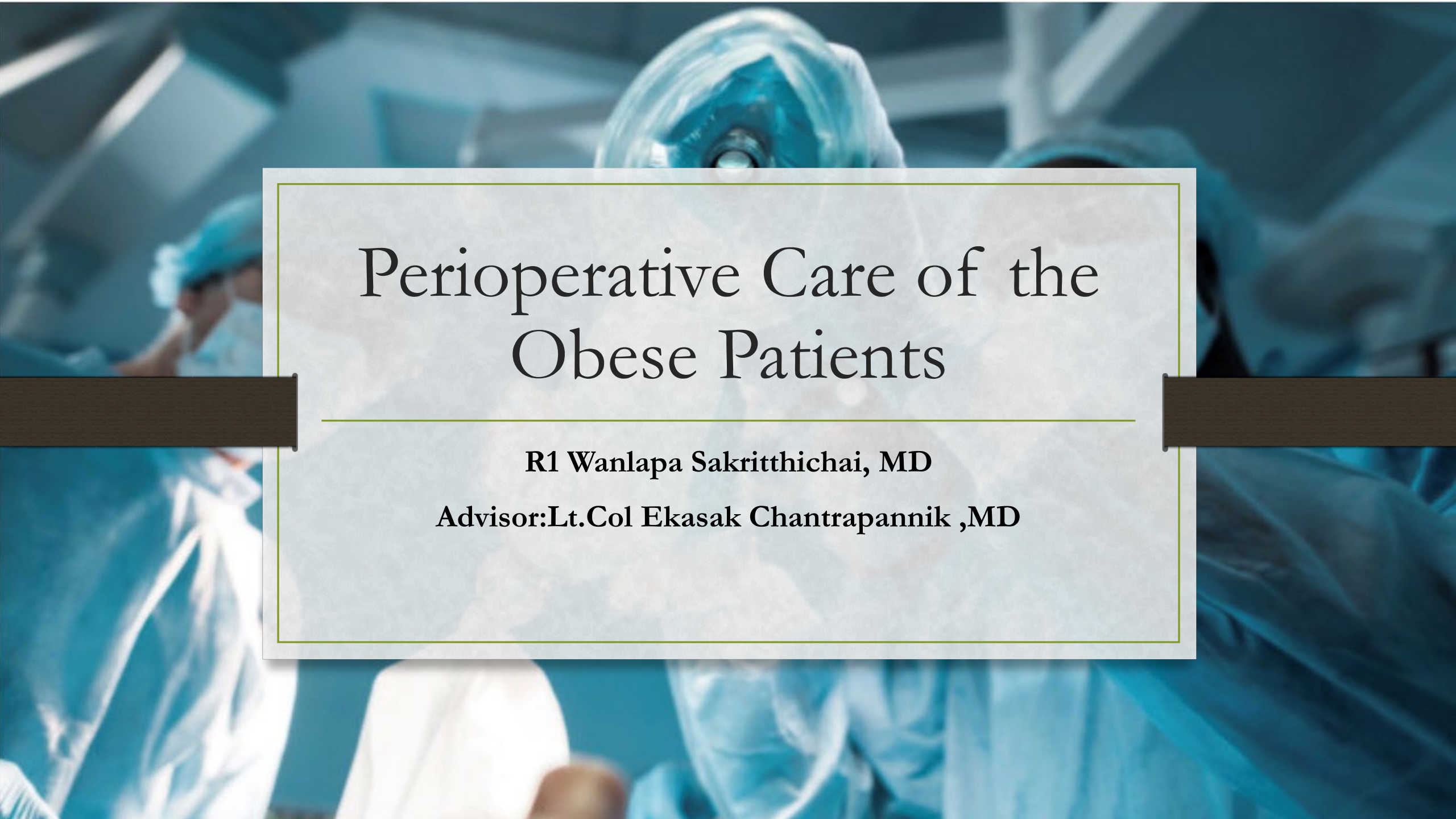

Perioperative Care of the Obese Patients

R1 Wanlapa Sakritthichai, MD

Advisor:Lt.Col Ekasak Chantrapannik ,MD

Outline

- Introduction
- Physiologic changes in obesity
- Preoperative Care
- Intraoperative Care
- Postoperative care

Introduction

Classification of obesity

BMI	Classification	WHO
18.5-24.9	Normal	
25.0-29.9	Overweight	
30.0-34.9	Obesity	Obesity class I
35.0-39.9		Obesity class II
40.0-49.9	Morbid obesity	Obesity class III
≥ 50	Super obesity	
≥ 60	Super-super obesity	

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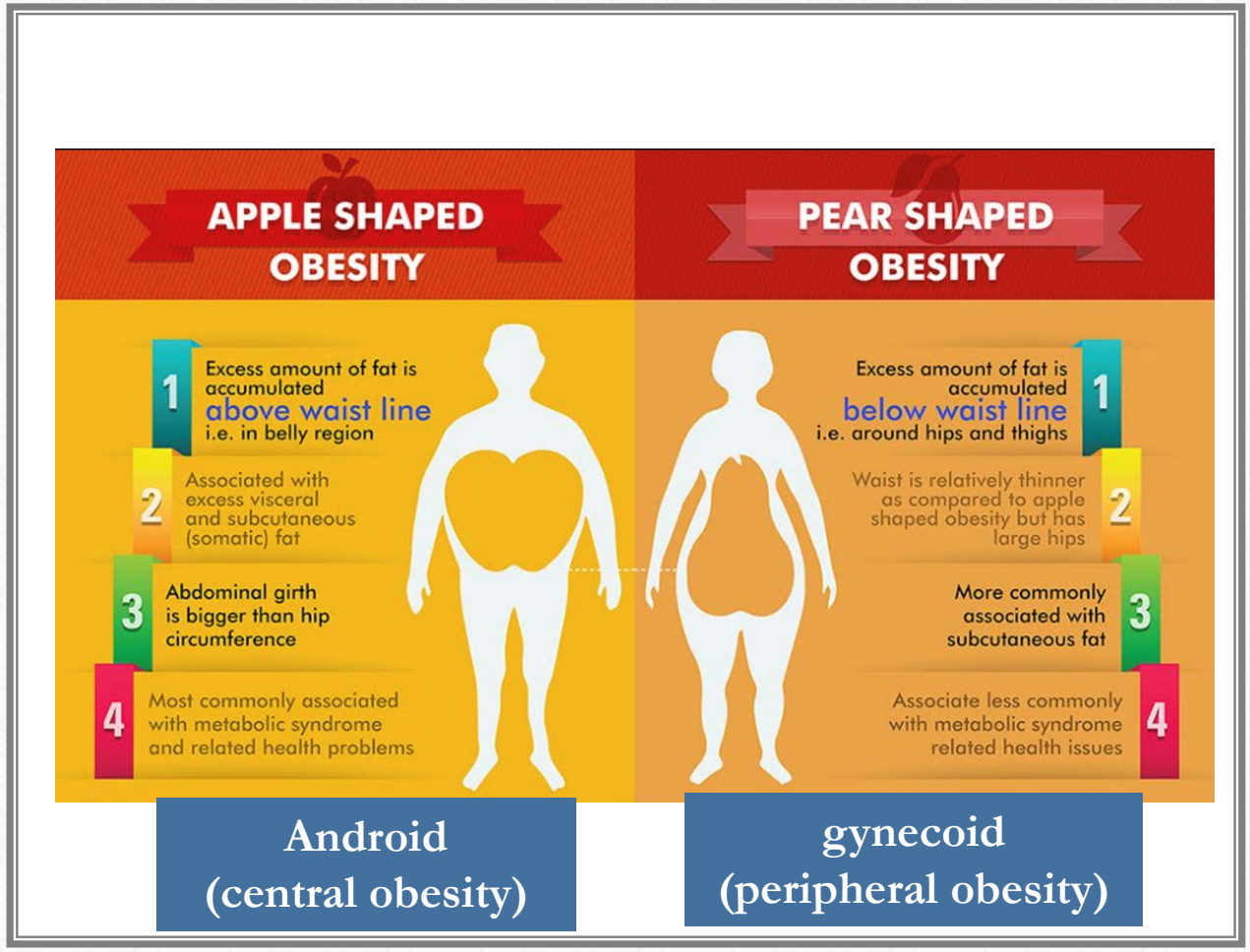
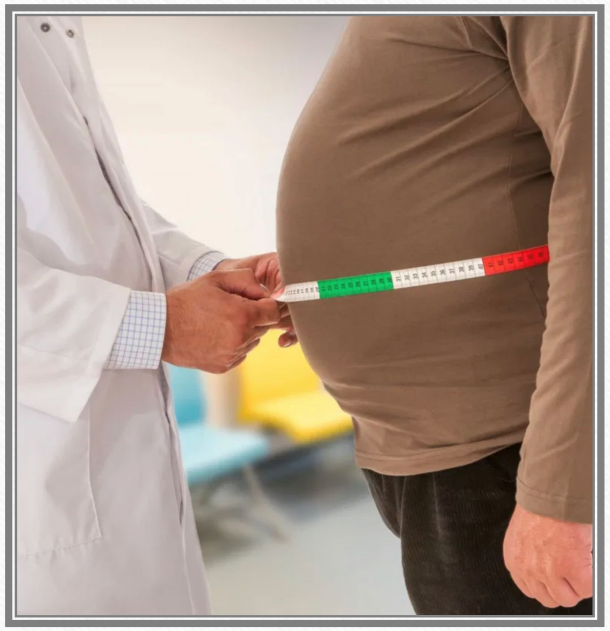
Fat Distribution



- Increase perioperative risk
- More likely to exhibit the metabolic syndrome; central obesity, HT, insulin resistance and DLP

Fat Distribution: Central obesity



Waist circumference	• >88 cm in women • >102 cm in men
Waist to height ratio	• > 0.55

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Physiologic Changes in Obesity

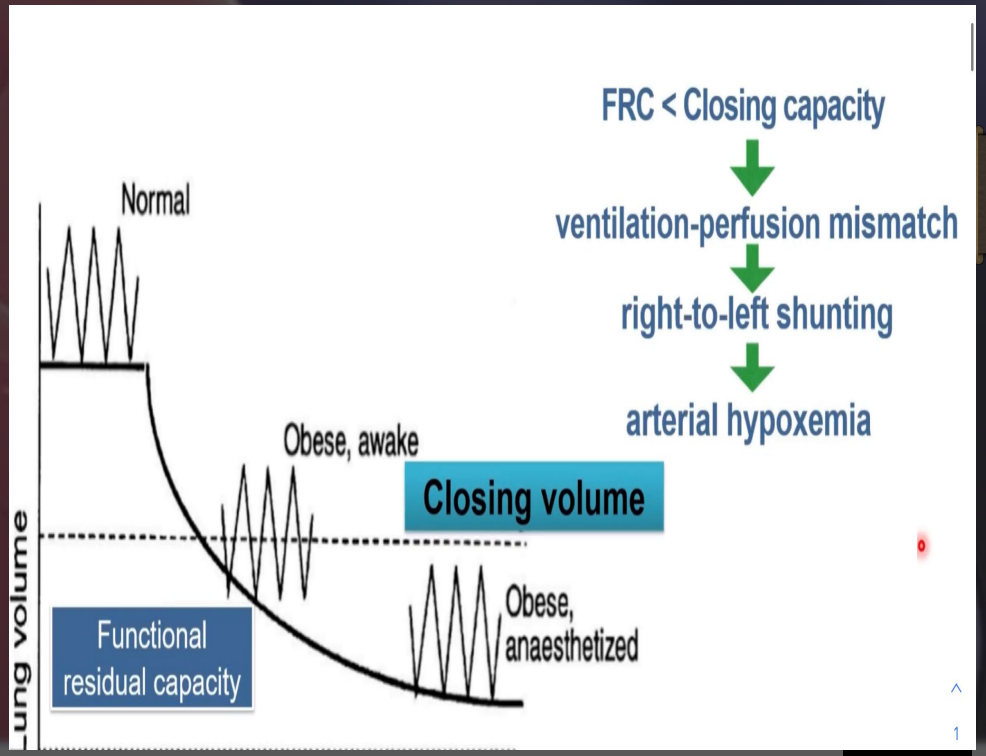
Physiological changes in obesity

- Respiratory System
- Cardiovascular System
- Gastrointestinal System
- Endocrine System
- Thrombosis

Respiratory System

Arterial oxygen levels decrease rapidly after cessation of breathing

- Reduced functional residual capacity(FRC)
- Significant atelectasis
- Increase in resting metabolic rate, working of breathing and minute oxygen demand



Respiratory System

Sleep-disordered breathing :

- Obstructive sleep apnea(OSA)
- Obesity hypoventilation syndrome(OHS)

Associated with :

- Difficult airway and laryngoscopy
- Increase the sensitivity to opioid-induced respiratory depression
- Increase incidence of postoperative desaturation and respiratory failure
- Postoperative cardiac events

Physiological change in OSA

Hypoxemia

- Increased risk of IHD and CVD
- Secondary polycythemia

Hypercapnia

- Desensitization of respiratory center to hypercapnia with result in respiratory failure

Pulmonary vasoconstriction

- Pulmonary hypertension
- Right venticular failure (cor pulmonale)

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Untreated OSA may progress to OHS

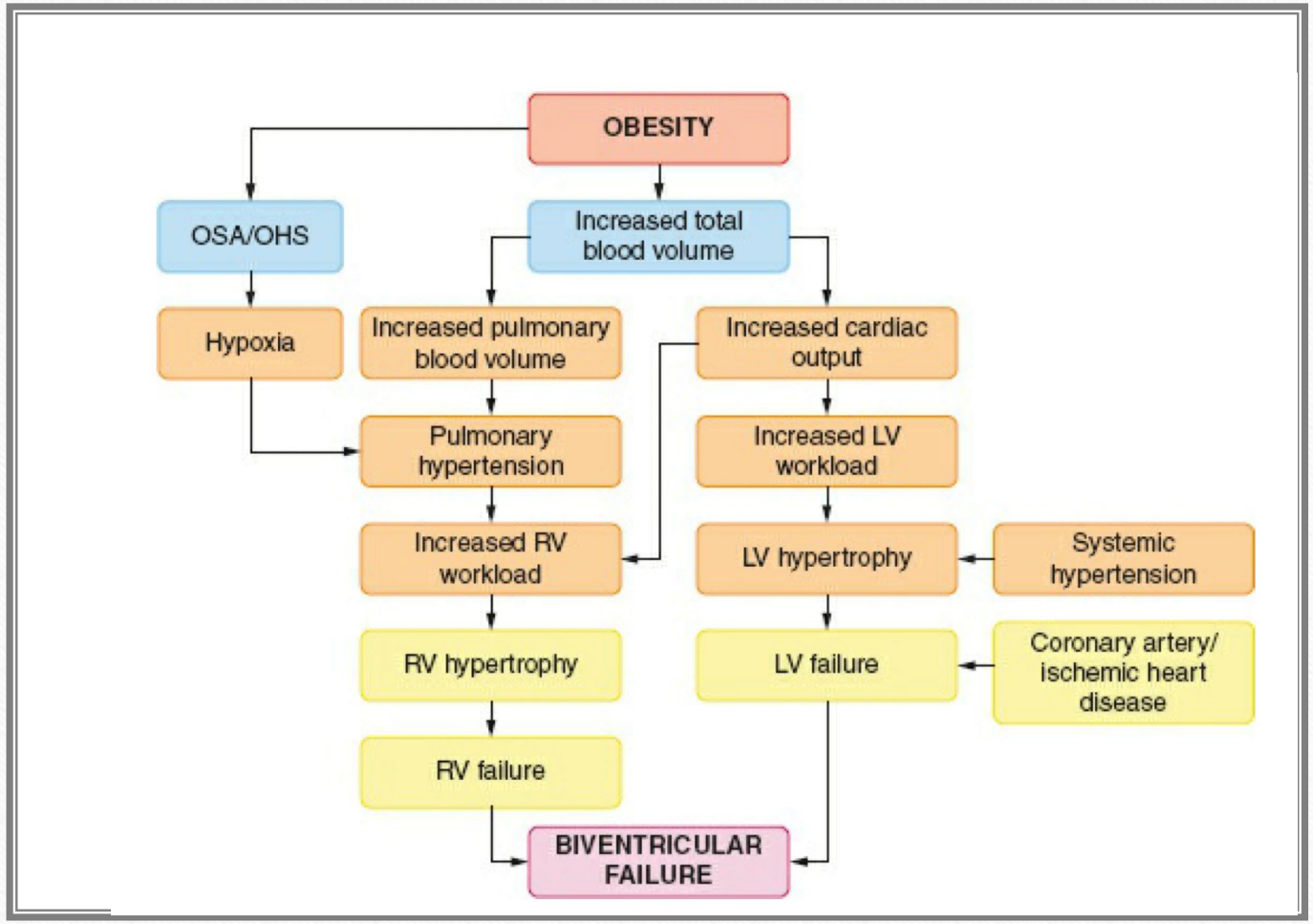
- Progressive desensitization of the respiratory centers to (noctural) hypercapnia
- Episodes of apnea without respiratory effort
- Clinical triad of OHS
  - Obesity(BMI) > 35 kg/m2
  - Sleep-disordered breathing (usually OSA)
  - Daytime hypercapnia ($PaCO_2$ > 45 mmHg)

Preoperative diagnosis and appropriate management of OSA

- Less postoperative sleep deprivation
- Improve response to analgesic and anesthetic drugs
- Normalization of cardiovascular disturbances

Cardiovascular System

- Obesity is a associated with a number of cardiac risk factors
  - HT
  - Ischemic heart disease(IHD)
  - Cardiomyopathy
  - Cardiac failure arrhythmias
  - Sudden cardiac death
  - Cerebrovascular disease
  - Peripheral vascular disease



Pathhysiology of Cardiomyopathy

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Gastrointestinal System

- The volume and acidity of gastric contents is often increased, always considered as **full stomach**
  - **Increase risk of aspiration**
  - Sufficient NPO time
  - Aspiration prophylaxis
- **High risk esp. GERD, chronic gastritis, hiatus hernia and gastroparesis**

Endocrine System

Impaired glucose tolerance	Hyperglycemia, insulin resistance, and DM	Exogenous insulin
• High prevalence of type II DM	• wound infections • increased risk of myocardial infarction	• oppose the catabolic response to surgery

Metabolic Syndrome

- Wrist circumference : Men > 102 cm, Women > 88 cm
- Plus 2/4 of
- Triglyceride > 150 mg/dl
- HDL : Men < 40 mg/dl ,women< 50 mg/dl
- BP ≥130/85 mmHg or use of medication
- Fasting glucose ≥ 110 mg/dl or use of medication

Miller's Anesthesia, Ninth Edition, Manuel C.Pardo, Jr.,Ronald D.Miller

Metabolic Syndrome

Impaired glucose tolerance

- disturbance of the autonomic nervous system
- abnormal adrenergic reflexes in 25% of patients

Metabolic syndrome is predictor of postoperative complications

- Pulmonary eg. atelectasis, pneumonia, ARDS, respiratory failure
- Cardiac adverse events
- AKI

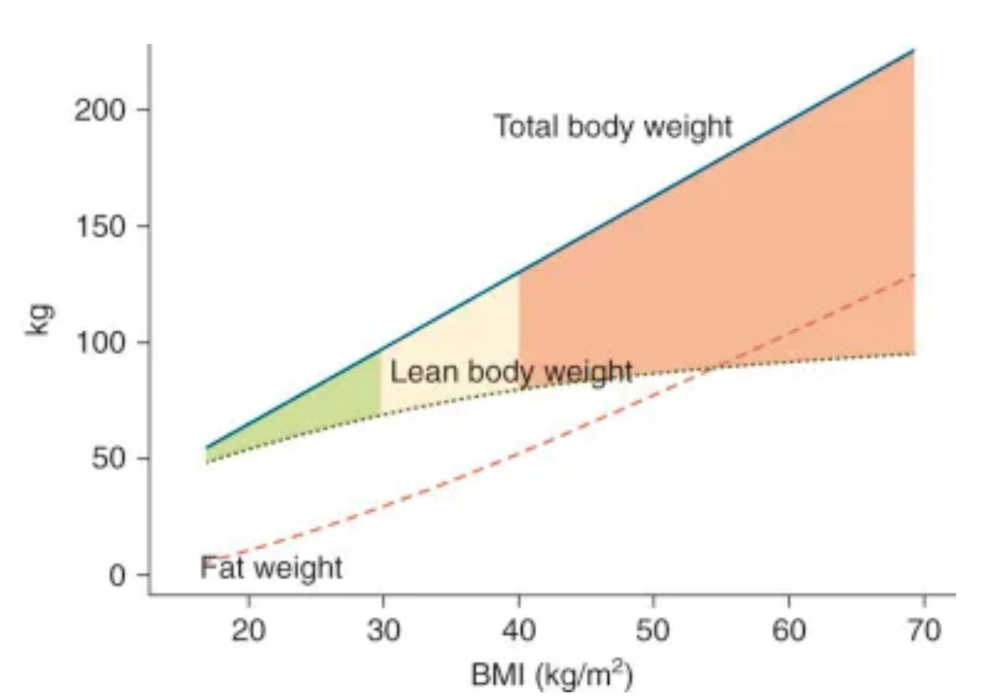
Thrombosis

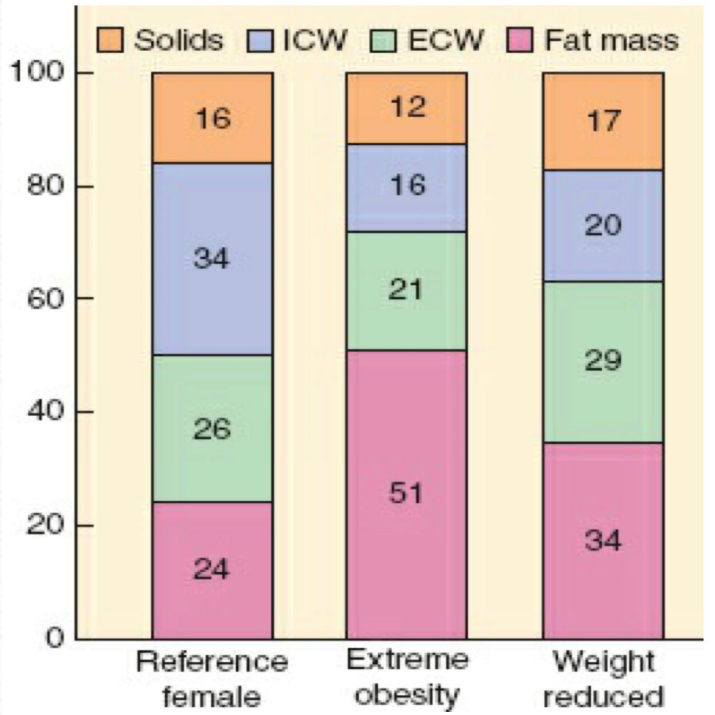
- Obesity is a pro-thrombotic state
- Associated with thrombotic disorders such as MI, stroke and VTE
- Hypercoagulable state may extend beyond 2 weeks, warranting extended postoperative VTE prophylaxis depending on the type of surgery and the patient's BMI

Thromboprophylaxis

- Appropriated sized compression stockings
- Unfractionated heparin
- LMWH

Pharmacologic Principles





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- **Ideal body weight (IBW) - what the patient should weigh with a normal ratio of lean to fat mass. Varies height and sex:**

$$\text{IBW (kg)} = \text{height (cm)} - x$$
$$(\text{where } x = 105 \text{ in females and } 100 \text{ in males})$$

- **Lean body weight (LBW) - patient's weight excluding fat. Most widely used formula is that of Janmahasatian et al.**

$$\text{LBW (kg)} = \frac{9270 \times \text{TBW (kg)}}{6680 + (216 \times \text{BMI (kg.m}^{-2}))} \text{ (men)}$$

$$\text{LBW (kg)} = \frac{9270 \times \text{TBW (kg)}}{8780 + (244 \times \text{BMI (kg.m}^{-2}))} \text{ (women)}$$

Regardless of TBW, LBW rarely exceeds 100 kg in men and 70 kg in women

Drug	Dosing	Practical Anesthesia Key Points
Thiopental	Induction: LBW (somewhat increased)	Increased initial dose due to increased blood volume, cardiac output, muscle mass Rapid distribution from plasma to periphery Increased absolute dose Prolonged duration of action due to high lipophilicity and increased VD Longer elimination half-life
Propofol	Induction: LBW (somewhat increased) Maintenance infusion: TBW	Short duration of action due to rapid redistribution Highly lipophilic Cardiac output is major determinant of peak plasma concentration Increased VD at steady state and increased clearance prevent increases in elimination half-life Total clearance and VD at steady state correlate with TBW during maintenance infusion Negative cardiovascular effects High affinity for fat and well-perfused organs High hepatic extraction and conjugation relate to TBW
Succinylcholine	TBW	Pseudocholinesterase activity increases linearly with increasing weight and large extracellular fluid compartment Dose of succinylcholine should be increased
Rocuronium	LBW	Dosing according to LBW to prevent delayed recovery due to increased VD Faster onset and longer duration when dosed according to TBW Pharmacokinetics and pharmacodynamics not altered in obese female patients
Vecuronium	LBW	Prolonged action when dosed according to TBW Dosing according to LBW to prevent delayed recovery due to increased VD and impaired hepatic clearance Obesity does not alter distribution or elimination of the drug
Atracurium	LBW	VD, absolute clearance, and elimination half-life unchanged by obesity Unchanged dose per unit body weight without prolongation of recovery because of organ function-independent elimination
Cis-atracurium	LBW	Pharmacokinetics similar to atracurium but prolonged duration of action when dosed according to TBW
Benzodiazepines		Highly lipophilic drugs with larger VD in obese patients result in longer duration of action Midazolam has potential for prolonged sedation because larger initial doses are required to achieve adequate serum concentrations

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Fentanyl	LBW	Measured total body clearance has a nonlinear relationship to TBW and overestimates plasma concentration Fentanyl dosing based on a derived LBW or "pharmacokinetic mass" model correlates better with clearance than TBW dosing Dosing based on TBW overestimates dose requirements in the obese patient
Sufentanil	LBW	Highly lipid soluble Increased VD and prolonged elimination half-life, which correlates with degree of obesity Distributes extensively in excess body fat Similar pharmacokinetic parameters in obese and nonobese predict similar plasma concentrations Overestimation of plasma concentration occurs in the morbidly obese range (BMI >40 kg/m^2)
Remifentanil	LBW	Pharmacokinetics similar in obese and nonobese patients (i.e., more closely related to lean body mass than LBW) Systemic clearance and VD corrected per kilogram of TBW are significantly smaller in the obese patient; consider age and LBW for dosing
Dexmedetomidine	TBW	Highly selective α_2-adrenergic agonist Sedative-hypnotic, anesthetic-sparing analgesic, sympatholytic properties Lacks significant effects on respiration Ideal analgesic adjuvant in the morbidly obese patient As part of a balanced anesthetic, infusion rates of 0.2–0.7 µg/kg/hr produce clinically effective sedation with decreased analgesic and anesthetic requirements
Neostigmine	TBW	Prompt early reversal but delayed full recovery during neostigmine-induced reversal of vecuronium dosed according to TBW
Sugammadex	TBW	A modified γ-cyclodextrin compound that encapsulates rocuronium (and other steroid-based neuromuscular blockers to a lesser extent) May prove invaluable for more rapid and complete neuromuscular blockade reversal in obese patients

Clinical Anesthesia, Eight Edition, Paul G Barash

Review

Perioperative care of the obese patient

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Preoperative Care

Preoperative Care

- Comprehensive medical management
- Equipment and monitoring
- Airway evaluation
- Preanesthesia medications

Compenhensive Medical Management

Weight loss

- improve hypertension, DLP and insulin resistance

Low-calorie diets

- reduced the size of the liver
- improves liver retraction and access to the gastroesophageal junction during bariatric surgery

Tobacco and alcohol stopped at least 4 weeks

- Decrease risk of postoperative complication

Comprehensive Medical Management

CPAP at least 4 weeks

- particularly if OSAS is severe or OHS

Oral hypoglycemic : discontinued 1–2 days

- restarted when patients resume eating.

Long-acting insulin

- switched to an intermediate-acting form 1–2 days

Compenhensive Medical Management

Obesity itself is not an independent predictor of pulmonary aspiration

- Routine aspiration prophylaxis is unnecessary

Prophylaxis when risk factors are present

- GERD, increased gastric volume, anticipated difficult airway

Oral carbohydrate conditioning

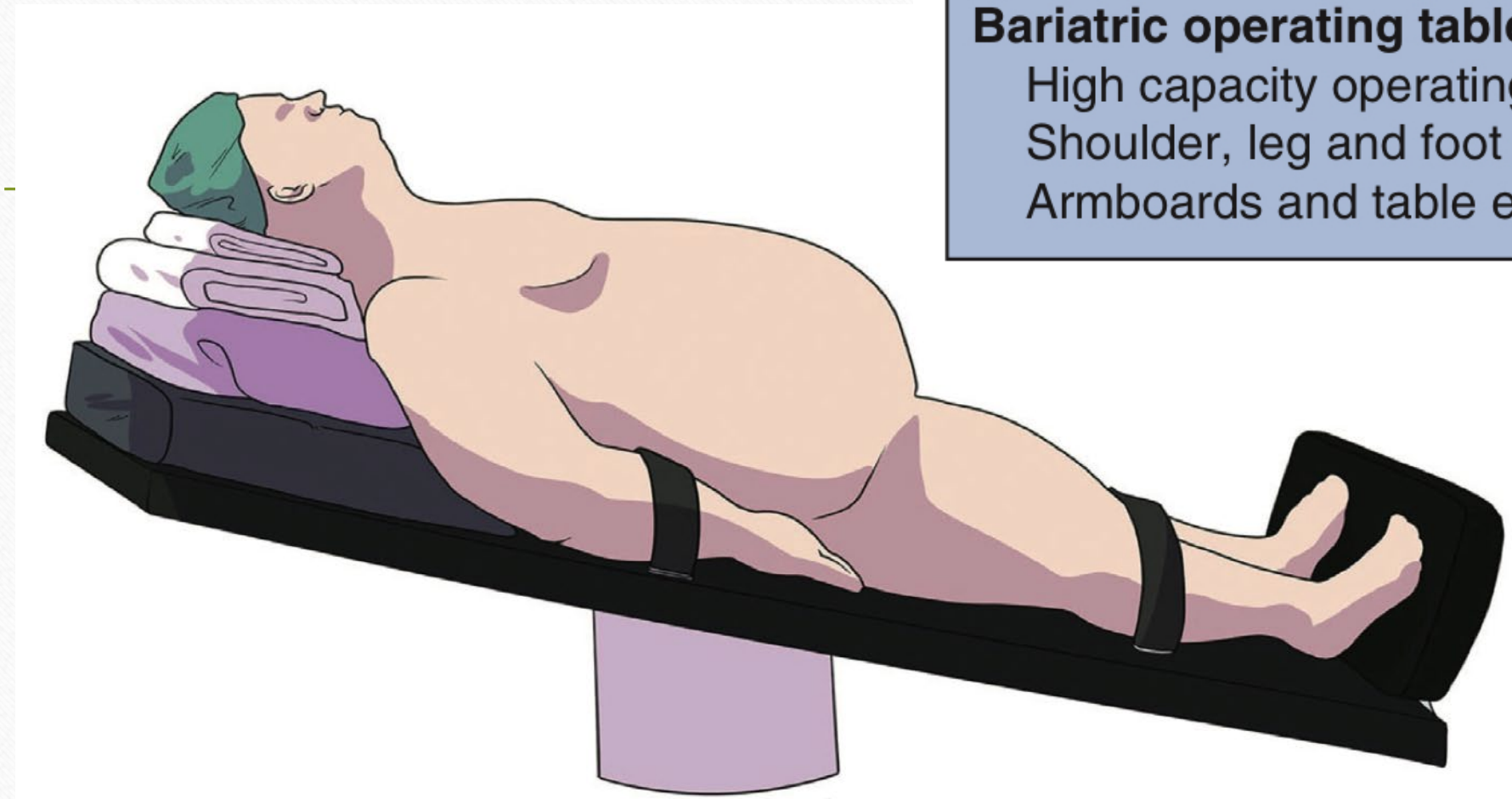
- before major abdominal surgery has metabolic and clinical benefits

Equipment and Monitoring

- Ramping device
- Difficult airway equipments
- Large BP cuff
- Depth of anesthesia and NMBD monitoring

Ramp device

Equipment and Monitoring

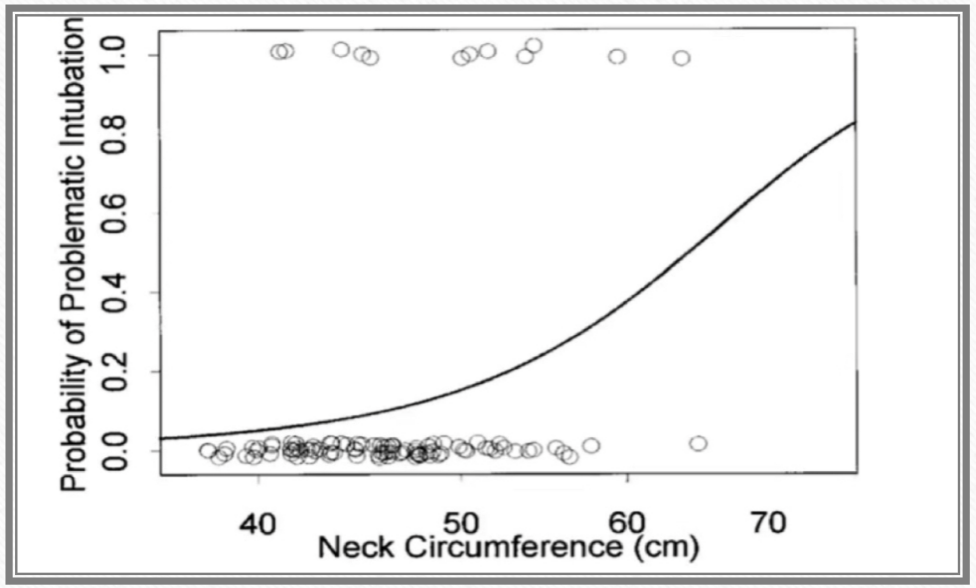


Bariatric operating table

- High capacity operating table
- Shoulder, leg and foot supports
- Armboards and table extensions

Airway Evaluation

- BMI by itself is not a predictor of difficult intubation
- Problematic intubation
  - increased age
  - male sex
  - temporomandibular joint pathology
  - Mallampati classes 3 and 4
  - OSA
  - abnormal upper teeth.



STOP-BANG

Item	Question
1. **S**noring	Do you snore loudly (louder than talking or loud enough to be heard through closed doors)?
2. **T**ired	Do you often feel tired, fatigued or sleepy during the daytime?
3. **O**bserved	Has anyone observed you stop breathing during your sleep?
4. Blood **P**ressure	Are you being, or have been, treated for high blood pressure?
5. **B**ody mass index	Is your body mass index > 35 kg/m^2?
6. **A**ge	Are you > 50 years old?
7. **N**eck circumference	Is your neck circumference > 40 cm?
8. **G**ender	Are you male?

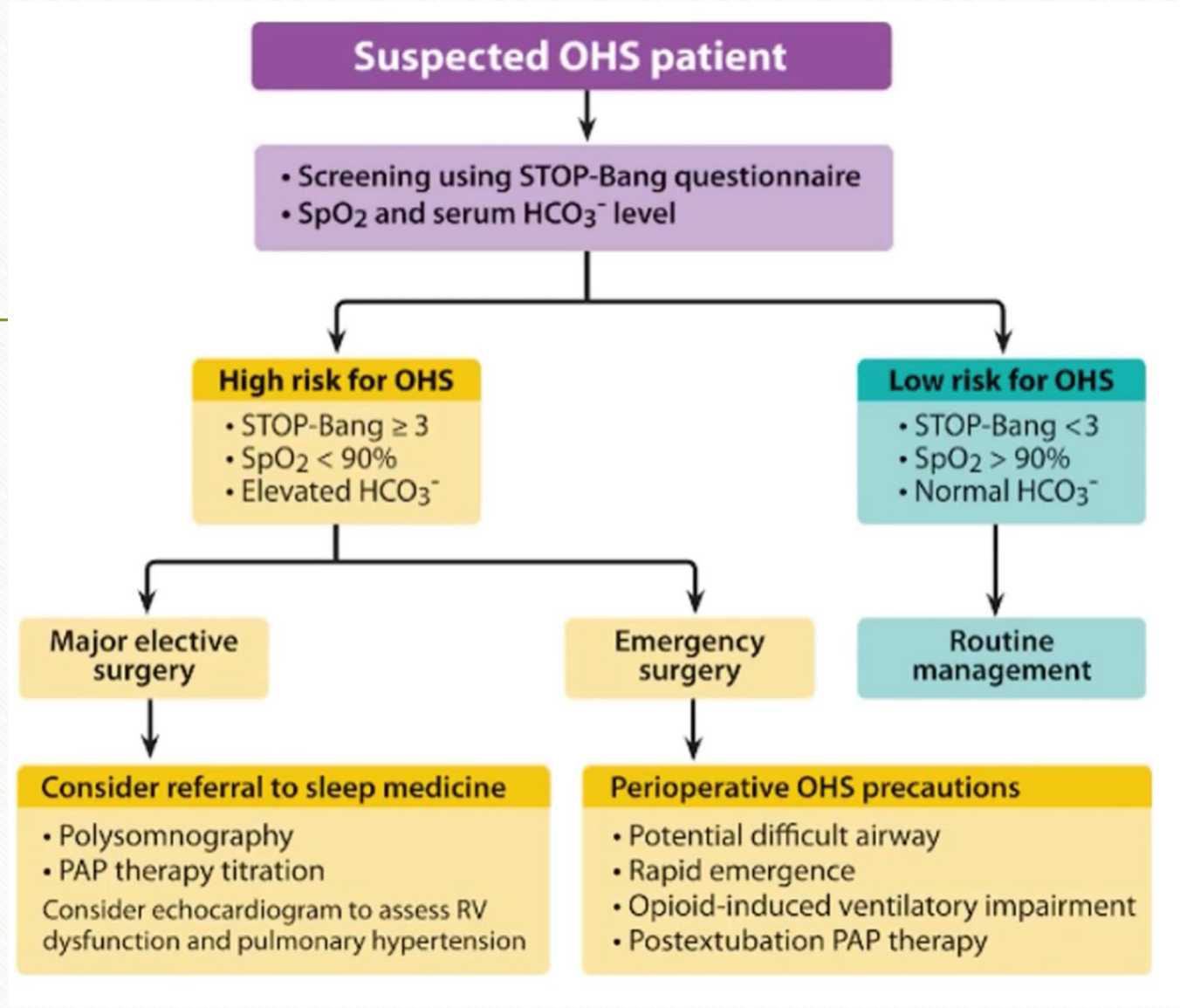
scores of ≥ 3 implies significant risk of OSA

scores of ≥ 5 implies very high likelihood of OSA

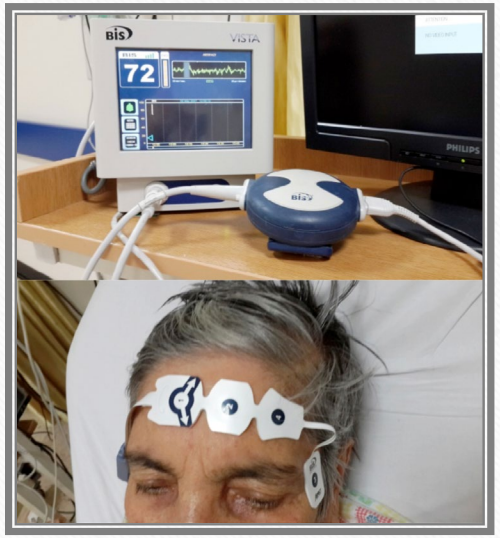
Severity	AHI
Mild	5-15
Moderate	15-30
Severe	>30

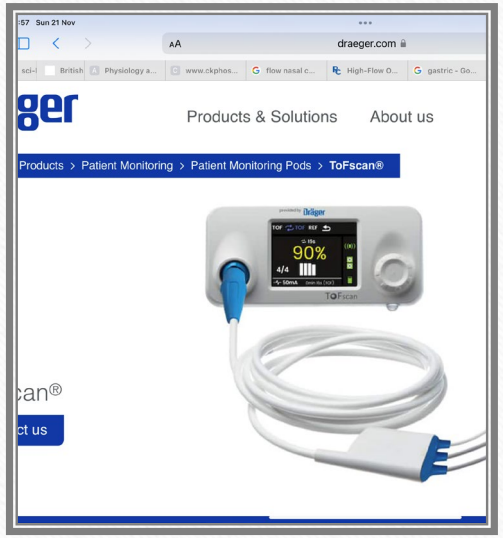
Polysomnography

- Apnea-hypopnea index(AHI) : total No. of episodes of apnea and hypopnea per hour
- Severe OSA :rapid and severe desaturation at induction, CPAP or BiPAP for 6-12 wks before surgery
- Moderate or severe OSA : baseline PaO_2, $PaCO_2$ and bicarbonate are determined
- CPAP > 10 : potential for difficult mask ventilation


Suspected OHS patient
• Screening using STOP-Bang questionnaire
• SpO_2 and serum HCO_3^- level
High risk for OHS
• STOP-Bang ≥ 3
• SpO_2 < 90%
• Elevated HCO_3^-
Low risk for OHS
• STOP-Bang <3
• SpO_2 > 90%
• Normal HCO_3^-
Major elective surgery
Emergency surgery
Routine management
Consider referral to sleep medicine
• Polysomnography
• PAP therapy titration
Consider echocardiogram to assess RV dysfunction and pulmonary hypertension
Perioperative OHS precautions
• Potential difficult airway
• Rapid emergence
• Opioid-induced ventilatory impairment
• Postextubation PAP therapy

Equipment and Monitoring





- Bispectral index : TIVA or $ETCO_2$ are not monitored during inhalation anesthesia
- TOF : reduced of residual muscle weakness

Preanesthesia Medications

- Multimodal approach to PONV prophylaxis
  - Combination of dexamethasone, ondansetron and haloperidol
    - Significant reduce PONV
    - Resue antiemetic use after laparoscopic sleeve gastrectomy
- Oral pregabalin and gabapentin : postoperative pain prophylaxis
- Melatonin : improve pain the day after surgery

Preanesthesia Medications

- VTE prophylaxis
  - Mechanical method : stockings, sequential alternating compressive devices
  - Chemoprophylaxis : low-dose subcutaneous unfractionated heparin or LMWH
  - early postoperative mobilization
  - obese patients with a high risk of VTE (men, older age, high BMI, OSAS, OHS, previous VTE)

Preanesthesia Medications

- Oral benzodiazepines : little or no respiratory depression
- If intravenous midazolam is used : closely monitored, with supplementary oxygen immediately available
- Ketamine plus clonidine or dexmedetomidine : minimal adverse respiratory effects

Intraoperative Care

Intraoperative Care

- Anesthetic management
- Analgesia
- Neuromuscular blockade
- Intraoperative lung ventilation
- Fluid and temperature management

Anesthetic Management

- In elective obese patient with no other risk factors for aspiration
- Rapid sequence induction
  - symptomatic GERD
  - gastrointestinal disorders
  - emergency surgery
- The risk and benefits of RSI and cricoid pressure should be weighted
  - Rapid desaturation during apnea
  - Cricoid pressure seems to make intubation more problematic

Anesthetic Management

- Propofol
  - ideally guided by bispectral index monitoring.
  - Propofol dosing based on LBW may avoid hypotension

Neuromascular blockade

- Both succinylcholine and rocuronium
  - rapidly achieve favorable intubation conditions
- succinylcholine
  - reduce the safe apnea period
- rocuronium followed by reversal with sugammadex
  - earlier re-establishment of spontaneous ventilation

Anesthetic Management

- Desflurane : best option
  - low lipophilicity and solubility limit distribution in adipose tissues
  - faster emergence and recovery
  - better early postoperative oxygenation and lung function than propofol anesthesia
- No differences between desflurane and propofol
  - incidence of rhabdomyolysis
  - postoperative cognitive dysfunction in older obese patients

Analgesia

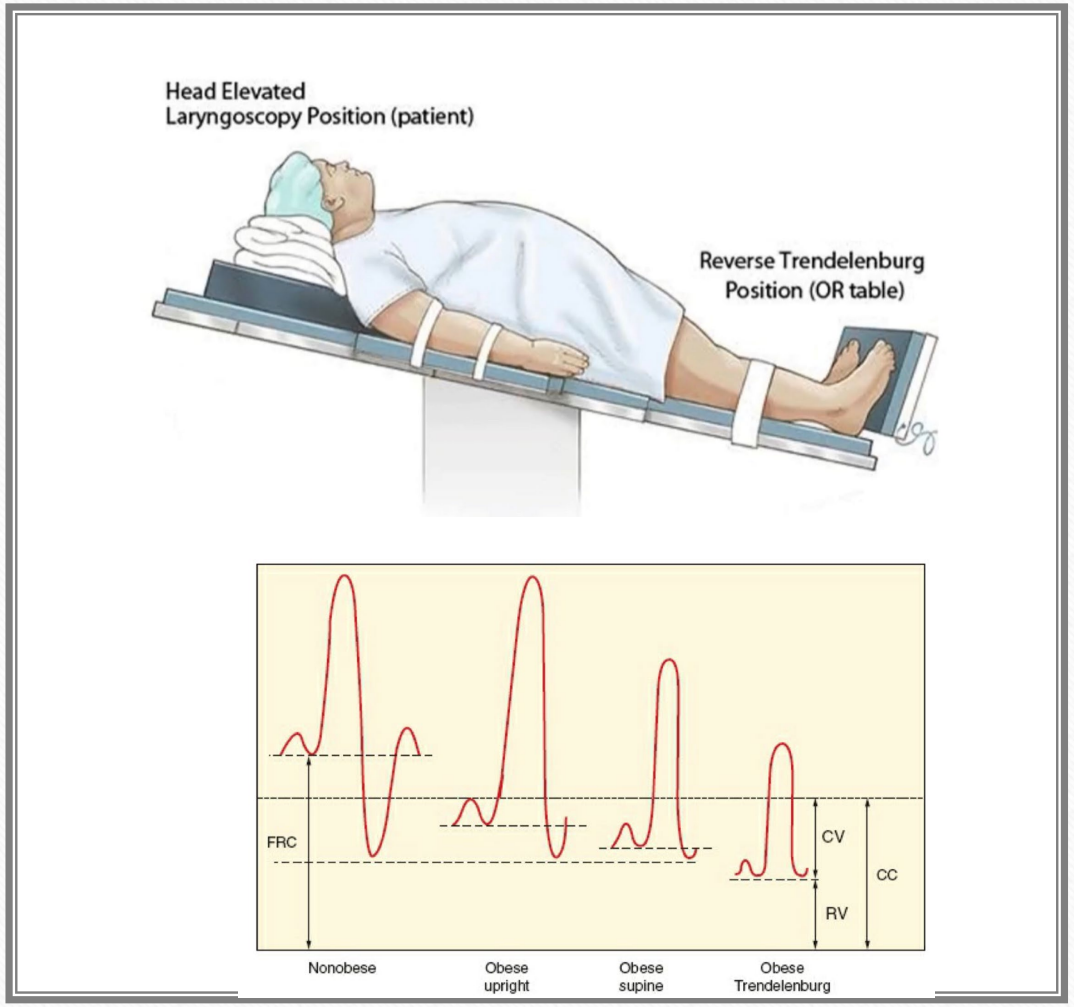
- Multimodal analgesia
  - Dexamethasone
  - Acetaminophen
  - NSAIDS
  - Ketamine
  - α-2 agonists (clonidine, dexmedetomidine)
  - Local anesthetic wound infiltration
  - TAP block
  - If intraoperative opioids are required, a short-acting opioid is preferred for obese patient

Intraoperative Lung Ventilation

- Decrease O_2 reserve and increase basal O_2 requirement lead to rapid desaturation
- Normally pre-oxygenation with 100% O_2 via a tight-fitting facemask
  - 3 min at TV ventilation
  - 8 vital capacity breaths within 60 sec
- Increase Safe Apnea Period(SAP) to 8-10 min in non-obese patients, but by only 2-3 min in obese patients

How to increase "Safe Apnea Period"(SAP)

Ideal position for morbid obes patient
"Reverse Trendelenburg"

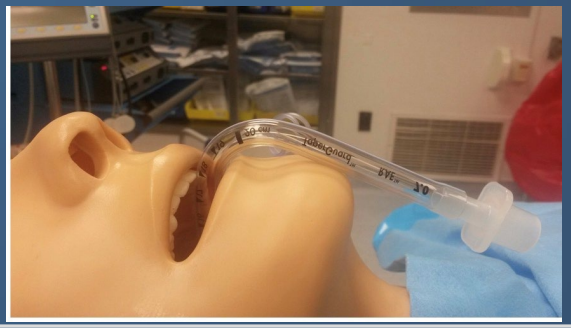


How to increase “Safe Apnea Period”(SAP)

- Preoxygenation until end tidal oxygen>0.9
- Apply of CPAP 5-10 cmH_2O during preoxygenation following by 5-10 cmH2O PEEP during face mask ventilation
- Minimize induction to ventilation interval
- During apnea, SAP can be increased by passive oxygenation “**apnea oxygenation :** nasal canula, HFNC, buccal RAE tube

How to increase “Safe Apnea Period”(SAP)

- Preoxygenation with CPAP:
  - Increase SAP 50 %
- 2nd Generation supraglottic devices before ETT
  - Increase SAP 50% compared with preoxygenation with CPAP
- Buccal oxygen delivery
  - Increase SAP 2.5 folds



Recent advances in anesthesia of the obese patient

Jay B. Brodsky, Writing – Original Draft Preparation, Writing – Review & Editing

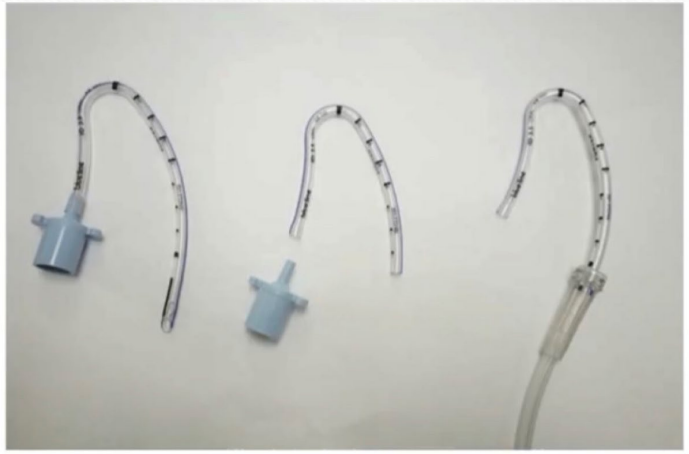
How to increase “Safe Apnea Period”(SAP)

- 70 L/minute of HFNC
  - routine pre-oxygenation and then continued both during intravenous induction of anesthesia and following paralysis.
- median apnea time was 14 minutes, and no SpO_2 less than 90%
- prevent hypoxia before and during intubation attempts by extending SAP

Patient Safety

Section Editor: **Richard C. Prielipp**

Apneic Oxygenation During Prolonged Laryngoscopy in Obese Patients: A Randomized, Controlled Trial of Buccal RAE Tube Oxygen Administration



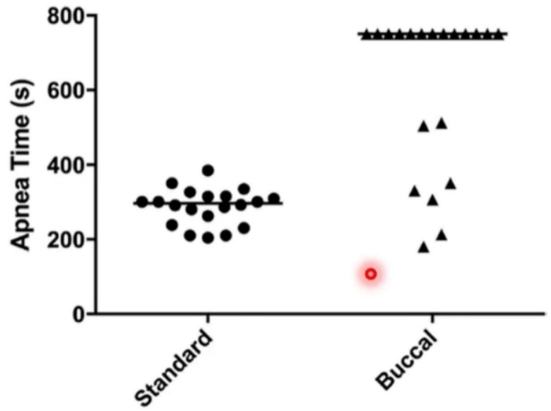


Figure 5. Apnea time with $Spo_2 \geq 95\%$, horizontal line = median.

Modifying a 3.5-mm RAE tube to deliver oral oxygen at 10l/min during laryngoscopy also significantly increases SAP in obese patients

Recommended Ventilation Strategies

- To reduce atelectasis during and after anesthetic induction
  - **FiO_2 between 0.3 and 0.8,** even during the preextubation period
  - **PPV during induction**, increase SAP
  - **Recruitment maneuver(RM) immediately after intubation,** with pressure 40-50 cm H_2O in 8-10 sec
  - Use of **Reverse trendelenburg position** whenever possible, from the time of preoxygenation to extubation

Recommended Ventilation Strategies

- Low tidal volume
  - VT 6-8 ml/kg of PBW
  - Avoid large VT and high ventilatory pressure
- Increase RR for excessive hypercapnia
  - Maintain physiologic $ETCO_2$
  - Consider permissive hypercapnia
- Keep plateau pressure < 30 cmH_2O

Predicted body weight (PBW):
Predicted BW (males) = 50 + 0.91 (cm of height − 152.4) in kg
Predicted BW (females) = 45.5 + 0.91 (cm of height − 152.4) in kg

Recommended Ventilation Strategies

- Keep lung expansion
  - **Application of PEEP 10 cmH_2O until extubation**
    - always after recruitment maneuvers
  - **Avoid losing PEEP**
    - effect by suctioning the tube or by accidental disconnection of the circuit

Fluid and Temperature Management

- Risk of CHF or respiratory compromise during head down and air embolism during head position
- Other functional parameters have been suggested (eg. **PPV**)
- Fluid therapy : IBW
- Perioperative hypothermia should be avoided
  - active forced-air warming, warmed intravenous fluids

Emergence from anesthesia

- Reversal of neuromuscular blockade: **nerve stimulator**
- Extubation : adequate reversal of NMB
- Almost upright or in reverse trendelenburg
- In those patients with confirmed OSA, the insertion of a nasopharyngeal airway, before waking helps mitigate the partial airway obstruction

Postoperative Care

Postoperative Care

- head-elevated or semiseated position
- CPAP in the early postoperative period
- continuous high-low nasal cannula
- patient-controlled analgesia is recommended, instead of a continuous infusion
- Analgesia by the enteral route should be commenced as early as possible

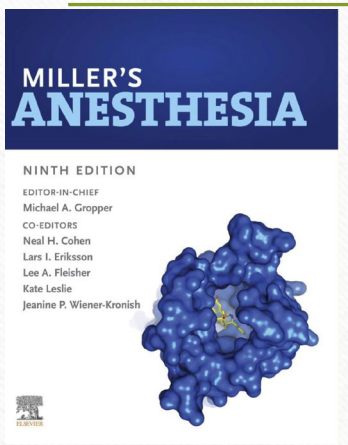
Postoperative Care

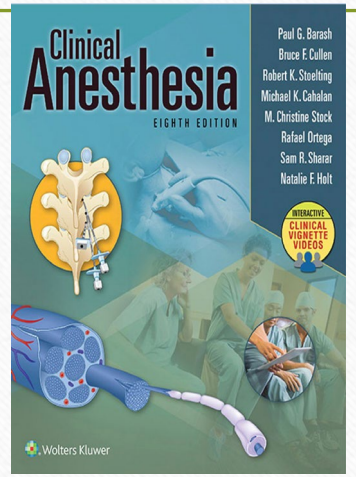
- Consider noctural oxygen for up to 5 days following major surgery
- Frequent chest physiotherapy and incentive spirometry
- Administer PONV and pain control with minimal sedation
- Encourage early ambulation

Take Home Messages

- OSA is common in obese patients and predispose to airway difficulties during anesthesia
- Large neck circumference is the single predictor of problematic intubation in morbid obese patients
- Head-elevated laryngoscopy position can improve laryngoscopy and intubation
- LBW is preferred dosing for common anesthetic agents except for succinylcholine, sugammadex, dexmetomidine, propofol(infusion) and neostigmine

References





Review

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Jay B. Brodsky, Writing — Original Draft Preparation, Writing — Review & Editing

Additional article information

Patient Safety

Section Editor: Richard C. Prielipp

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Thank You