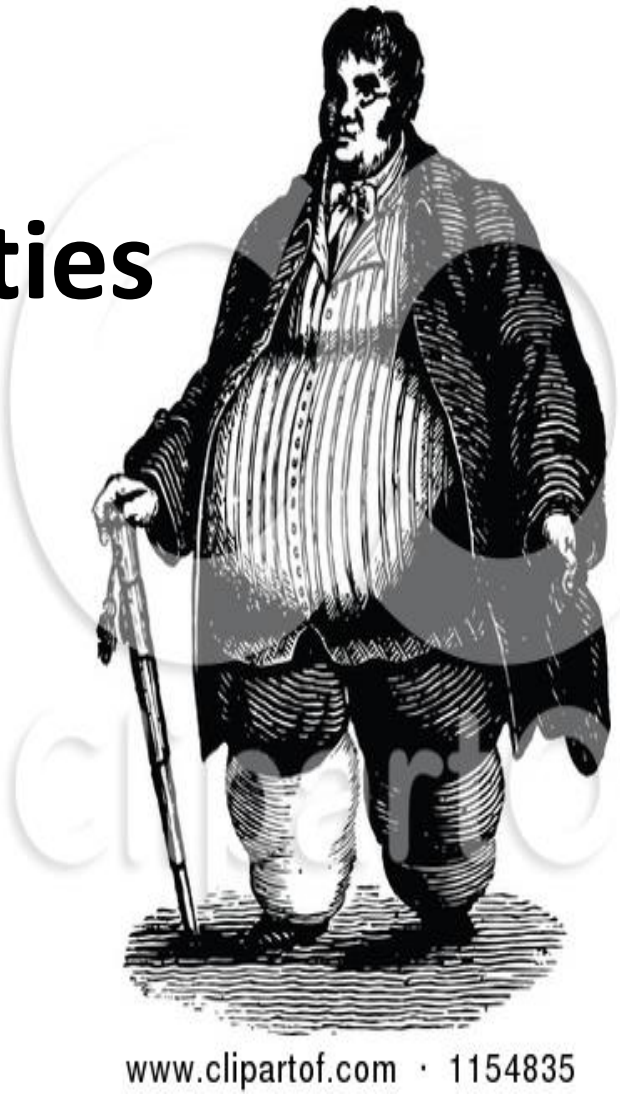
Females → PBW = 45.5 + 0.91(height – 152.4)

- **LBW = Lean Body Weight** = TBW (Total Body Weight) – adipose tissue

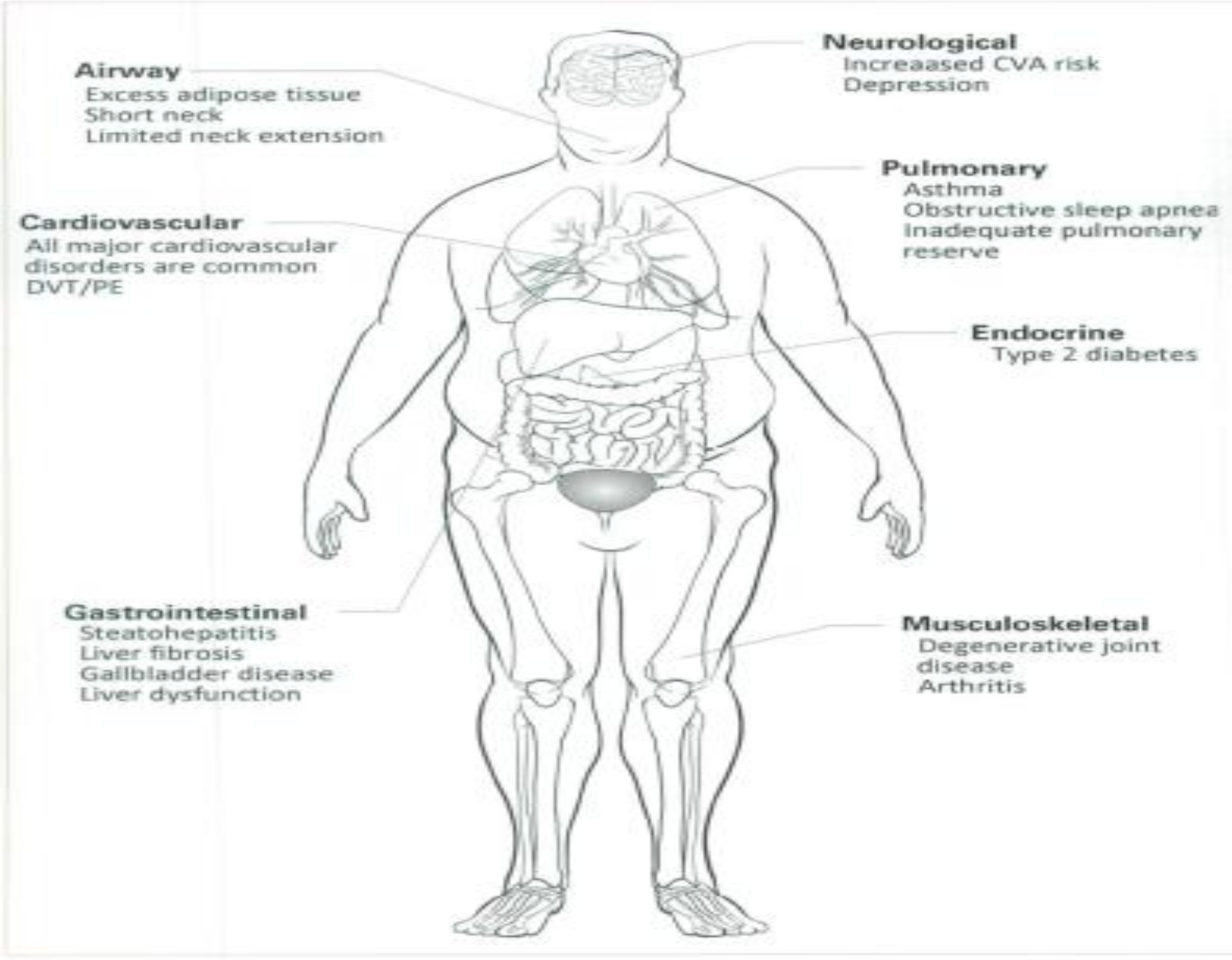
Males = 80% of TBW

Females = 75% of TBW

Associated co-morbidities



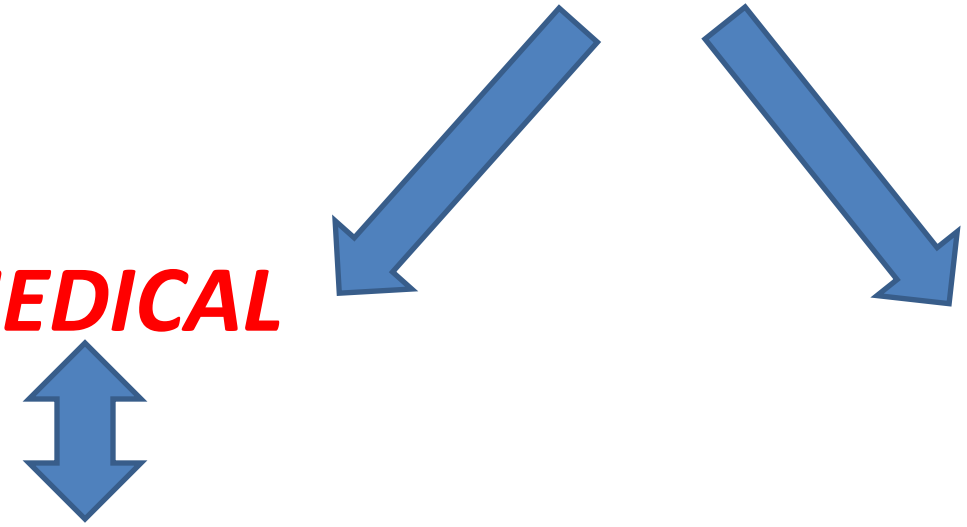
- Hypertension
- Coronary Artery Disease and Stroke
- Sudden death (cardiac)
- Restrictive lung disease
- Obstructive Sleep Apnea, Hypoventilation
- Diabetes Mellitus, Insulin Resistance
- Cancer (breast, gynecological, gastrointestinal)
- Osteoarthritis
- Socioeconomical and psychosocial impairment


Airway
Excess adipose tissue
Short neck
Limited neck extension
Neurological
Increaased CVA risk
Depression
Pulmonary
Asthma
Obstructive sleep apnea
Inadequate pulmonary reserve
Cardiovascular
All major cardiovascular disorders are common
DVT/PE
Endocrine
Type 2 diabetes
Gastrointestinal
Steatohepatitis
Liver fibrosis
Gallbladder disease
Liver dysfunction
Musculoskeletal
Degenerative joint disease
Arthritis

➔ ***Studies : weight loss of 5-10% can improve glucose intolerance, DM2, HTN and DLP!!***

➔ ***Obesity is second only to smoking as a preventable cause of death!!***

Treatment



MEDICAL

Sibutramine

Orlistat

Rimonabant

SURGICAL

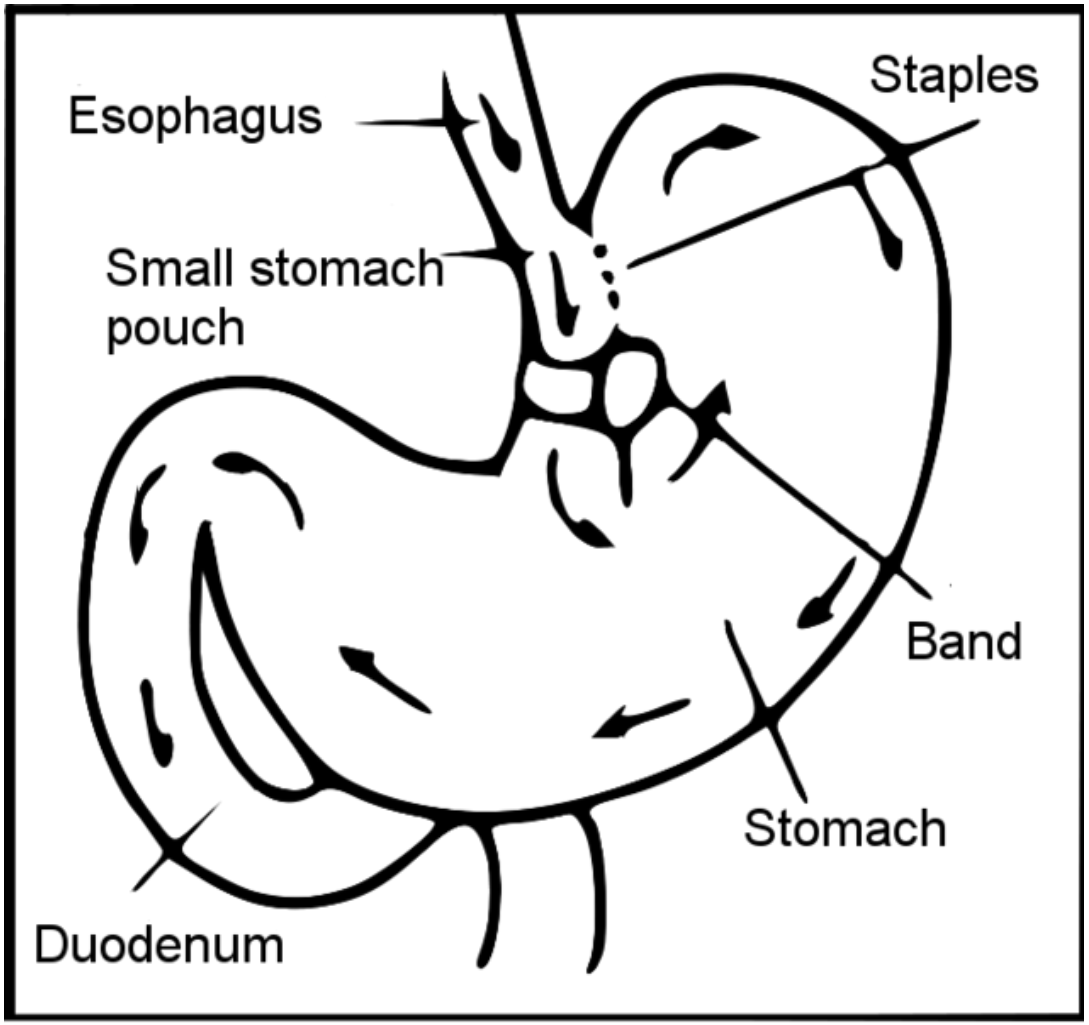
Restrictive Surgery

Malabsorptive

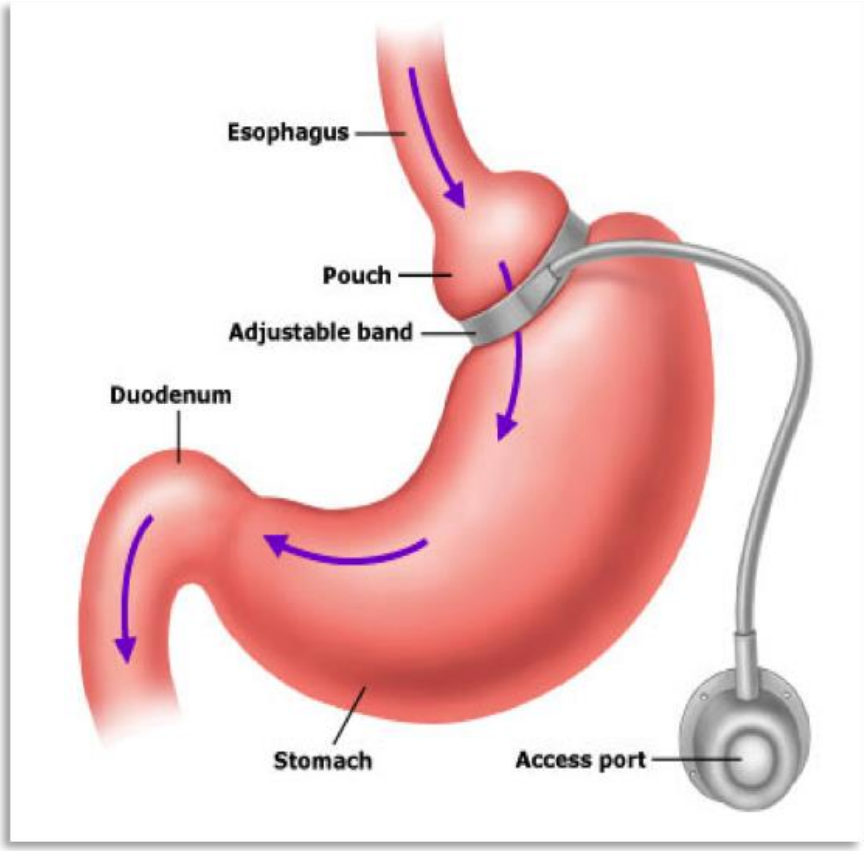
Combined

There are many types of bariatric surgeries…

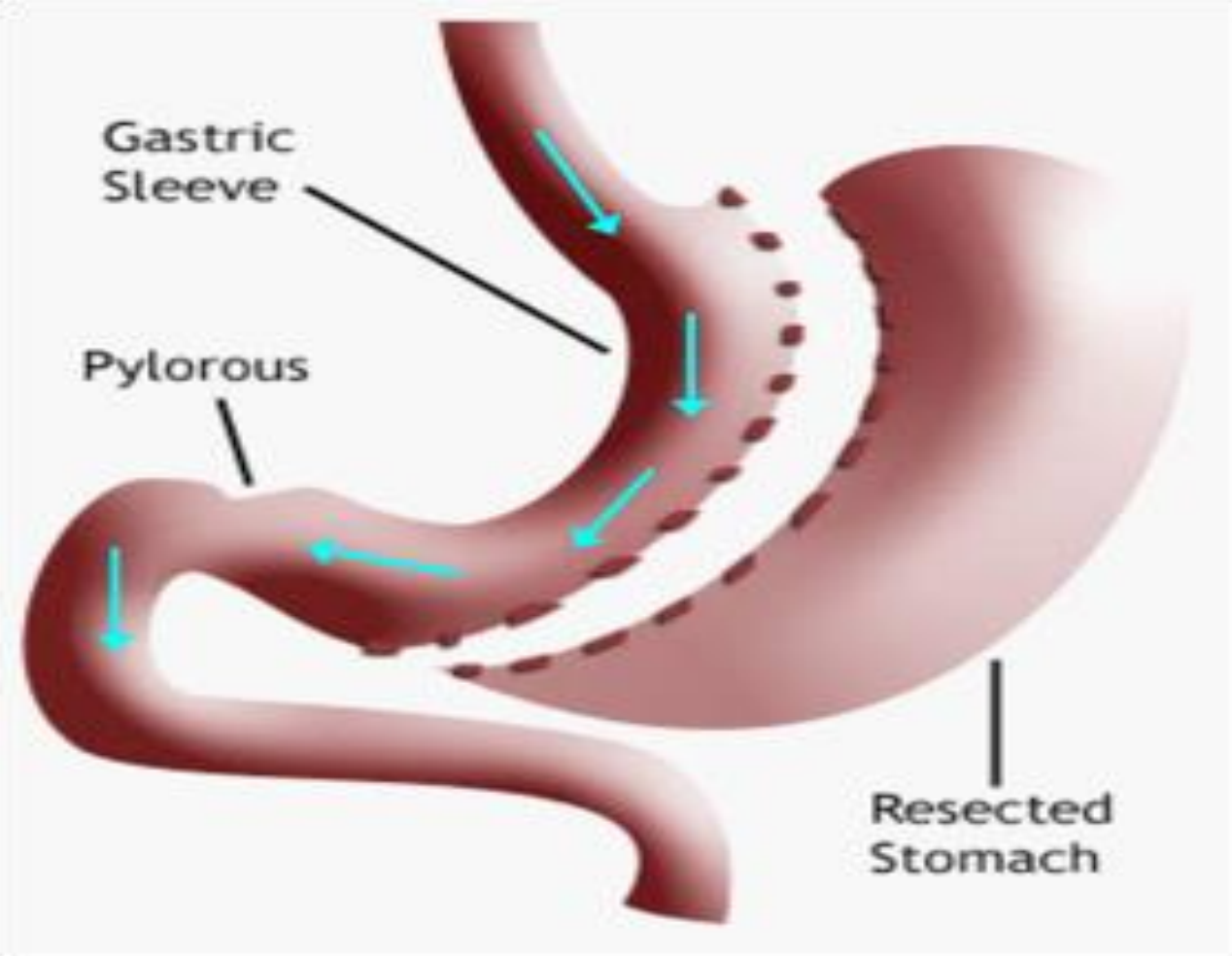
Vertical Banded Gastroplasty



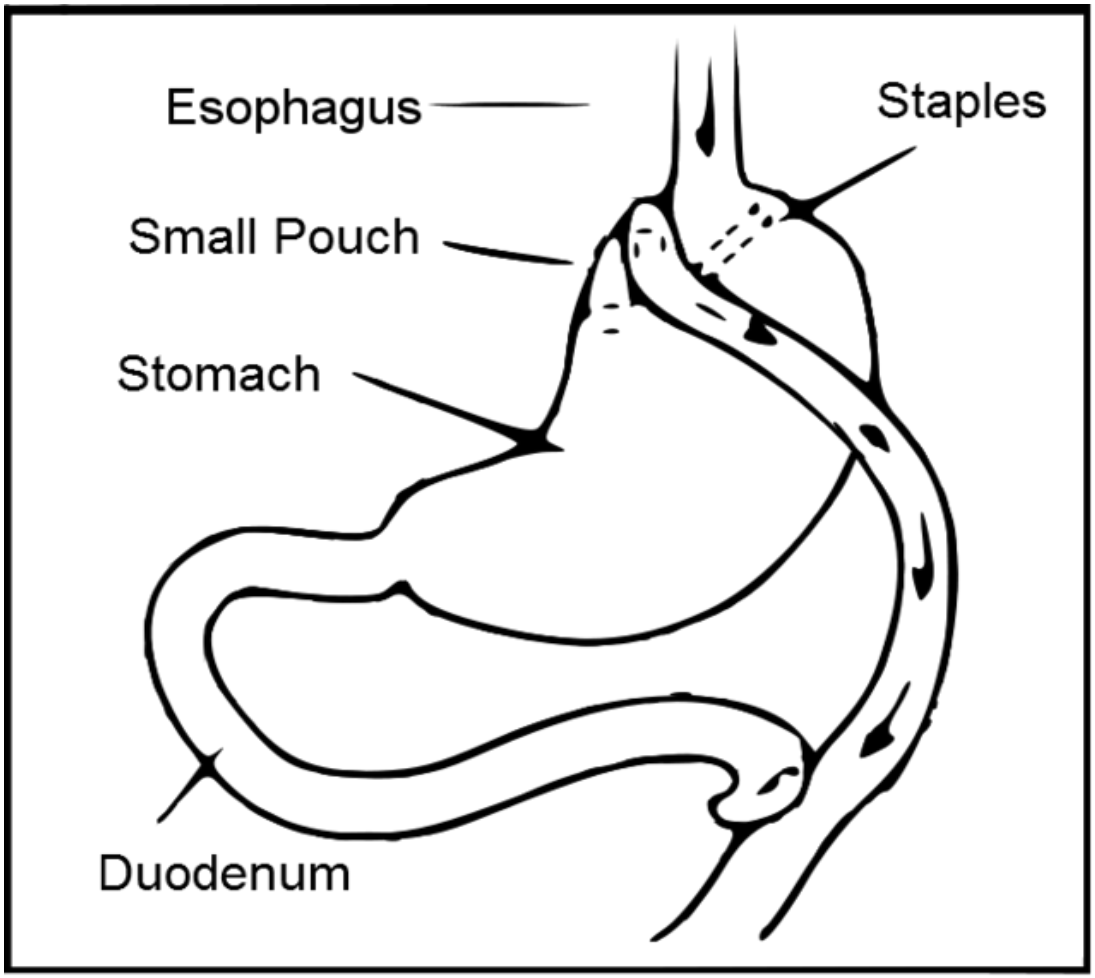
Adjustable Gastric Band



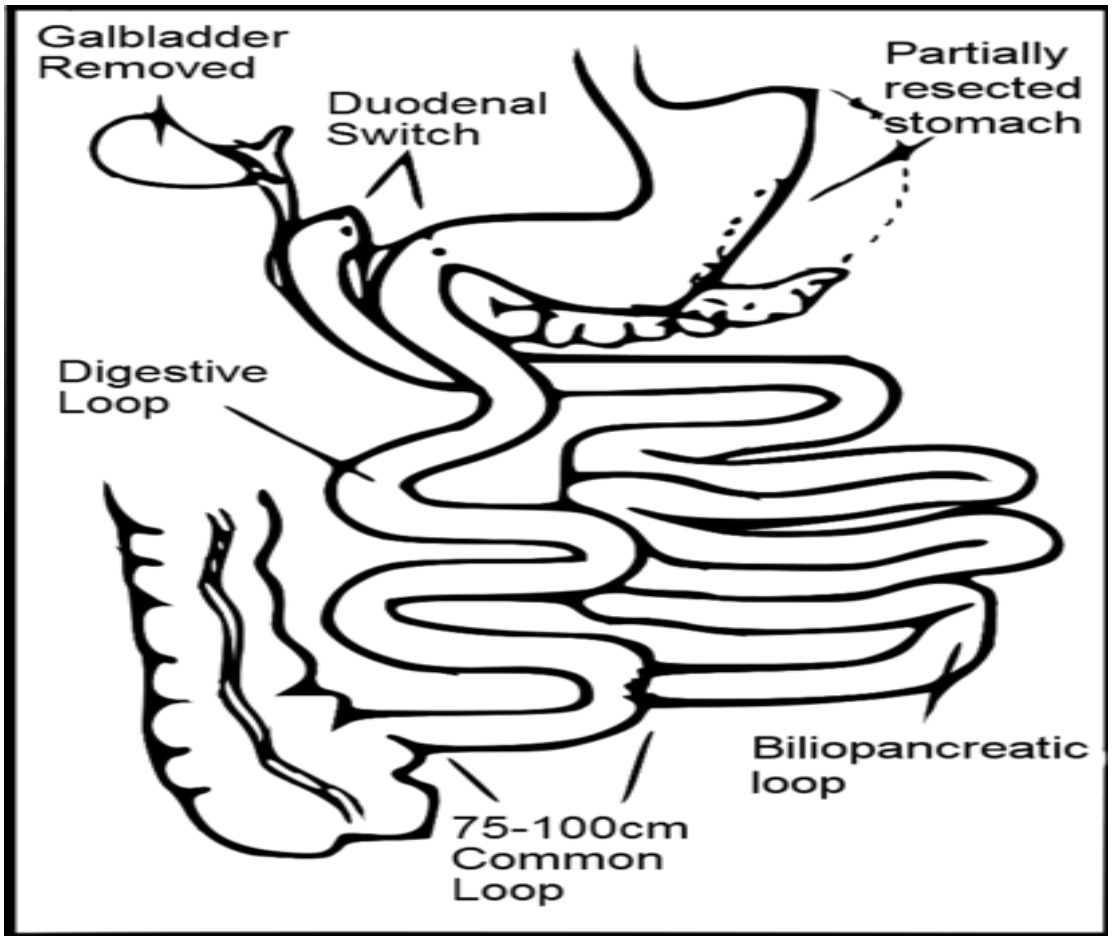
Sleeve Gastrectomy



Roux-en-Y Gastric Bypass



Sleeve Gastrectomy with duodenal switch



Indications for Surgery

- ✓ *BMI > 40 or between 35 – 40 + comorbidities*
- ✓ *Failed non-surgical treatment (6 months)*
- ✓ *METABOLIC SYNDROME!*
- ✓ *Needing intensive specialist management*
- ✓ *Fit for anesthesia and surgery*
- ✓ *Committed to the need of long term follow-up*

Contraindications

- Unstable CAD
- Uncontrolled severe OSA
- Uncontrolled psychiatric disorder
- Mental retardation (IQ<60)
- Inability to understand the surgery
- Perceived inability to adhere to postoperative restrictions
- Continued drug abuse
- Malignancy with a poor 5-year prognosis

Health benefits of bariatric surgery

Improvement of Comorbidities

Anesthetic management for bariatric surgery

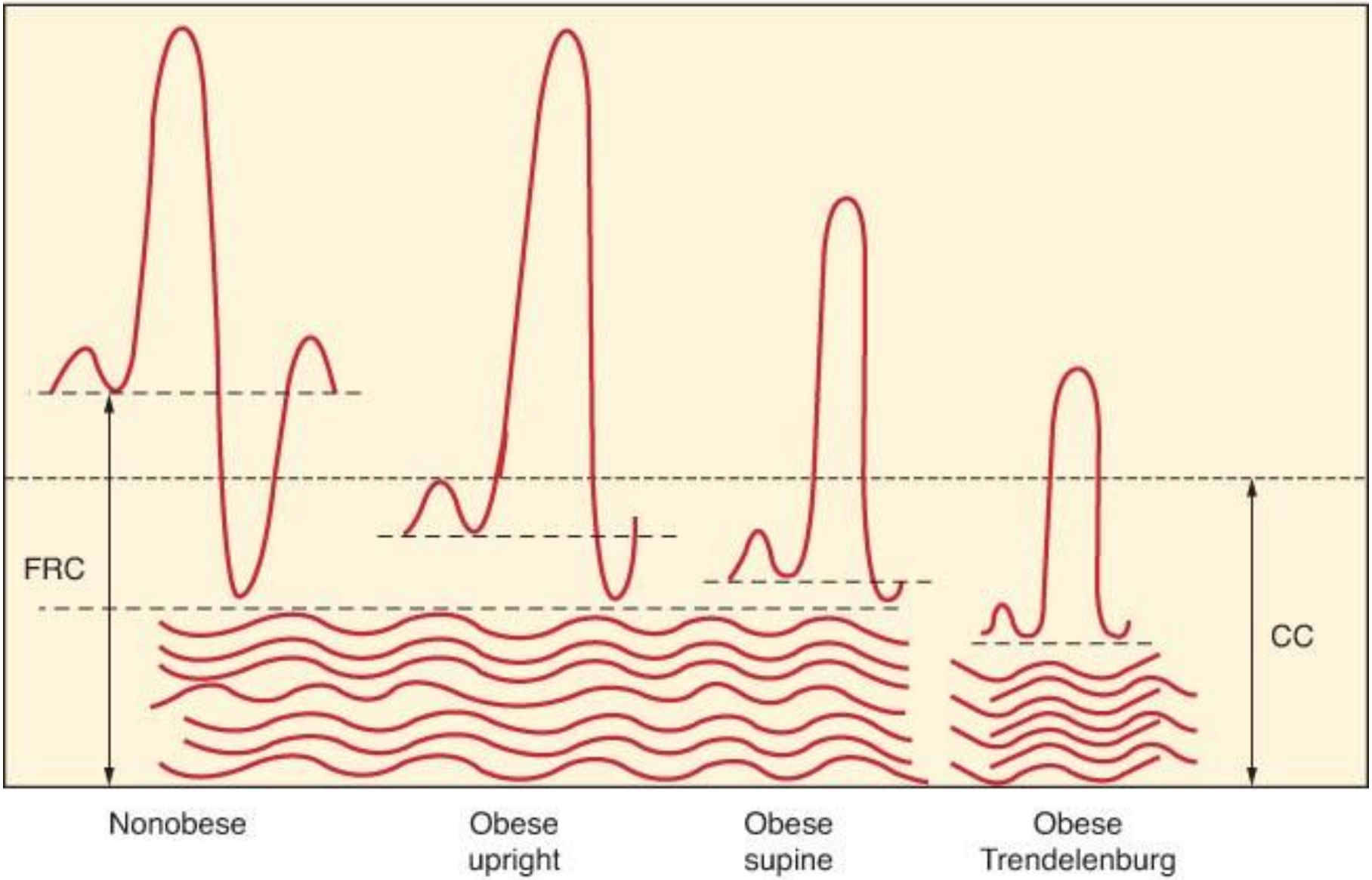
What the anesthesiologist should know preoperatively?

The pathophysiological changes associated with obesity

Respiratory system

- Decreased chest wall compliance
- Decreased lung compliance
- Decreased FRC → **decreased ERV** → decreased safe apnea time → rapid desaturation

  → CC > FRC
- Decreased VC

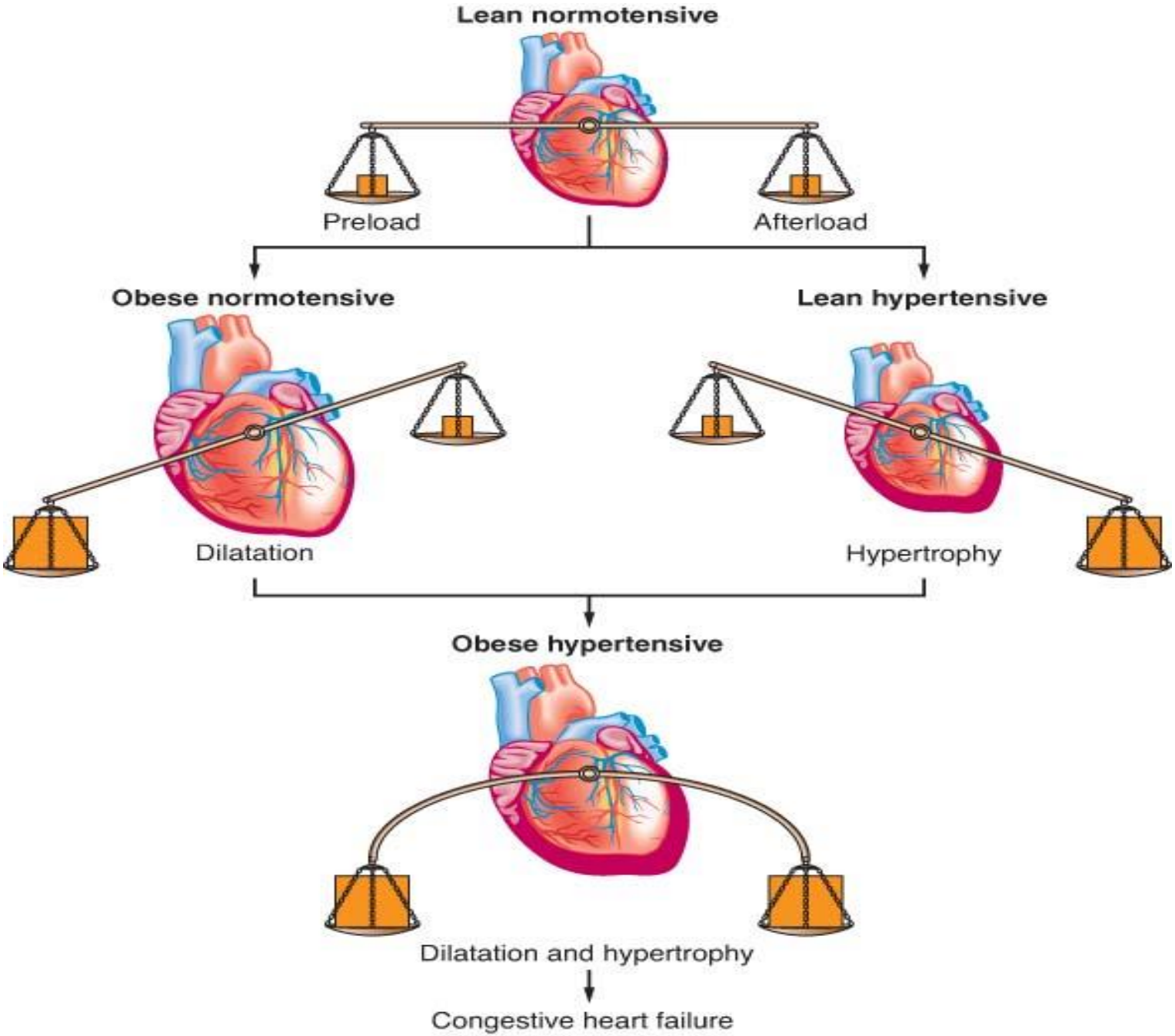

Effect of position on lung volumes
FRC
CC
Nonobese
Obese upright
Obese supine
Obese Trendelenburg

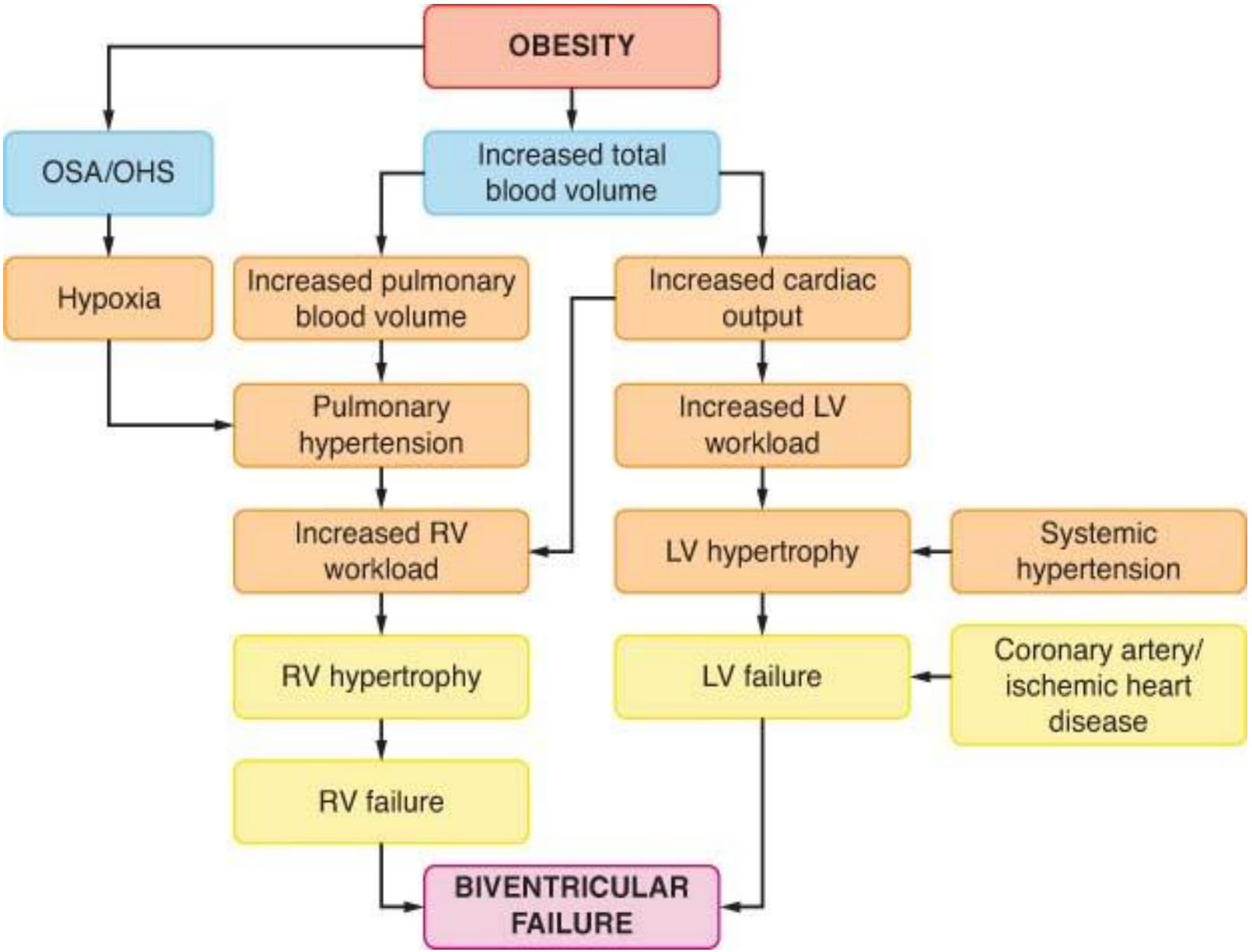
Respiratory system (cont'd)

- Increased (A-a) O2 gradient
- Increased O2 consumption and CO2 production → high energy turnover
- Increased V/Q mismatch!!
- OSA → do polysomnography preoperatively → need for CPAP?

Cardiovascular system

- Increased blood volume → fat!
- Atherosclerosis and hypercoagulability!
- Increased Cardiac Output → 20-30 ml/kg
- LV wall stress → dilatation and hypertrophy → **obesity cardiomyopathy**
- Sympathetic activation → HTN
- Arrythmias → fatty infiltration of conductive system


Lean normotensive
Preload
Afterload
Obese normotensive
Lean hypertensive
Dilatation
Hypertrophy
Obese hypertensive
Dilatation and hypertrophy
Congestive heart failure


OBESITY
OSA/OHS
Increased total blood volume
Hypoxia
Increased pulmonary blood volume
Increased cardiac output
Pulmonary hypertension
Increased LV workload
Increased RV workload
LV hypertrophy
Systemic hypertension
RV hypertrophy
LV failure
Coronary artery/ ischemic heart disease
RV failure
BIVENTRICULAR FAILURE

Gastrointestinal system

- Increased gastric volume (> 25 mL)
- Increased acidity (pH< 2.5)
- Increased risk of regurgitation and aspiration!!
- DM type 2
- Metabolic syndrome
- Fatty infiltration of liver
- Hiatal hernia and GERD!

Musculo-skeletal and other systems

- Oestheoarthritis
- Compression fractures
- Urinary incontinence
- Skin infections (candidiasis) → **wound**
- Varicose veins
- Lymphoedema
- Hypothyroidism

Airway Changes

- **Limitation of movement of atlantoaxial joint and cervical spine → upper thoracic and low cervical fat pads**
- **Excessive tissue folds in the mouth and pharynx**
- **Suprasternal, presternal and posterior cervical fat**
- **Short thick neck**
- **Very thick submental fat pad**
- **OSA → excessive tissue in lateral pharyngeal walls**

How does this affect drug dosing??

Effects on drug distribution

- Reduced total body water
- Increased total body fat
- Increased lean body mass
- Altered protein binding
- Increased blood volume
- Increased cardiac output

- Loading Dose → Volume of Distribution
- Maintenance Dose → Clearance

- Increased redistribution → increased T1/2
- Increased alpha-1-glycoprotein → decreased free drug concentration

Effects on drug elimination

- Hepatic clearance → only phase II affected

- Renal clearance increased → increased RBF → increased GFR (ex: increased dosing of cimetidine and aminoglycosides antibiotics)

- Highly lipophilic (BZD, BrB) → increased VD → dosed on TBW
- Less lipophilic (nondepolarizing muscle relaxants) → no change → dosed on LBW

- Increased blood volume → increased plasma concentrations of rapidly injected IV drugs
- Repeated injections → accumulation in fat → increased duration of action

→ Exceptions: Digoxin, Procainamide and Remifentanil → highly lipophilic but dosed on LBW

Preoperative assessment

What should we focus on??

- Stabilizing comorbidities
- Identifying OSA symptoms
- Previous surgeries and previous anesthetics
- Difficult airway anticipation

➔NECK CIRCUMFERENCE!!:*

➢40 cm → 5% risk

➢60 cm → 35% risk

➔ BMI per se is not a predictor of a difficult airway!

**Brodsky JB, Lemmens HJ, Brock-Utne JG, Vierra M, Saidman LJ. Morbid obesity and tracheal intubation. Anesth Analg 2002; 94:732-6*

Routine and specific lab tests

- Glucose, lipid profile
- Vitamin deficiencies
- Liver function tests
- ABG
- Lung function tests
- Polysomnography → initiate CPAP periop
- Echocardiography

Preoperative preparation

- ✓ Avoid Sedatives!
- ✓ Aspiration prophylaxis → PPIs, H2 antagonists
- ✓ Thromboembolism prophylaxis

Intraoperatively…

We need:

→**Special equipment**

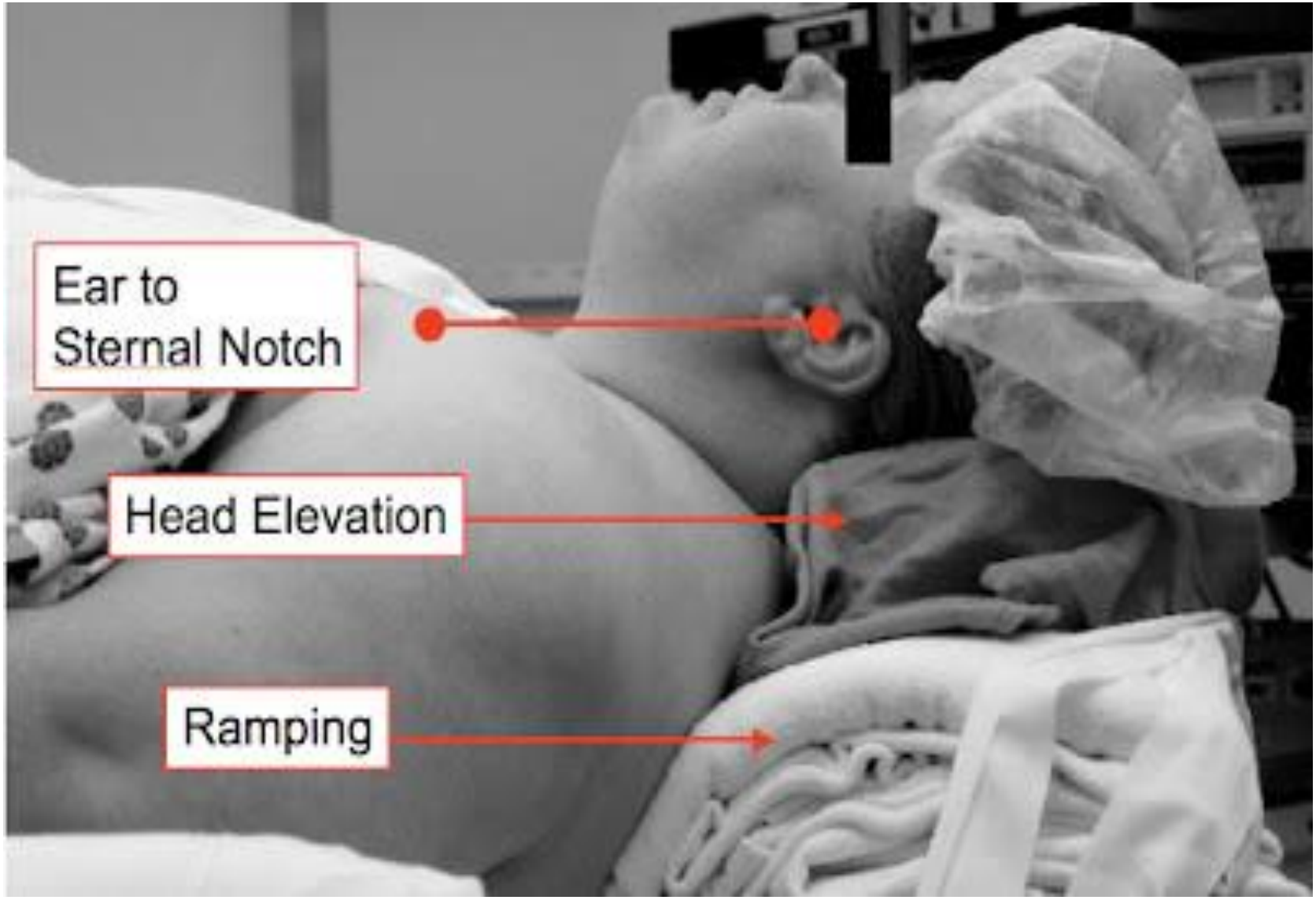
→**Trained personnel**

→**Anesthetic expertise!!**

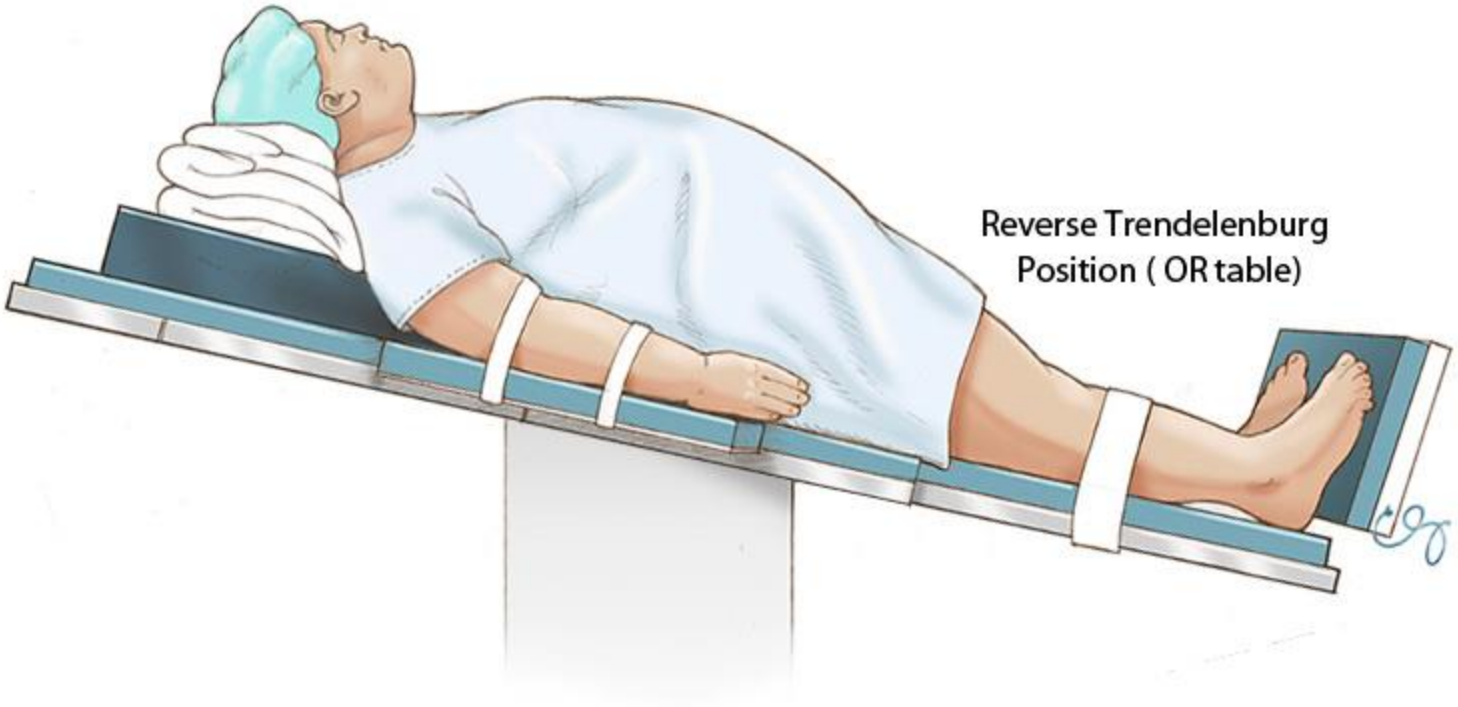
Positioning

- **Special table with a bean bag**
- **Cushion gel pads → pressure on gluteal muscles may lead to rhabdomyolysis!**
- **Proper positioning:**

✓ **Modified Lloyd – Davis position = steep trendelenburg with legs spread apart and both arms out on arm boards**


Ear to
Sternal Notch
Head Elevation
Ramping

Head Elevated
Laryngoscopy Position (patient)



Reverse Trendelenburg
Position (OR table)

ALWAYS CHECK FOR THE CRITERIA OF A DIFFICULT AIRWAY MANAGEMENT

Induction

- Head-up position (HELP)
- Stacking
- Good preoxygenation
- Tidal volumes < 13 ml/kg
- PEEP and recruitment maneuvers

Induction Issues

- Regurgitation*
- Aspiration
- Hypoxemia

** Koolwig J, et al. BMJ Case Rep 2013. doi:10. 1136/bcr-2013-201009*

Maintenance

- Sevoflurane and Desflurane → lower lipid solubility than Isoflurane
- **AVOID N_2O**
- Fluids well balanced → avoid ATN and volume overload
- Short- acting agents preferred
- Consider Dexmedetomidine*

* *Bakhamees HS, El-Halafawy YM, Ek-Kerdawy HM, Gouda NM, Altemyatt S. Effects of dexmedetomidine in morbidly obese patients undergoing laparoscopic gastric bypass. Middle East J Anesthesiol 2007; 19:537-51*

- Profound muscle relaxation needed → Vecuronium, Rocuronium and Cisatracurium
- Pneumoperitoneum < 15 mmHg
- Cephalad displacement of diaphragm → displace ETT to mainstem bronchus!

- Help with intragastric baloon placement and leak tests!

Emergence

- **Semirecumbent and FULLY awake**
- **Prompt but SAFE**
- **Observe in OR before transfer**

Recovery Room

- SKILLED personnel
- Watch ventilation
- Initiate CPAP or BiPAP if needed
- Use multimodal analgesia

Postoperatively…

- Initiate thrombophylaxis
- Continue analgesics
- Continue CPAP if initiated
- Antibioprophylaxis
- PPIs and gastric protection
- Fluid management

Complications of bariatric surgery

Risk factors for complications

- ✓ Male
- ✓ Age > 65
- ✓ Open surgery
- ✓ Long operative time
- ✓ Cardiac and respiratory comorbidities
- ✓ Diabetes
- ✓ Low case load

General complications

- *Infection*
- *Hemorrhage*
- *Incisionnal hernia*
- *Bowel obstruction*
- *Deep Venous Thrombosis*

Specific complications

- ❖ Anastomotic leak
- ❖ Anastomotic stricture
- ❖ Dumping syndrome
- ❖ Nutritional deficiencies:
  - ✓ *Vitamin B12*
  - ✓ *Thiamine*
  - ✓ *Protein*
  - ✓ *Vitamin A*

	All Surgeries	Gastric Banding	Roux-en-Y
Early	Bleeding Infection Dehydration Peritonitis Bowel obstruction Perforation Pneumonia DVT/PE Death	Band slippage Band malfunction Infection at band site	Leak from anastomotic site
Late	Cholelithiasis Cholecystitis Pouch dilation GERD/dysphagia Herniation at the surgical site Nutrionnal issues Fat-soluble vitamin deficiencies (vit B12)	Anorexia Band slippage Band malfunction Infection at band site	Small bowel obstruction Marginal ulcers Pancreatitis Stricture

In conclusion…

Health benefits

- Sustained loss of 65-80% of excess body weight
- Resolution of:

✓ Diabetes

✓ Hypertension

✓ Dyslipidemias

✓ OSA

✓ GERD

✓ Low back pain and joint pain

Obesity and Heart-Rate Variability

What's HRV?

- Variation in intervals between heartbeats
- Reflects cardiac autonomic modulation
- Influenced in a favorable way by increased parasympathetic activity

Thayer JF et al. The relationship of autonomic imbalance, heart rate variability and cardiovascular disease risk factors. International journal of Cardiology 141 (2010) 122-131

- Obesity → autonomic imbalance → increased sympathetic and decreased parasympathetic activities → increased workload and stress on the heart → decreased HRV → risk factor for heart diseases (MI, sudden death…)

- Weight loss → restored autonomic balance → increase HRV → correlates with decreased heart diseases!!!

Nault I. et al. Impact of bariatric surgery-induced weight loss on heart rate variability. Metabolism Clinical and Experimental 56 (2007) 1425-1430

Increased self-esteem and participation in social activities!!

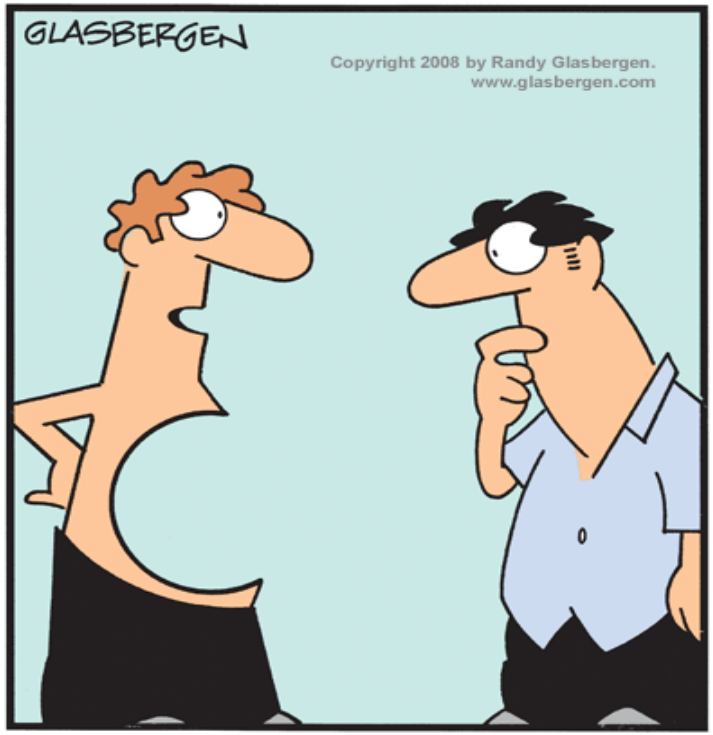
To Conclude…

Obesity…

- ✓ Is a major healthcare problem
- ✓ Increases co-morbidities and decreases the quality of life
- ✓ Is a daily challenge for the anesthesiologists
- ✓ Needs extra care during the perioperative period

➔ ***Advancement in the anesthesia technology has made a dramatic improvement***

Bariatric surgery is a beneficial and cost-effective healthcare intervention!



"Belly button enlargement is a popular alternative to other types of weight loss surgery."

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Thank you!