Anesthesia for Bariatric Surgery

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Obesity

Major causes of morbidity and mortality

Health risks associated with increased BMI

Great Epidemics of the 21st century

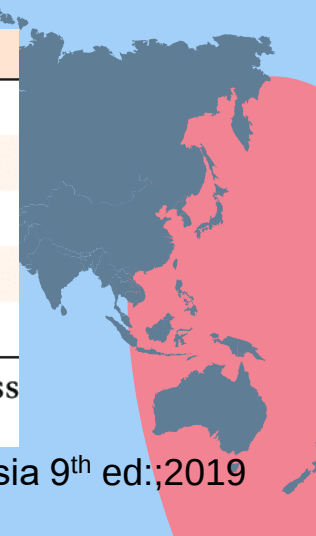
TABLE 58.1 Levels of Risk Associated With Increasing Body Mass Index

Classification	BMI (kg/m²)	Risk of Developing Health Problems
Underweight	<18.5	Increased
Normal weight	18.5-24.9	Least
Overweight	25.0-29.9	Increased
Obese		
Class 1	30.0-34.9	High
Class 2	35.0-39.9	Very high
Class 3	40.0-49.9	Extremely high
Superobese	≥50	Exceedingly high

BMI, Body mass index.

BMI (kg/m²)	Classification
<18.5	Underweight
18.5 - 22.9	Normal
23.0 - 24.9	At-risk of obesity
25.0 - 29.9	Obese I
≥30.0	Obese II

IOTF, International Obesity Taskforce; BMI, body mass index.



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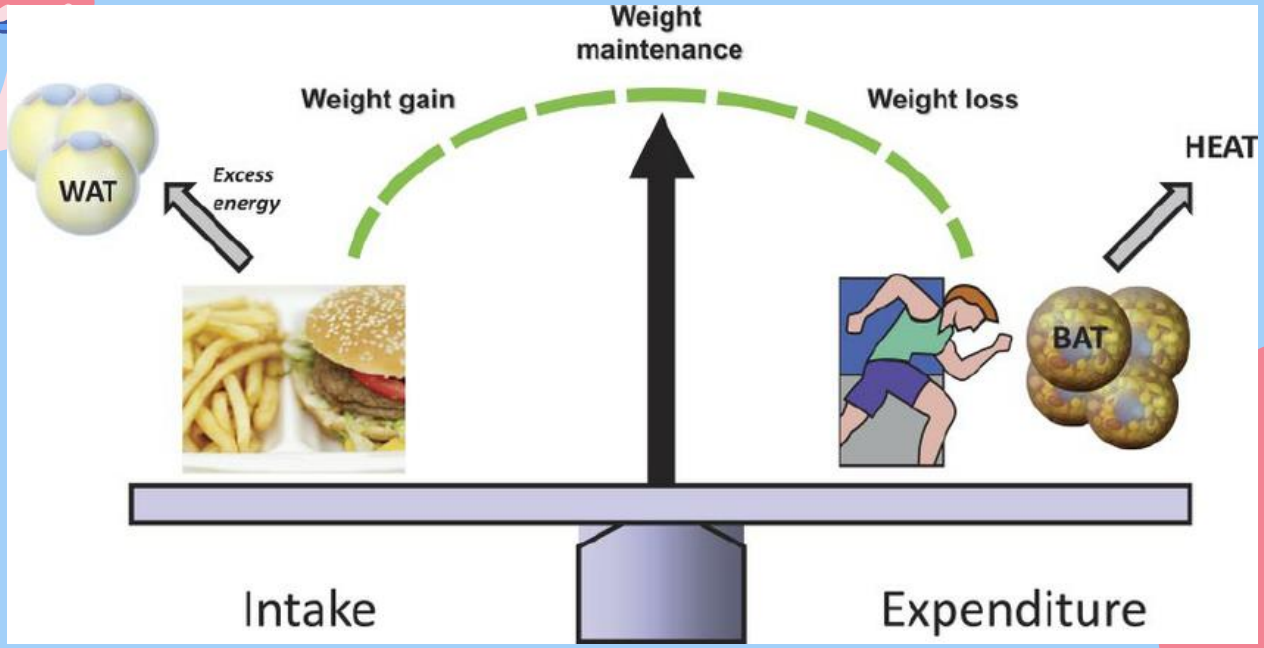
Obesity



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Outline

Introduction

Preoperative Evaluation

Intraoperative Management

Postoperative Management

Introduction

Metabolic Syndrome

TABLE 71-4 CLINICAL CRITERIA FOR DIAGNOSING METABOLIC SYNDROME*

Criteria	Defining Value
Abdominal obesity	Waist circumference >102 (>88) cm in men (women)
Triglycerides	≥150 mg/dL
HDL cholesterol	<40 (<50) mg/dL in men (women)
Blood pressure	≥130/85 mm Hg
Fasting glucose	≥110 mg/dL

HDL, High-density lipoprotein.
*Three of five criteria must be met.

TABLE 58.2 Waist Circumference and Risk

Waist Circumference	BMI (KG/M²) Normal Weight	Overweight	Obese Class 1
<102 cm (♂) <88 cm (♀)	Least risk	Increased risk	High risk
≥102 cm (♂) ≥88 cm (♀)	High risk	Very high risk	Increased risk

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Metabolic Syndrome

TABLE 58.3 Health Risks Associated With Increasing Body Mass Index

Metabolic syndrome	30% of middle-aged people in developed countries have features of metabolic syndrome
Type 2 diabetes	90% of type 2 diabetics have a BMI of >23 kg/m^2
HTN	5× risk in obesity 66% of HTN is linked to excess weight 85% of HTN is associated with a BMI >25 kg/m^2
CAD	3.6× risk of CAD for each unit change in BMI
CAD and stroke	Dyslipidemia progressively develops as BMI increases from 21 kg/m^2 with rise in small particle low-density lipoprotein

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Obstructive Sleep Apnea

STOP-Bang questionnaire

Please answer the following questions by checking "yes" or "no" for each one.

	Yes	No
Snoring (Do you snore loudly?)	❑	❑
Tiredness (Do you often feel tired, fatigued, or sleepy during the daytime?)	❑	❑
Observed Apnea (Has anyone observed that you stop breathing, or choke or gasp during your sleep?)	❑	❑
High Blood **P**ressure (Do you have or are you being treated for high blood pressure?)	❑	❑
BMI (Is your body mass index more than 35 kg per m^2?)	❑	❑
Age (Are you older than 50 years?)	❑	❑
Neck Circumference (Is your neck circumference greater than 40 cm [15.75 inches]?)	❑	❑
Gender (Are you male?)	❑	❑

Score 1 point for each positive response.

Scoring interpretation: 0 to 2 = low risk, 3 or 4 = intermediate risk, ≥5 = high risk.

Source: University Health Network, Toronto, Ontario, Canada (www.stopbang.ca/osa/screening/php). Used with permission from Sauk Prairie Healthcare.

Nonsurgical Management

Behavioral intervention and modification
Pharmacotherapy
Alternative pharmacologic options
Implanted electrical stimulator

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Surgical Management of Obesity

Operative Procedures

- Restrictive Procedures
- Malabsorptive Procedure
- Minimally Invasive Procedure

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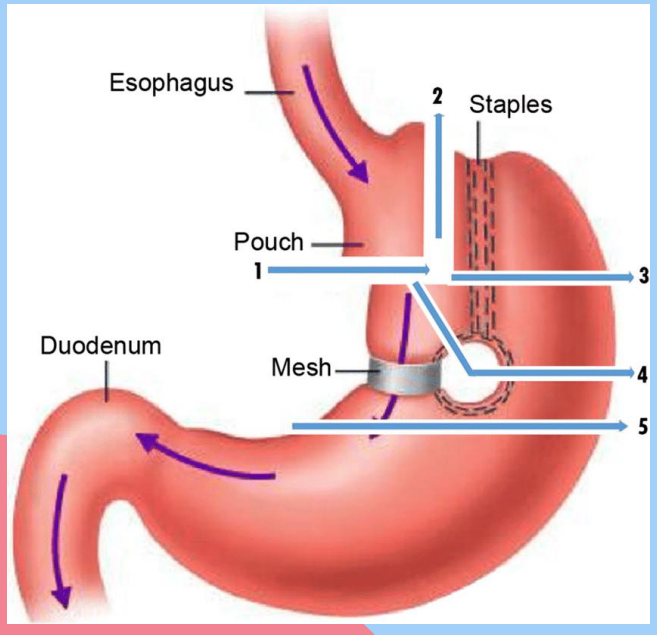
Restrictive Procedures



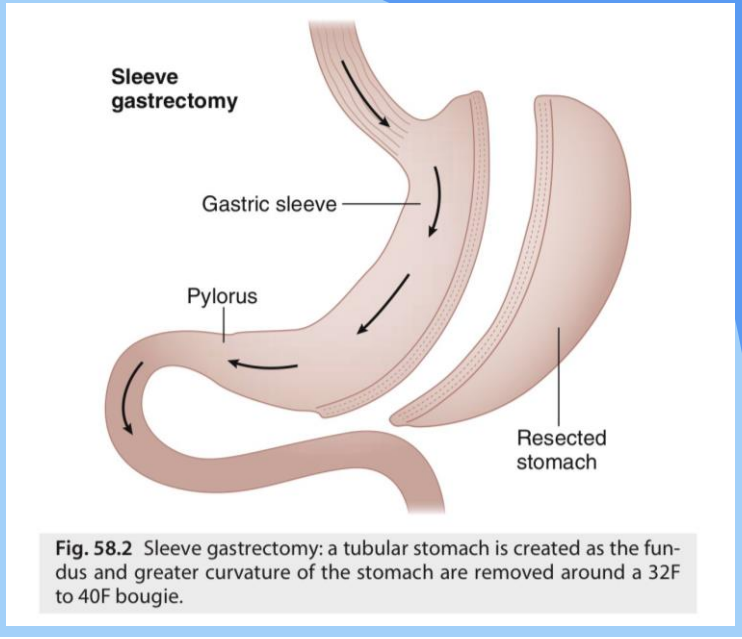


Fig. 58.2 Sleeve gastrectomy: a tubular stomach is created as the fundus and greater curvature of the stomach are removed around a 32F to 40F bougie.

Reduce and limit food intake capacity 80

Reduce stomach reservoir capacity

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Malabsorptive Procedures

Gastric restriction and nutrient malabsorption

Fig. 58.4 32F tapered bougie *(top)*, 40F nontapered bougie *(middle)*, and OrVil device *(bottom)* commonly used during bariatric surgery.

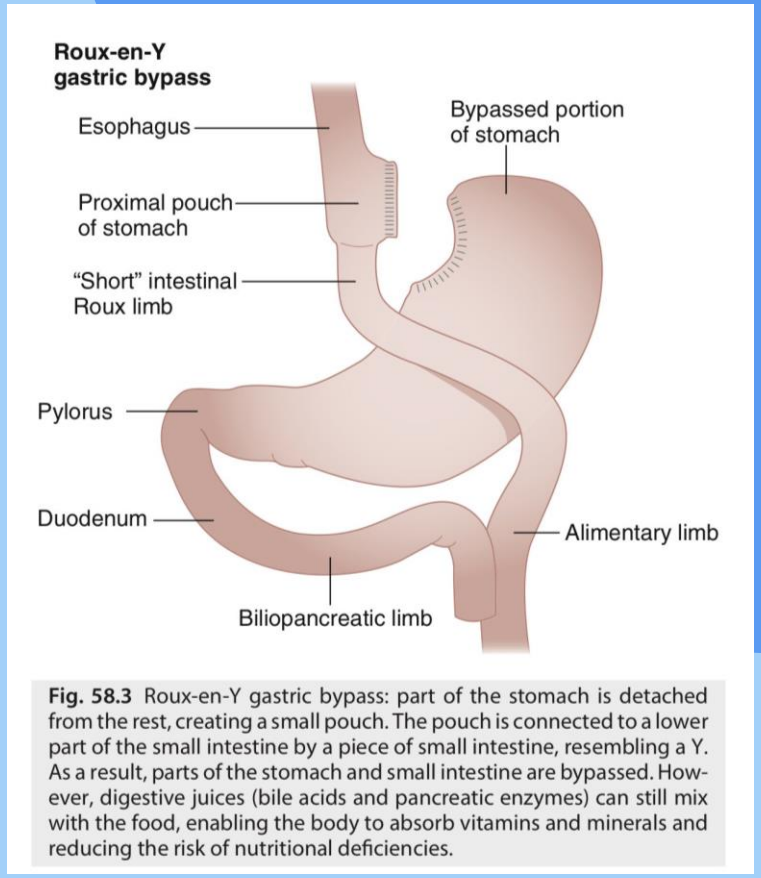

Fig. 58.3 Roux-en-Y gastric bypass: part of the stomach is detached from the rest, creating a small pouch. The pouch is connected to a lower part of the small intestine by a piece of small intestine, resembling a Y. As a result, parts of the stomach and small intestine are bypassed. However, digestive juices (bile acids and pancreatic enzymes) can still mix with the food, enabling the body to absorb vitamins and minerals and reducing the risk of nutritional deficiencies.

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Minimal Invasive Procedures

Intragastric balloon

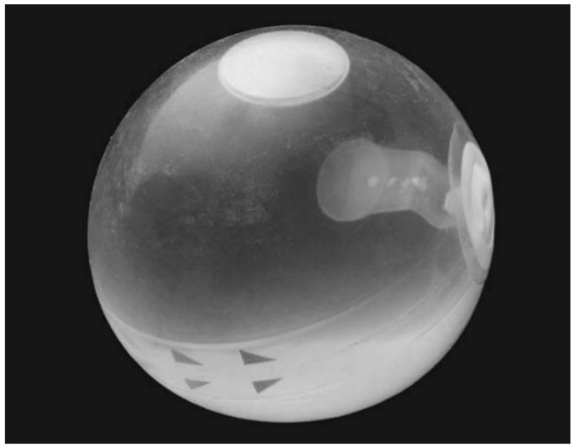


Figure 2. The BioEnterics Intragastric Balloon. The balloon is smooth and spherical. The arrows at the equator point toward the valve. The shell consists of inert, nontoxic silicone elastomer, impervious, and resistant to gastric acid. The radiopaque self-sealing and repenetrable valve with its Z-shape configuration (visible inside balloon) allows adjustment of the balloon volume from 400 to 800 mL.

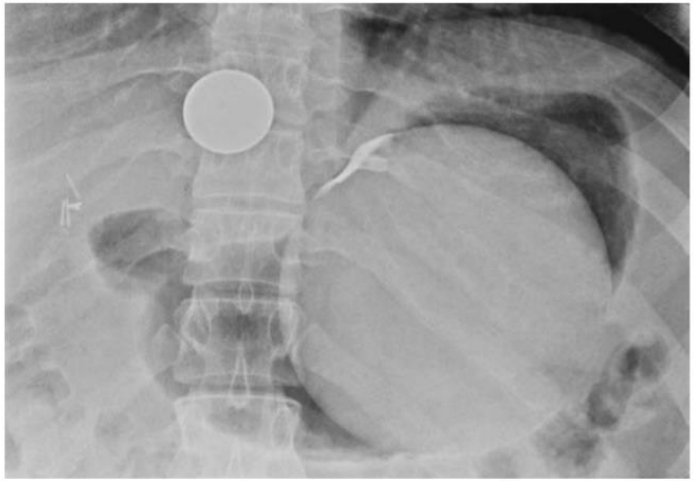
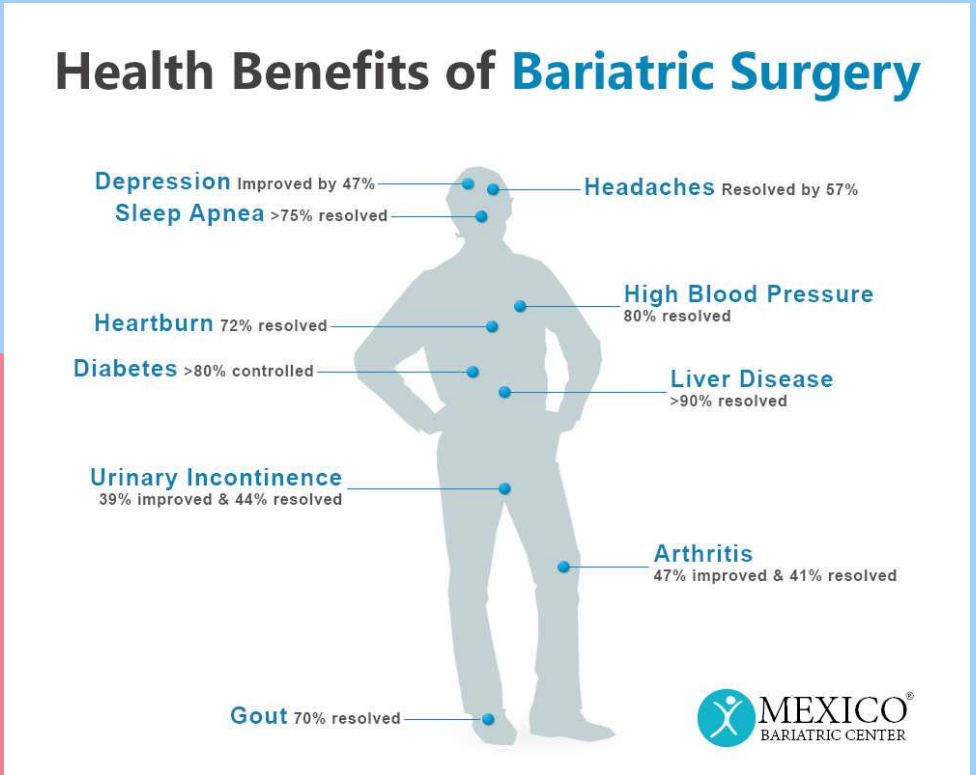


Figure 3. Plain abdominal radiograph showing balloon in body of stomach. A coin taped on the lower sternum permits follow-up comparisons of balloon size to detect premature deflation.

Mathus-Vliegen EM, et al. Gastrointest endosc. 2005;61(1):19–27.

Health Benefits Of Bariatric Surgery

Weight loss and resolution of comorbidity



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Anesthetic
Management

Preoperative Evaluation

Preoperative Assessment

Hypertension
Diabetes
Heart failure
Obesity hypoventilation syndrome

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Preoperative Assessment

History of previous surgery
- Difficult airway
- ICU admission
- Surgical outcome
- Weight at that time

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Preoperative Assessment

- FBS
- Lipid profile
- Serum chemistries
  - Liver function
  - Renal function
- CBC

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Preoperative Assessment

History of CAD
OSA: Polysomnography, Overnight oximetry
Liver function: NAFLD

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Indications

BMI ≥ 40 kg/m^2

BMI ≥ 30 kg/m^2 with comorbidities

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Contraindications

Unstable CAD
Uncontrolled severe OSA
Uncontrolled psychiatric disorder
Intellectual Disability (IQ<60)
Inability to understand surgery
Inability to adhere postoperative restriction
Continued drug abuse
Malignancy with a poor 5-year survival prognosis

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Intraoperative Management

Patient Positioning

Supine

Pressure sore

Prone

Cushioning gel pads
Weight bearing rolls

Lithotomy

Leg Stirrups121

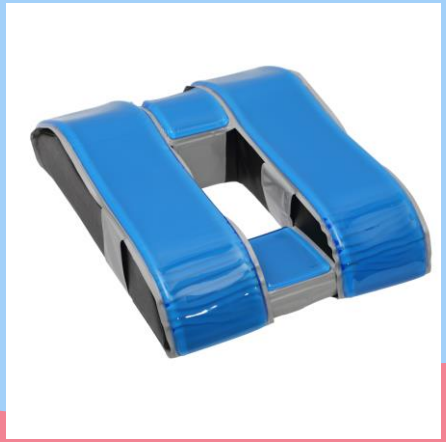
Patient Positioning

Supine

Pressure sore

Prone

Cushioning gel pads
Weight bearing rolls



Lithotomy

Leg Stirrups121

Patient Positioning

Supine

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Cushioning gel pads
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Lithotomy

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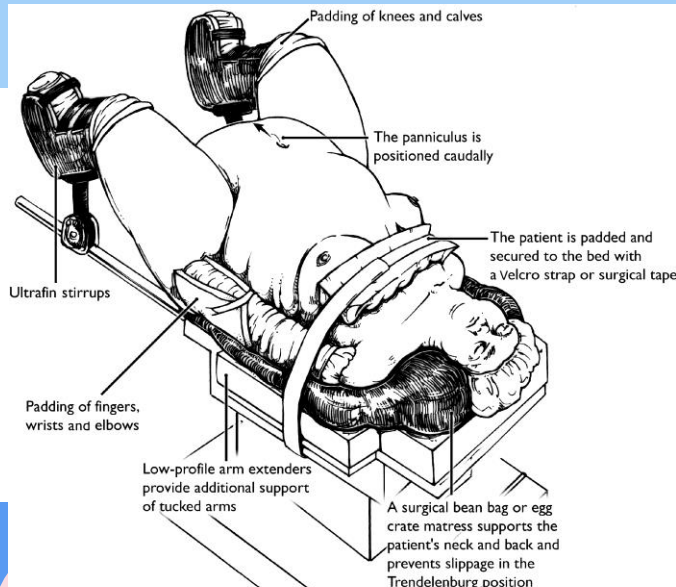
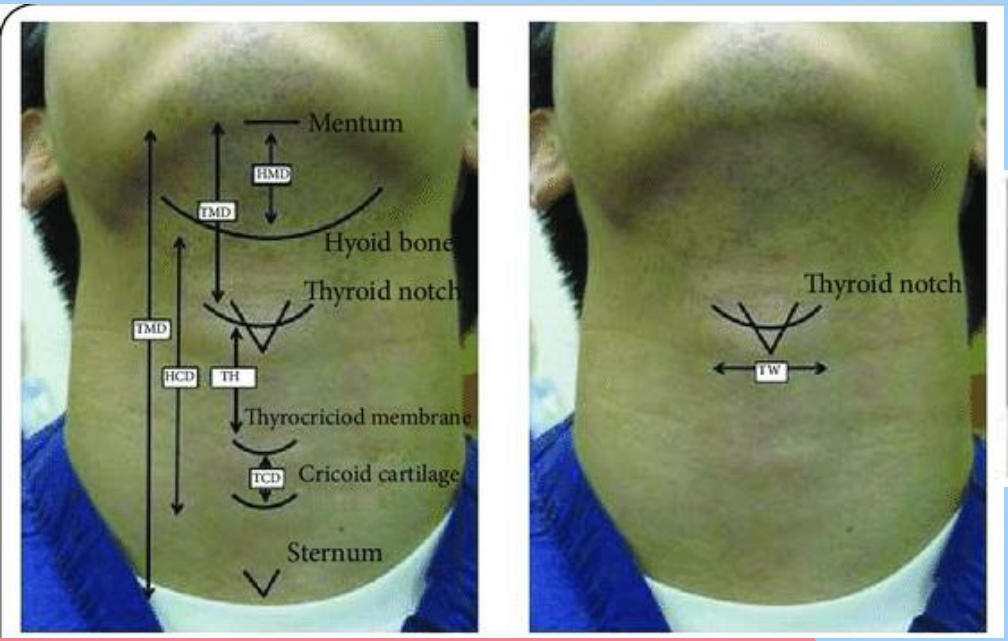


Airway Management



Shiga T, et al. Anesthesiol. 2005;103(2):429–437.1

Airway Management

Wilson risk sum score	0	1	2
Weight	<90 kg	90-110 kg	>110 kg
Head & neck movement	>90 degrees	About 90 degrees (i.e. +/- 10 degrees)	<90 degrees
Jaw movement	IIG >5 cm or Slux >0	IIG <5 cm and Slux =0	IIG <5 cm and Slux <0
Receding mandible	Normal	Moderate	Severe
Buck teeth	Absent	Moderate	Severe

Wilson risk sum score for predicting difficult intubation; IIG= Inter-incisor gap, Slux= mandibular subluxation

Shiga T, et al. Anesthesiol. 2005;103(2):429–437.1

Airway Management

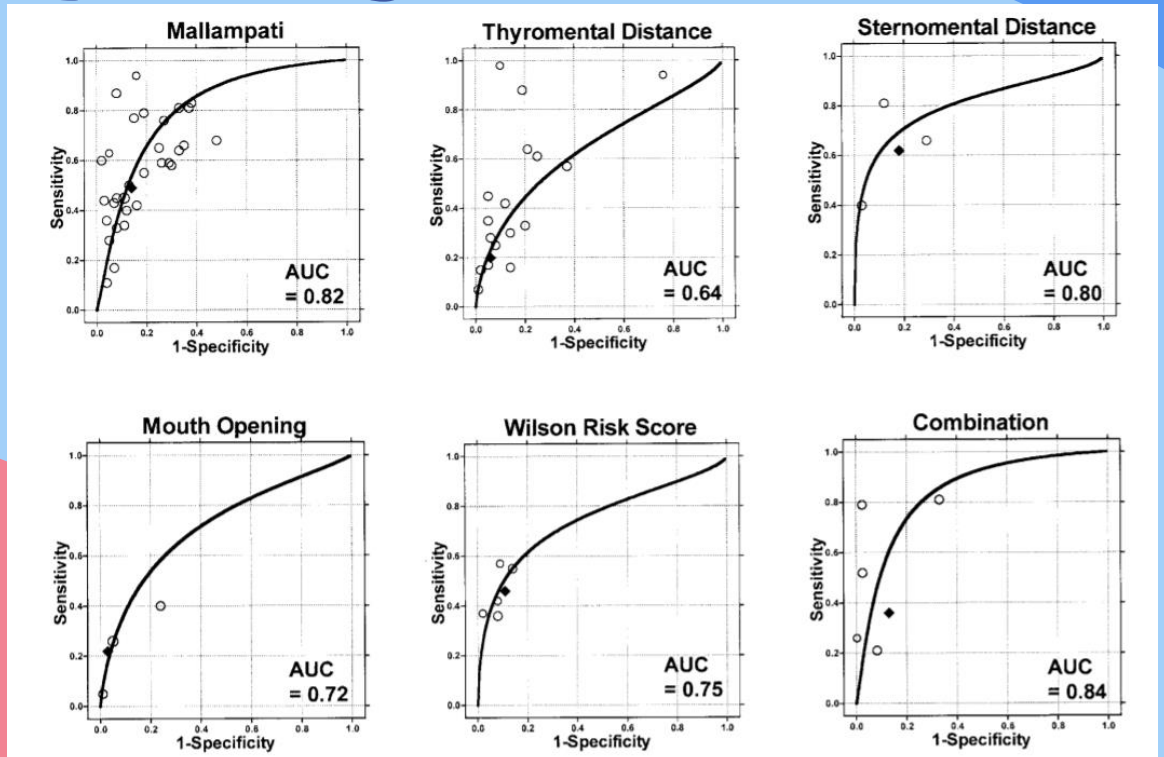
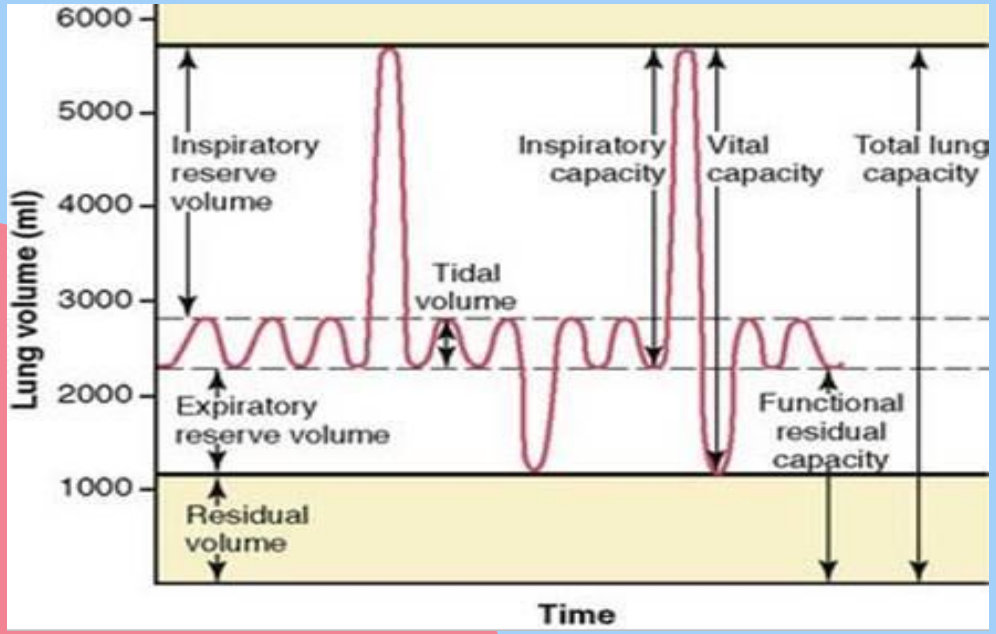


Fig. 2. Summary receiver operating characteristic curve analysis of six different bedside screening tests for difficult intubation. Weighted summary receiver operating characteristic curve is expressed by a *solid line*. Individual study estimates of sensitivity and (1 − specificity) are shown by *open circles*. Each *circle* is proportional to the inverse of the variance. *Diamonds* indicate pooled point estimates of sensitivity and specificity. AUC = area under the curve; Combination = Mallampati classification, thyromental distance in combination.

Shiga T, et al. Anesthesiol. 2005;103(2):429–437.1

Pulmonary Physiology

- VC, IC, ERV, FRC
- Closing capacity is close to or fall within tidal breathing



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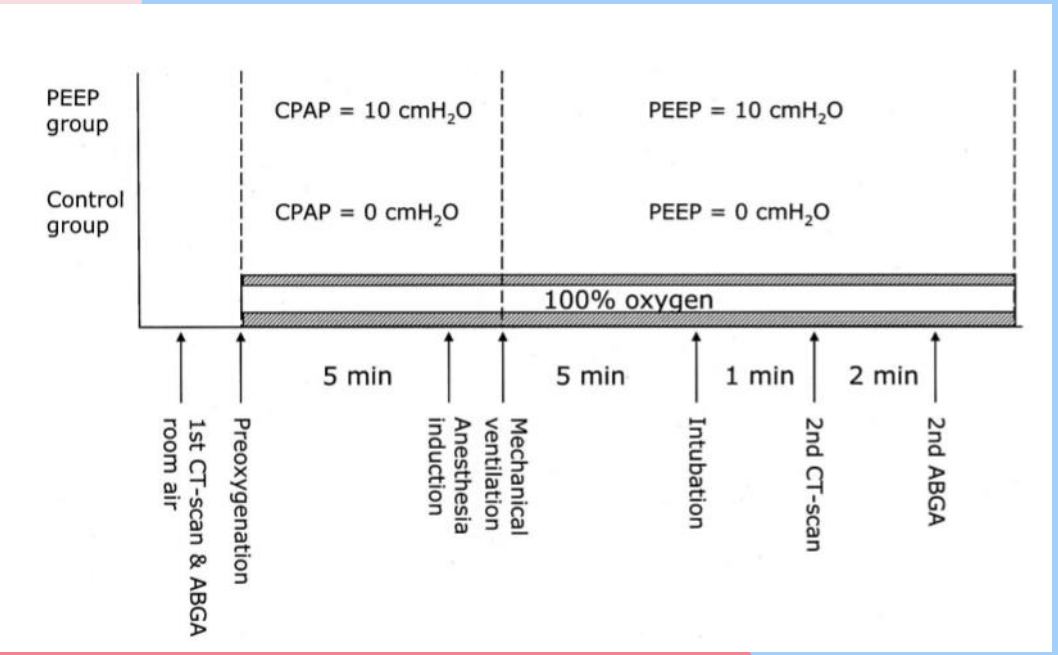
Prevention of Atelectasis Formation During the Induction of General Anesthesia in Morbidly Obese Patients



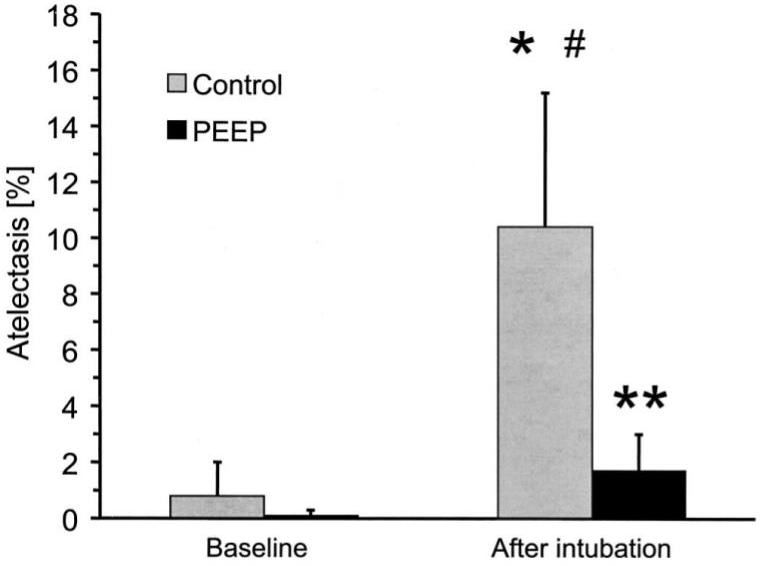
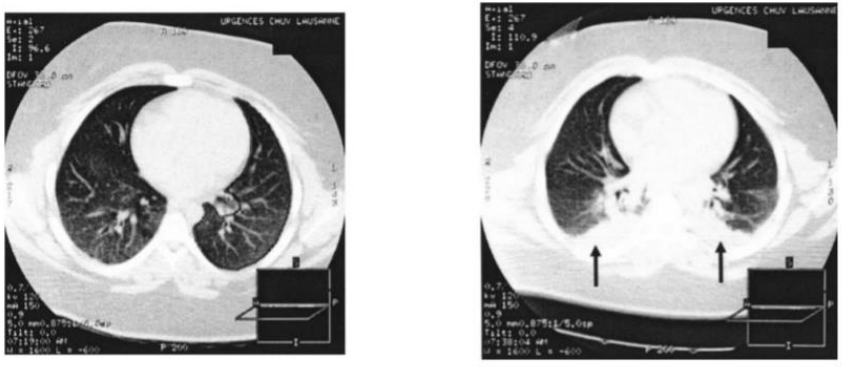


Figure 2. Percentage of pulmonary atelectasis at baseline and after the anesthesia induction in control and positive end-expiratory pressure (PEEP) patients. #$P < 0.0001$ compared with the PEEP group; *$P = 0.0001$ compared with baseline; **$P = 0.006$ compared with baseline.

Coussa M, et al. Anesth Analg. 2004;98(5):1491–1495.1

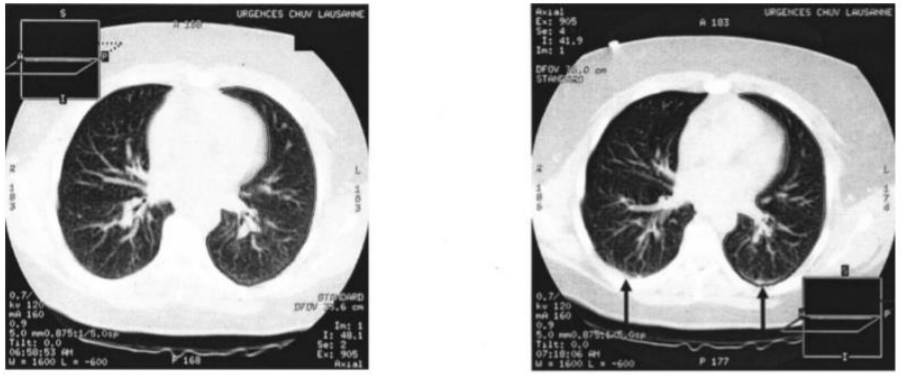
Prevention of Atelectasis Formation During the Induction of General Anesthesia in Morbidly Obese Patients



Before induction

After intubation

Figure 3. Samples of computed thoracic tomographies (CT) of a control patient before and after the anesthesia induction. The CTs were obtained 1 cm above the level of the right diaphragm. ↑ shows atelectasis.



Before induction

After intubation

Figure 4. Samples of computed thoracic tomographies (CT) of a positive end-expiratory pressure (PEEP) patient before and after the anesthesia induction. The CTs were obtained 1 cm above the level of the right diaphragm. ↑ shows atelectasis.

Coussa M, et al. Anesth Analg. 2004;98(5):1491–1495.1

Positive End–Expiratory Pressure During Induction of General Anesthesia Increases Duration of Nonhypoxic Apnea in Morbidly Obese Patients

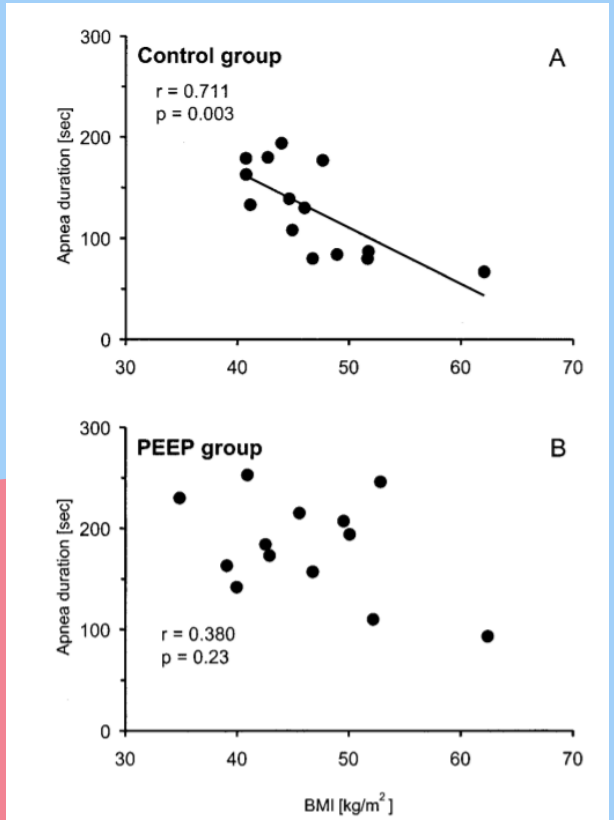
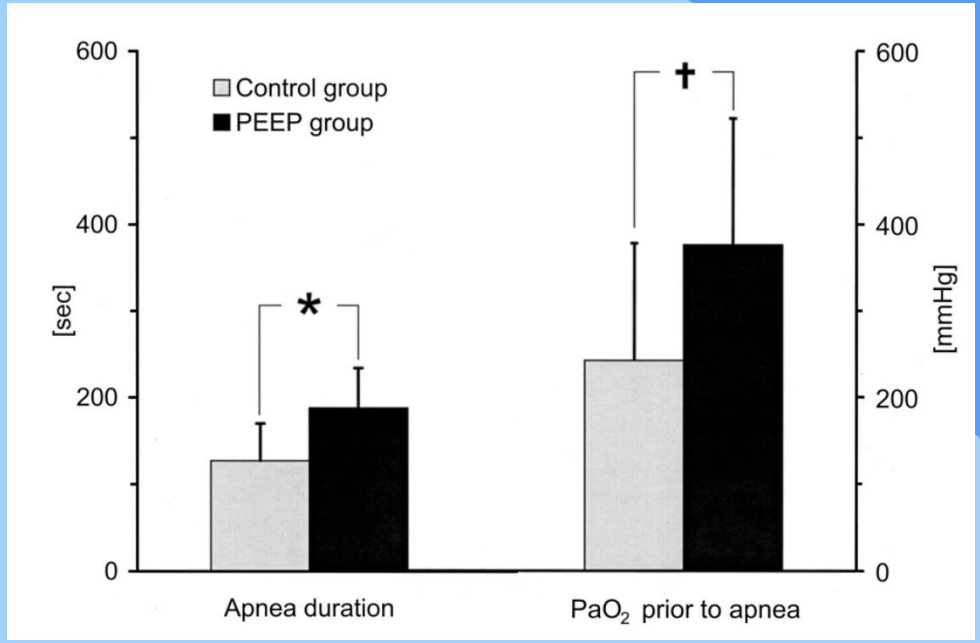


Figure 2. Correlation between duration of nonhypoxic apnea and body mass index (BMI) in control (A) and positive end-expiratory pressure (PEEP) patients (B).



Gander S, et al. Anesth Analg. 2005;100(2):580–584.1

Anesthetic drugs

↓ Pharyngeal muscular tone

Opioids, Propofol, Benzodiazepines

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Anesthetic drugs

Table 4.1. Recommended dosing scalars for anesthetic drugs in obese patients.

Drug	Dosing scalar	Remarks
Propofol	Induction: LBW Maintenance: TBW	LBW dosing in MO subjects for induction required similar amounts of propofol and similar times to loss of consciousness compared with lean subjects given propofol based on TBW. Volume of distribution and clearance at steady state increases with increasing TBW.
Thiopental	Induction: LBW Maintenance: TBW	Simulations showed a 60% decrease in peak plasma concentration in MO subjects compared with lean subjects after a 250 mg dose. Induction dose adjusted to LBW results in same peak plasma concentration as dose adjusted to CO. Volumes and clearances increase proportionally with TBW
Fentanyl	LBW	Clearance increases linearly with 'PK mass', a scalar correlated to LBW
Remifentanil	LBW	LBW dosing in MO patients results in similar plasma concentrations as normal weight subjects dosed based on TBW

Brodsky, Jay B.; Lemmens, Hendrikus J. M. (2011). Anesthetic Management of the Obese Surgical

Anesthetic drugs

Succinylcholine	TBW	Administration of 1 mg/kg TBW resulted in a more profound block and better intubating conditions compared with doses based on IBW or LBW
Vecuronium	IBW or LBW	Doses based on TBW result in a prolonged duration of action in obese vs. non-obese subjects
Rocuronium	IBW or LBW	There is an increased duration of action when the drug is given based on TBW vs. IBW
Cis-atracurium	IBW or LBW	There is an increased duration of action when the drug is given based on TBW vs. IBW

IBW = Ideal Body Weight, LBW = Lean Body Weight, TBW = Total Body Weight.

Brodsky, Jay B.; Lemmens, Hendrikus J. M. (2011). Anesthetic Management of the Obese Surgical

Postoperative Recovery After Desflurane, Propofol, or Isoflurane Anesthesia Among Morbidly Obese Patients: A Prospective, Randomized Study

Table 2. Early Recovery Parameters, PONV, and Analgesic Requirements in the PACU

	Desflurane	Isoflurane	Propofol
Early recovery (min)			
Time to eye opening	4.2 ± 1.3	10.3 ± 4.9*	10.7 ± 6.9*
Time to extubation	5.6 ± 1.4	12.2 ± 6*	13.2 ± 7.6*
Time to stating name	6 ± 1.8	14 ± 7*	14.6 ± 8.7*
PONV (*n*)			
Patients with postoperative nausea	3	4	3
Patients with postoperative vomiting	2	2	1
Patients who received antiemetic	1	1	0
Analgesic requirements in the PACU (*n*)			
Patients who received nefopam	1	0	0
Patients who received morphine	1	0	2
Patients who received ketoprofen	3	3	2

Early recovery was significantly more rapid and constant after desflurane anesthesia than after isoflurane or propofol anesthesia. There was no statistically significant difference among the desflurane, isoflurane, and propofol treatment groups with respect to the incidence of postoperative nausea and vomiting (PONV) or the analgesic requirements in the postanesthesia care unit (PACU). Data are expressed as mean ± SD or count.

* $P < 0.05$, compared with desflurane.

Juvin P, et al. Anesth Analg. 2000;91(3):714–719.1

Postoperative Recovery After Desflurane, Propofol, or Isoflurane Anesthesia Among Morbidly Obese Patients: A Prospective, Randomized Study

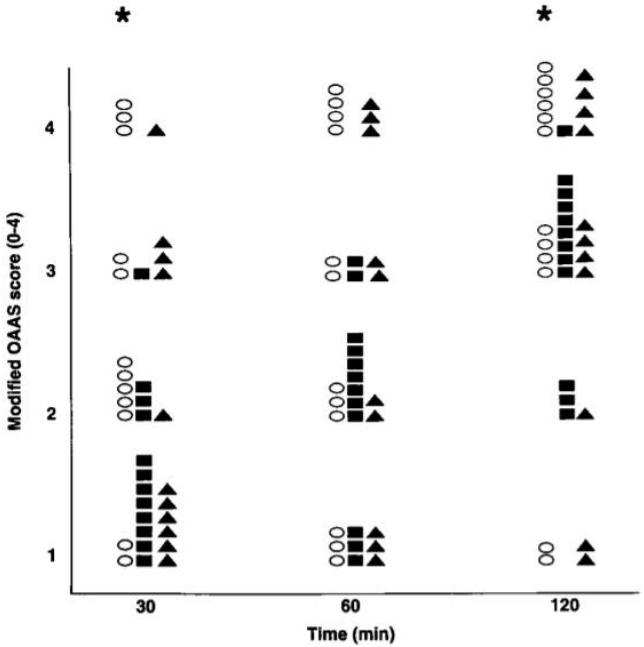

Figure 1. Postoperative sedation levels at 30, 60, and 120 min postoperatively. The postoperative sedation level (as assessed by using the Observer's Assessment of Alertness/Sedation Scale [OAAS]) was significantly less pronounced after desflurane (○) than after isoflurane (■) or propofol (▲) at 30 and 120 min postoperatively. Individual values are noted at each of the study time points. *$P <$ 0.05, when the isoflurane and propofol groups are compared with the desflurane group.

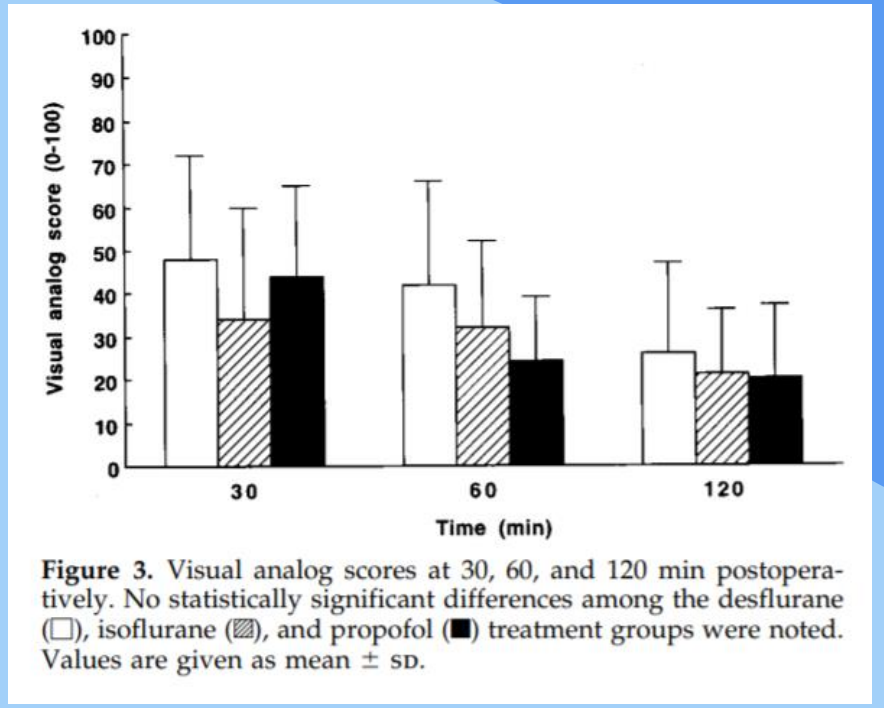

Figure 3. Visual analog scores at 30, 60, and 120 min postoperatively. No statistically significant differences among the desflurane (□), isoflurane (▨), and propofol (■) treatment groups were noted. Values are given as mean ± SD.

Juvin P, et al. Anesth Analg. 2000;91(3):714–719.1

Aspiration prophylaxis

Type 2 diabetes, GERD
Drugs
- H2 receptor agonist
- Proton pump inhibitor

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Intraoperative Management

Table
Safety strap
Bean bag under the patient
Thermal management

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Pain Management

Epidural improves outcome
IV PCA
Thoracic epidural analgesia
+ Local infiltration
Non-narcotic medication
-Paracetamol
-NSAIDs
-Ketamine
-Dexmedetomidine

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Fluid Requirement

Larger than predicted in normal BMI patient

Hypovolumia → Prerenal state →Acute tubular necrosis

Primary acute renal failure

2% of patients

Predisposing factors

- BMI ≥ 50 kg/m^2
- Prolonged surgical time
- History of renal disease
- Intraoperative hypotension

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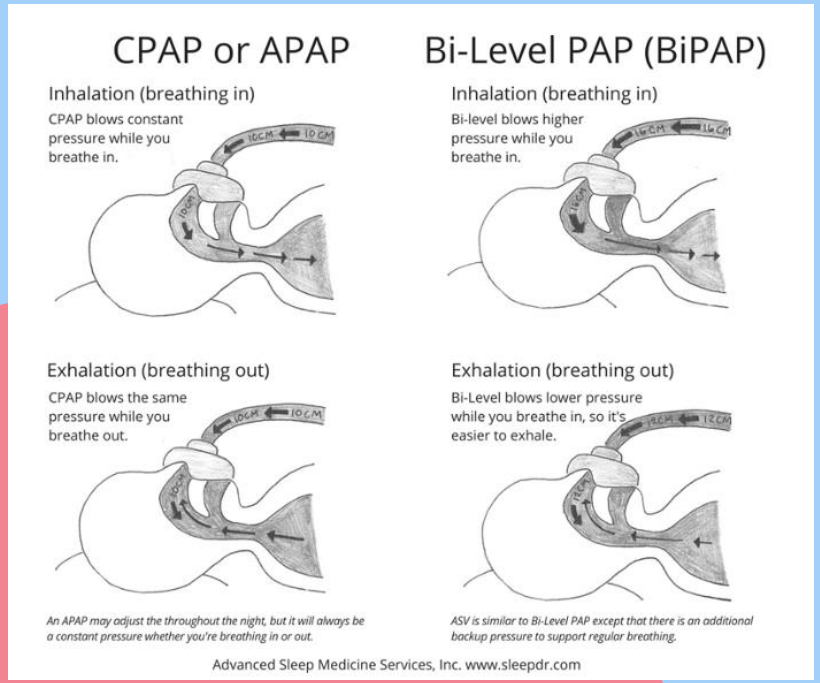
Postoperative Management

Management

CPAP or Bilevel positive airway pressure machines



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PONV

Multimodal approach
- Ondansetron
- Dexamethasone
- Scopolamine patch

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ERAS Protocol

Standardized preoperative patient education
Shortened preoperative fasting
Multimodal analgesia
Antiemetic therapy
Avoid fluid overload
Early ambulation and feeding
Incentive spirometry 173

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Management of Complication

Immediate postoperative morbidity

Wound
Gastrointestinal
Pulmonary
Cardiovascular

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Reoperation Causes

Postoperative Intraabdominal bleeding
Anastomotic leakage
Suture line dehiscence
Small bowel Obstruction
Deep wound Infection

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TABLE 71-5 SPECIFIC AND NONSPECIFIC COMPLICATIONS OF BARIATRIC SURGERY

	All Surgical Procedures	Gastric Banding	Roux-en-Y
Early	Bleeding Infection Dehydration Peritonitis Bowel obstruction Perforation Pneumonia DVT or PE Death	Band slippage Band malfunction Infection at band site	Leak from anastomotic site

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TABLE 71-5 SPECIFIC AND NONSPECIFIC COMPLICATIONS OF BARIATRIC SURGERY

	All Surgical Procedures	Gastric Banding	Roux-en-Y
Late	Cholelithiasis Cholecystitis Pouch dilation GERD or dysphagia Herniation at surgical site Nutritional issues Vitamin deficiencies, especially fat-soluble vitamins and vitamin B_{12}	Anorexia Band slippage Band malfunction Infection at band site	Small bowel obstruction Marginal ulcers Pancreatitis Stricture

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Venous Thromboembolism

DVT or Pulmonary embolism
IVC filter

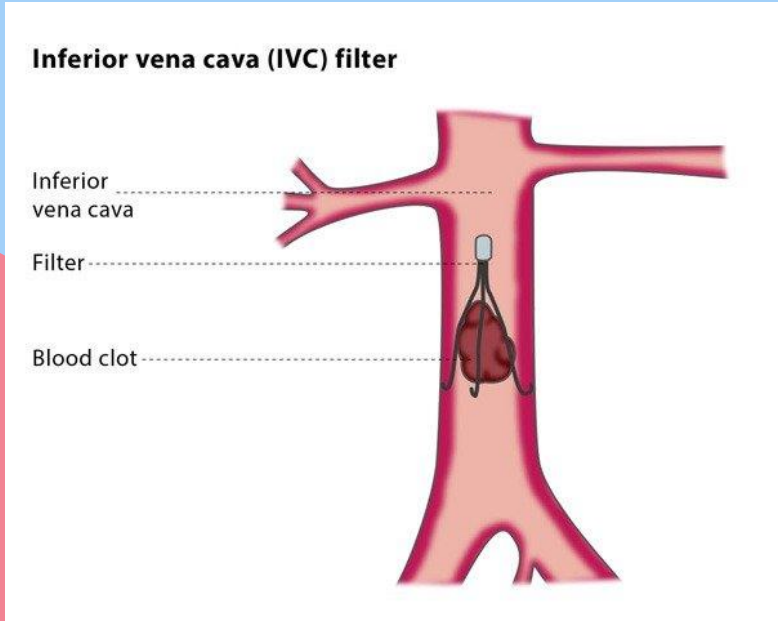

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TABLE 2. Univariate Mortality, Morbidity, and LOS Outcomes

Outcomes	LGB	OGB	*P*
Mortality	0.27%	0.81%	< 0.0001
Wound complications	1.35%	1.98%	< 0.005
Gastrointestinal complications	4.52%	5.33%	< 0.05
Pulmonary complications	2.60%	5.36%	< 0.0001
Cardiovascular complications	1.92%	3.02%	< 0.0001
LOS	3.12 + 4.4 d	4.75 + 9.2 d	< 0.0001

Ricciardi R, et al. Surg Laparosc Endosc Percutan Tech. 2006;16(5):317–320.1

Take Home Message

- Preoperative evaluation
  - Cardiopulmonary issues
  - Securing airway
  - Comorbidities (DM, HT, OSA)
- Patient preparation and positioning
- Intraoperative ventilation
  - Moderate PEEP
  - Tidal volume based IBW
  - Recruitment maneuver
- Complication : DVT, Staple line

THANK YOU