

# Anesthetic Implications of Obesity

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# Objectives

- Update on the epidemiology and etiology of obesity
- Review of the pathophysiologic consequences of obesity with a focus on right heart failure and OSA
- Recommendations for the perioperative evaluation and management of obese patients

# Definition

- BMI = Kilograms / Meters<sup>2</sup>
  - < 18.5 is underweight
  - 18.5 - 24.9 is normal
  - 25-29.9 is overweight
  - 30 -34 is obese (class I)
  - 35 - 39 is obese (class II)
  - > 40 is obese (class III)

# Definition

- Limitations to BMI classification
  - Heavily muscled individuals
  - Pediatric population

# Epidemiology: Ghana

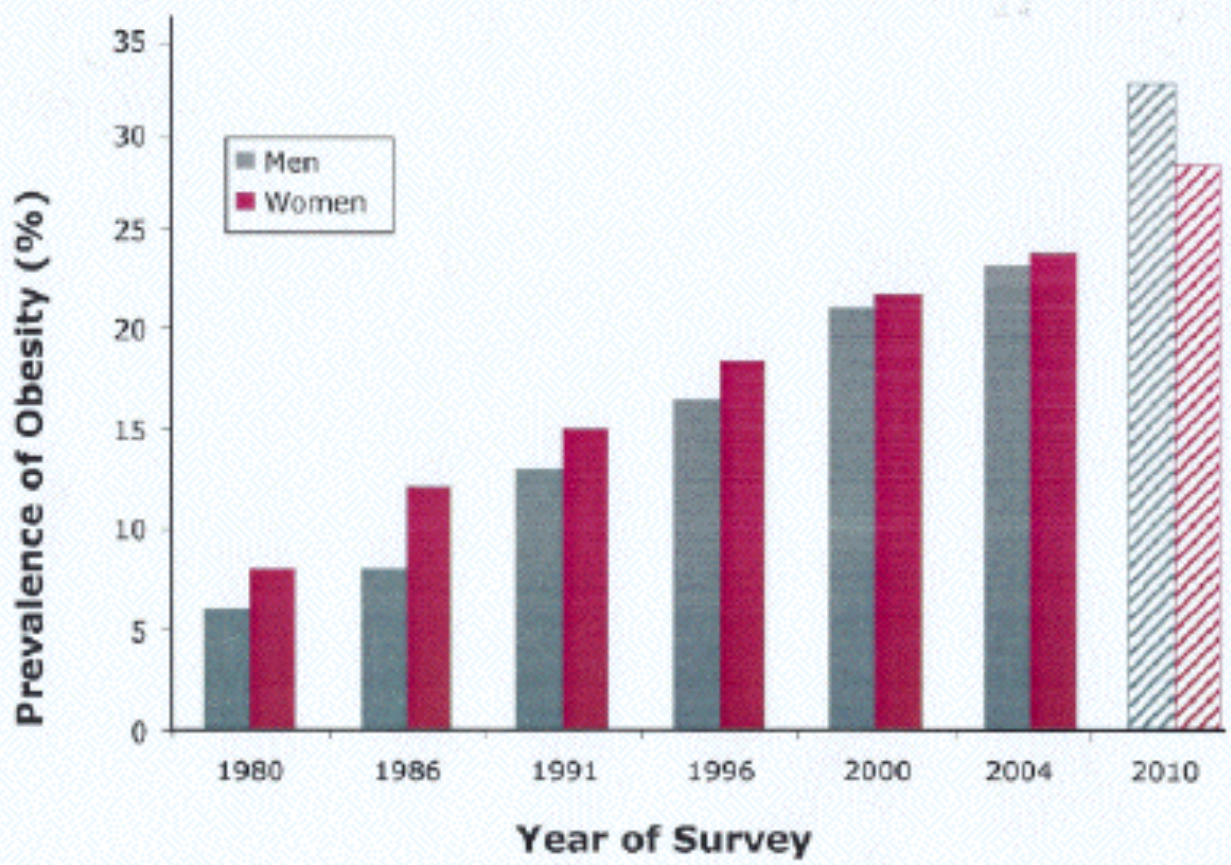
- Height / weight determined in 4733 Ghanains
- Mean age of 44.3 and BMI of 24.4
- Prevalence of overweight 23.4%
- Prevalence of obesity 14.1%
- Age standardized prevalence of obesity 13.6%

Amoah AG, Obesity in adult residents of Accra, Ghana. *Ethn Dis.* 2003 Summer; 13 (2 Suppl 2): S97-101.

# Epidemiology: U.S.A

- Prevalence
  - 66% of U.S. adults were overweight in 2004
  - 32% of U.S. adults were obese in 2004
- Demographics
  - Prevalence increases with age
  - Greater prevalence of *overweight* men
  - Greater prevalence of *obese* women
  - Prevalence decreases with higher education
  - More common in ethnic minorities
- Economics
  - 114 billion dollars in health care costs

# Increasing obesity among adults

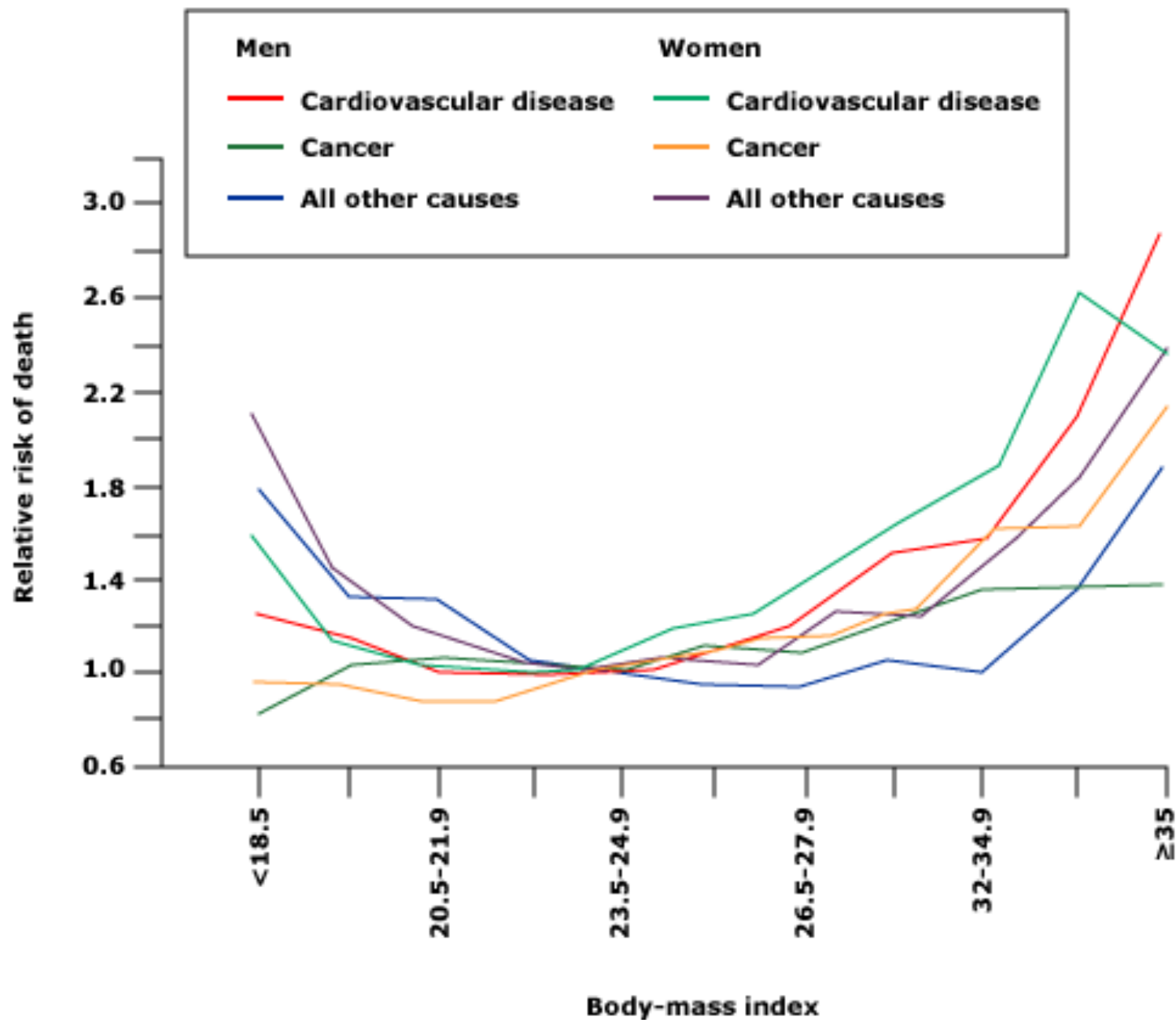


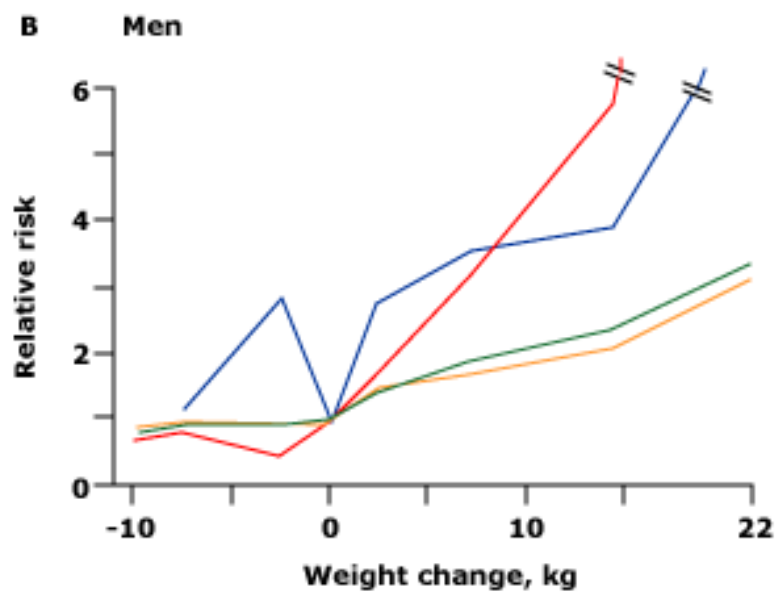
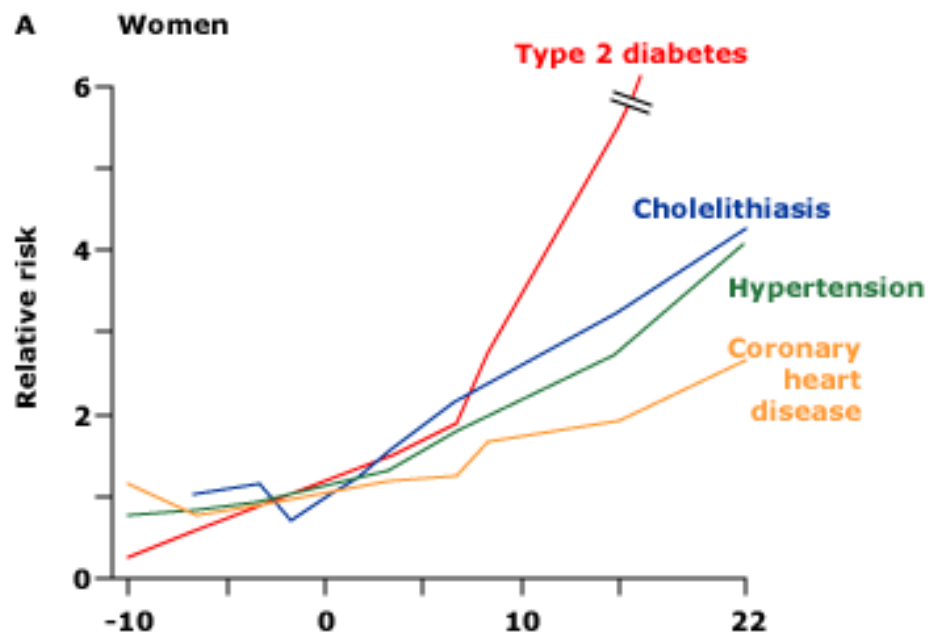
Health Survey of England

# Causes

- Environment and Culture
- Genetics
- Calorie and Energy Balance
- Diet







# Pathophysiology

- Cardiovascular System
  - Chamber dilation
  - Ventricular hypertrophy
  - Congestive heart failure
  - Fatty infiltration of the myocardium
  - Coronary artery disease
  - Blood volume alterations
  - Hypertension

# OBESITY

Obstructive Sleep Apnea

Hypertension

Pulmonary Hypertension

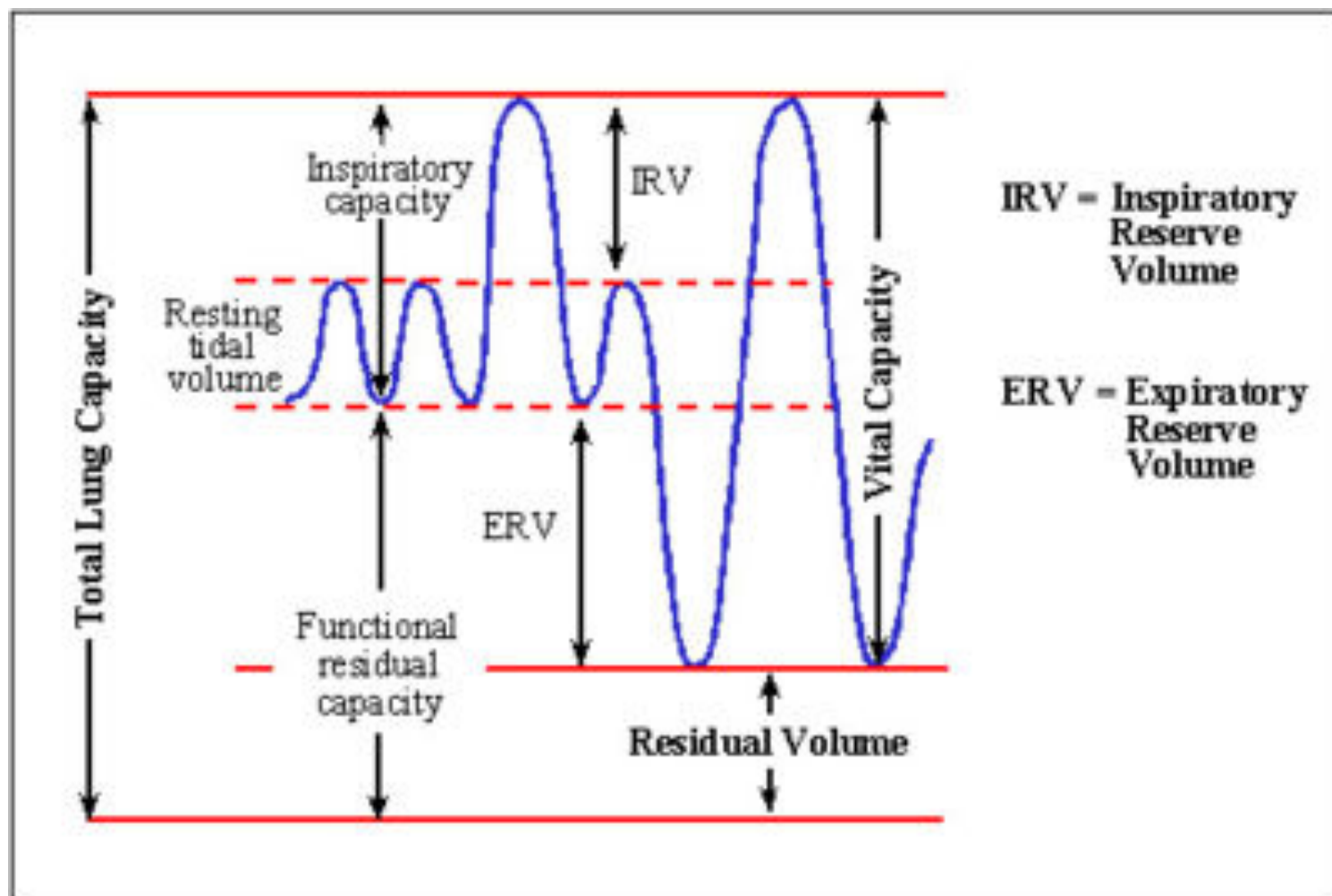
Increased Myocardial Oxygen Demand

Elevated RV Filling Pressures

LV Hypertrophy, Dilation, and Ischemia

**RIGHT VENTRICULAR FAILURE**

**LEFT VENTRICULAR FAILURE**



# Pathophysiology

- Respiratory Physiology
  - Functional residual capacity reduced
  - Expiratory reserve volume is reduced
  - Total lung capacity is reduced
  - Pulmonary compliance is decreased
  - Oxygen consumption is elevated

# Obstructive Sleep Apnea

- Periodic partial or complete obstruction of the upper airway during sleep causing repetitive arousal to restore airway patency. This results in daytime hypersomnolence in adults and aggressive behavior in children.

# Obstructive Sleep Apnea

- Pharynx has functions that contradict each other
- Normal function requires a specific set of muscles
- Function of these muscles is altered in sleep
- If the pharynx is abnormal, the body can not compensate during sleep



# Obstructive Sleep Apnea

- Signs and Symptoms
  - Snoring
  - Daytime somnolence
  - Decreased concentration
  - Hypoxemia
  - Hypercarbia
  - Polycythemia

# Obstructive Sleep Apnea

- Physical
  - BMI of 35
  - Large neck circumference
  - Craniofacial abnormalities
  - Nasal obstruction
  - Touching tonsils
- Obstruction during sleep
  - Snoring
  - Pauses in breathing
  - Frequent arousals
- Somnolence
  - Frequent fatigue
  - Falls asleep easily
  - Aggressive child



# Pathophysiology

- Endocrine System
  - Hyperlipidemia
  - Irregular menses
  - Diabetes Type II

# Pathophysiology

- Gastrointestinal System
  - Cholelithiasis
  - Fatty liver
  - Esophageal cancer
  - Reflux

# Pathophysiology

- Gastrointestinal System
  - Do NOT have slower gastric emptying nor elevated gastric volumes
  - Are NOT at increased risk for aspiration pneumonitis

# Pathophysiology

- Hematologic
  - Venous thrombosis
  - Pulmonary embolism
- Neurologic
  - Stroke
  - Dementia
- Kidneys
  - Renal insufficiency
- Musculoskeletal
  - Osteoarthritis
  - Osteoporosis
- Skin
  - Hirsutism
  - Acanthosis Nigricans
- Oncology
  - Cancer

# Preoperative Management

- Evaluation
  - Coronary artery disease
  - Heart failure
  - Diabetes mellitus
  - Obstructive sleep apnea



# Obstructive Sleep Apnea

- Preoperative evaluation
  - Severity of sleep apnea
  - Invasiveness of surgical procedure
  - Requirement for postoperative opioids

# Obstructive Sleep Apnea

- Severity of Sleep Apnea
  - None = 0
  - Mild = 1
  - Moderate = 2
  - Severe = 3

# Obstructive Sleep Apnea

- Invasiveness of procedure
  - Superficial without sedation = 0
  - Superficial with sedation/general = 1
  - Peripheral with neuraxial = 1
  - Peripheral with general = 2
  - Airway with sedation = 2
  - Major surgery or airway with general = 3

# Obstructive Sleep Apnea

- Requirement for postoperative opioids
  - None = 0
  - Low-Dose Oral = 1
  - High-Dose Oral = 3
  - Parenteral or Neuraxial = 3

# Obstructive Sleep Apnea

- Preoperative Evaluation
  - Score from “Severity of Sleep Apnea”
  - Add the greater of “Invasiveness” or “Postoperative Opioids”
  - Increased risk: 4
  - Significantly increased risk: 5-6

# Preoperative Management

- Medications
  - Histamine blockers
  - Prokinetic agents
  - Non-particulate antacid
  - Sedative and hypnotics with caution

# Intraoperative Management

- Considerations
  - Choice of anesthetic
  - Airway management
  - Positioning
  - Monitoring

# Intraoperative Management

- Choice of anesthetic
  - Regional
  - General
  - Combined



# Intraoperative Management

- Airway management
  - Mask ventilation
  - Laryngoscopy
  - Extubation



Figure 1 - Normal Position

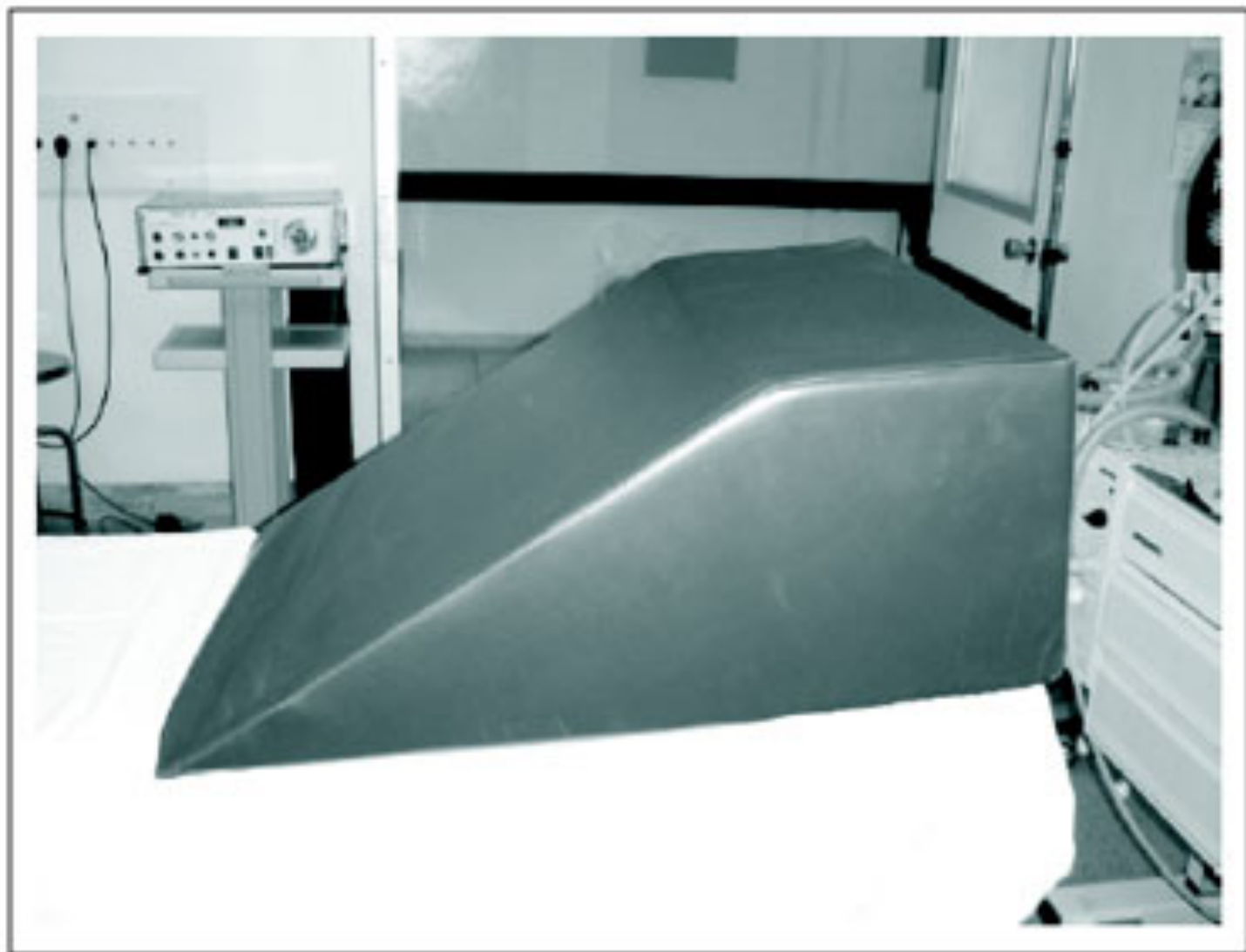


Figure 4 - Trapezoidal Device



Figure 6 - Trapezoidal Device Use

# Intraoperative Management

- Positioning
  - Pressure points
  - IVC compression
  - Pulmonary compromise

# Intraoperative Management

- Ventilation
  - Restrictive pattern
  - Elevated peak pressures
  - Positive end expiratory pressures
  - High FiO<sub>2</sub>
  - End-tidal CO<sub>2</sub> may be inaccurate

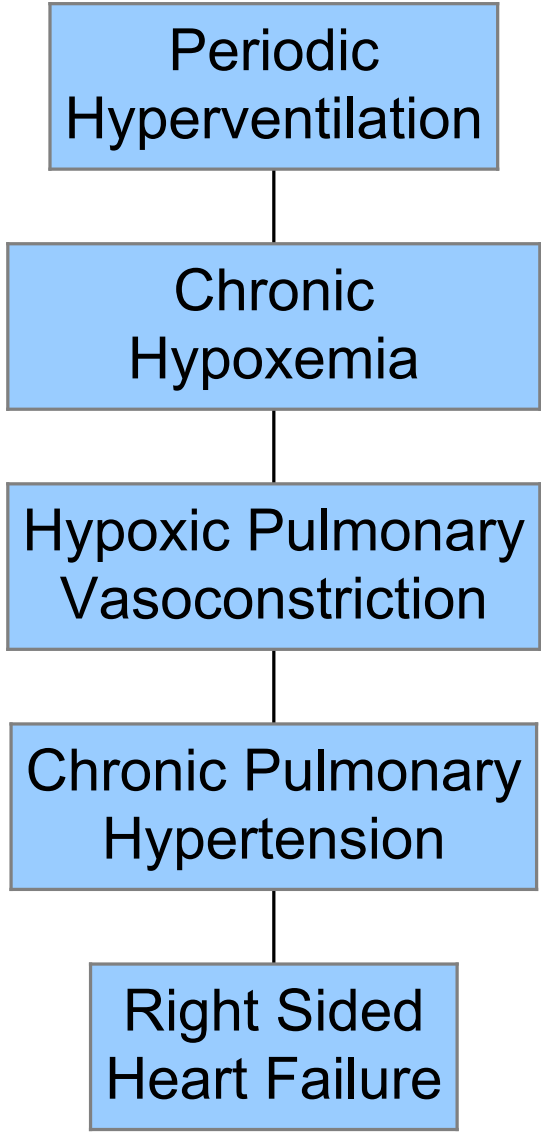
Periodic  
Hyperventilation

Chronic  
Hypoxemia

Hypoxic Pulmonary  
Vasoconstriction

Chronic Pulmonary  
Hypertension

Right Sided  
Heart Failure



# Right Heart Failure

- Signs and Symptoms
  - Dyspnea, Hypoxemia
  - Lower extremity edema
  - Jugular venous distension
  - Hepatomegally, Ascites
  - Syncope



# Right Heart Failure

- Increased O2 Demand
  - ↑ PVR
  - High heart rate
  - Dilation
  - LV dysfunction
- Decreased O2 Supply
  - RCA occlusion
  - Systemic hypotension
  - ↓ arterial O2 content
  - LV dysfunction

# Right Heart Failure

- Decrease O2 Demand
  - Optimize preload
  - Lower heart rate
  - Lower PVR
- Support Contractility
  - Phosphodiesterase inhibitors
  - Catecholamines
- Increase O2 Supply
  - Increase SVR
  - Transfuse
  - Maintain oxygenation
  - Remove RCA obstruction

# Right Heart Failure

- How to decrease PVR
  - Maintain oxygenation and ventilation
  - Correct acidosis
  - Deepen anesthetic
  - Drugs

# Intraoperative Management

- Anesthetic Agents
  - Pharmacokinetics and -dynamics altered
  - Volume of distribution altered
  - Metabolism and excretion altered

# Intraoperative Management

$$V_D = \frac{\text{total amount of drug in the body}}{\text{drug blood concentration}}$$

# Intraoperative Management

- Dosed on TBW
  - Propofol infusion
  - Thiopental
  - Midazolam
  - Succinylcholine
  - Cisatracurium
  - Fentanyl
  - Sufentanil bolus
- Dosed on IBW
  - Propofol bolus
  - Vecuronium
  - Rocuronium
  - Remifentanyl
  - Sufentanil infusion

# Intraoperative Management

- Inhaled Anesthetics
  - General
  - Nitrous

# Intraoperative Management

- Monitoring and IV Access
  - Blood pressure
  - Ventilation and oxygenation
  - Central lines



# Intraoperative Management

- Emergence
  - Ensure adequate oxygenation
  - Minimize the possibility of aspiration
  - Maximize lung mechanics

# Postoperative Management

- Overall Concerns
  - Analgesia
  - Oxygenation
  - Positioning
  - Monitoring

# Postoperative Management

- Analgesia
  - Goals
  - Recommendations

# Postoperative Management

- Outpatient Criteria
  - Sleep apnea status and severity
  - Coexisting disease
  - Type of surgery
  - Postoperative pain
  - Age
  - Capabilities as an outpatient facility

# Outpatient Criteria

- Okay
  - Superficial: local/regional
  - Minor ortho: local/regional
  - Lithotripsy
- Not Okay
  - Airway surgery
  - Tonsillectomy < 3 yo
  - Laparoscopic surgery
  - Abdominal surgery
- Equivocal
  - Superficial: general
  - Tonsillectomy < 3 yo
  - Minor ortho: general

# Outpatient Criteria

- Caveats with OSA
  - Appropriate equipment must be available
  - Severity of OSA
  - Postoperative monitoring

# Summary

- Definition and epidemiology of obesity
- Pathophysiologic features of obesity
  - Obstructive Sleep Apnea
  - Right Heart Failure
- Preoperative management
- Intraoperative management
- Postoperative management