

They Are Not Just Little Adults The Obese Child: Does the Proposed Surgery Matter?

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Disclosures

no relevant financial relationships with commercial
interests

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Outline

- Systemic morbidity associated with obesity, the effect on drug dosing, and technical challenges
- Preoperative screening process, development of criteria for selection of pediatric patients in an ambulatory surgical center (ASC) setting
- Challenges of obesity in certain surgical procedures in the freestanding ASC versus a hospital ambulatory department

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Introduction

- The key to the success and safety of pediatric surgery at an ASC lies in careful selection, screening, and preparation of prospective patients
- The primary factors that must be considered
 - physical status of the patient
 - type of surgical procedure to be performed
 - capability of the surgical facility and the ability of its staff to deal with any expected or unexpected events.

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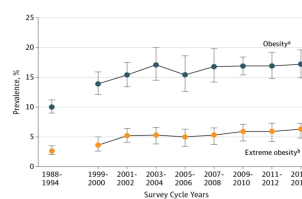
Background



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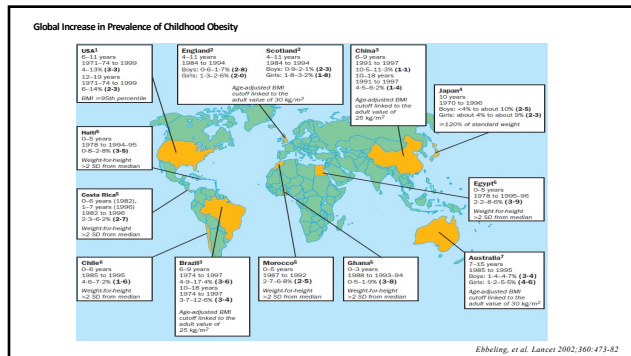
Pediatric Obesity is the New Normal

Trends in Obesity Prevalence Among Children and Adolescents in the United States, 1988-1994 Through 2013-2014

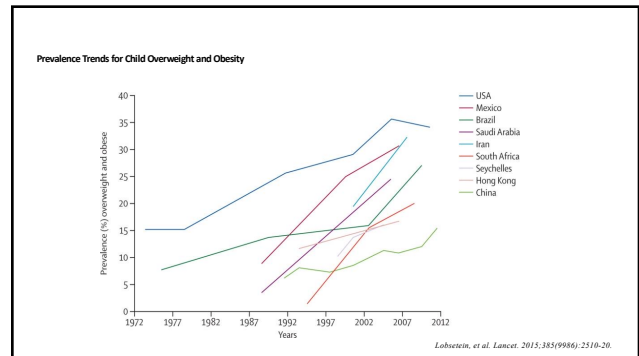


Ogden, et al. JAMA. 2016;313(21):2292-2299

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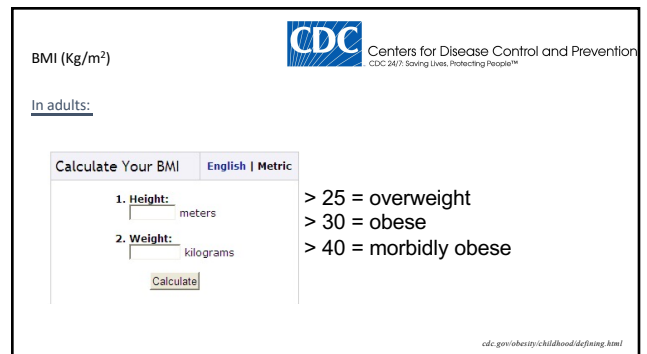


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- ## Defining the Obese Child

- In children, there is debate on the appropriateness of BMI as a predictor of adiposity across populations differing in race and ethnicity

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BMI Calculator for Child and Teen

☒ English ☐ Metric

* Age: Years, Months
☐ Date of Birth, Date of Measurement

Age:

years (2 to 19)
 months (0 to 11)

or enter only the total number of months:
 months (24 to 228)

Sex:

☐ Boy ☐ Girl

Height (decimal places allowed):
 cm

Weight (decimal places allowed):
 kg

Calculate

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Orthopedic Surg/Sports ...

Follow Up Note - Focused

VS: HEENT

Pediatric Ambulatory Intn.

VS, Ht, Wt

Chief Complaint/Duration: F.U.V - RIGHT KNEE

Does Patient Have Trach?: No

Temperature Temporal: 36.7 DegC(Converted to: 98.1 DegF)

Peripheral Pulse Rate: 100 bpm

R Arm Systolic: 139 mmHg

R Arm Diastolic: 83 mmHg

BP Position R Arm: Sitting

Monitor Weight: 129.3 kg(Converted to: 285 lb 1 oz, 285.06 lb, 4.560.92 oz)

Height: 177.5 cm(Converted to: 5 ft 10 in, 5.82 ft, 69.88 in)

BSA Measured: 2.52

Body Mass Index Measured: 41.04 kg/m2

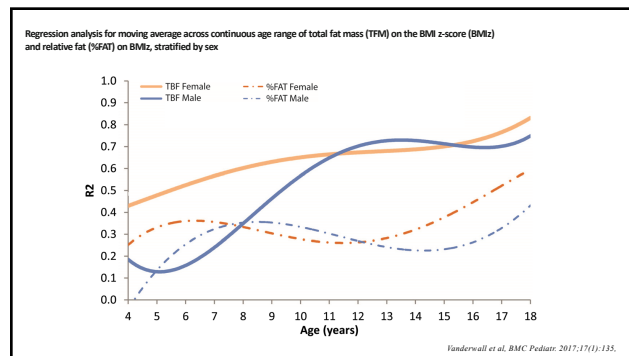
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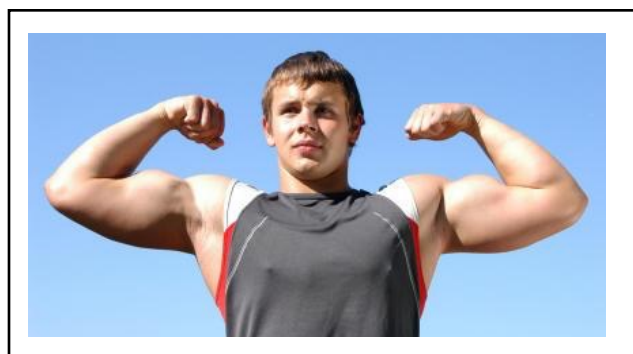
Orthopedic Surg/Sports
Follow Up Note - Focused
AMBI Intake
Pediatric Ambulatory Info

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 Height: 177.5 cm (Converted to: 5 ft 10 in, 5 ft 9.85 in)
 BMI Measured: 41.04
 BMI Measured: 41.04
 BMI Measured: 41.04

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Defining the Obese Child

Children's National ASC Guidelines for Obese Children



- Young children (≤ 8 yr.)
- < 98 BMI %ile-for-age
- Adolescents (> 8 yr.)
- BMI < 30 for airway surgery
- BMI < 35 for non-airway surgery
- No co-morbidities / OSAS
- Exceptions by consultation

Note that these are *not* national standards.
 BMI, body mass index; OSAS, obstructive sleep apnea syndrome.

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Outline

- Systemic morbidity associated with obesity, the effect on drug dosing, and technical challenges
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The Obese Child and Anesthesia

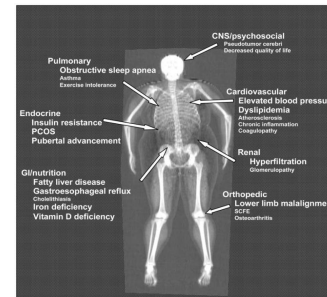
- Systemic Morbidity
- Drug Dosing
- Technical Challenges
 - difficult mask ventilation
 - difficult IV access
 - difficult positioning

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The Obese Child and Anesthesia

- Patients with obesity are classified by the American Society of Anesthesiologists (ASA) as having a physical status of at least 2

Morbidity



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Morbidity

Frequency of QA Events Between Normal Weight, Overweight and Obese Patients

QA Events	Normal weight (n = 4171), (%)	Overweight (n = 875), (%)	Obese (n = 1048), (%)	P value ^a
Preoperative				
Asthma	12.7	14.4	16.1	0.006
Diabetes	0.53	0.4	2.6	0.001
Hypertension	1.4	2.6	4.1	0.001
Intraoperative				
Difficult mask airway	2.2	3.6	7.4	0.001
Difficult laryngoscopy	0.4	0.2	1.3	0.005
Bronchospasm	0.4	0.0	0.5	0.156
Dental injury	0.0	0.1	0.1	0.111
Cardiac arrest	0.0	0.0	0.0	ns
PACU				
Upper airway obstruction	0.07	0.3	1.6	0.001
Stay >3 h	0.86	1.3	1.9	0.026
22 antiemetics	0.6	1.1	1.3	0.039
Vomiting	0.4	0.8	0.6	0.263
Unplanned admit	0.5	0.5	1.0	0.063

Nafu et al. Pediatric Anesth 2007;17:426-30

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Morbidity

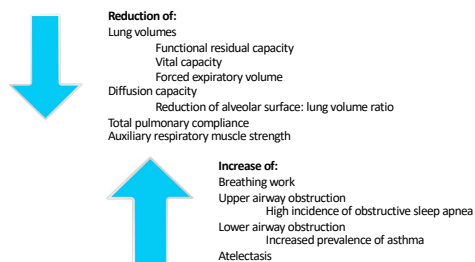
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Nafu et al. Pediatric Anesth 2007;17:426-30

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Respiratory changes in obese children



Lerman et al. Curr Opin Anaesthesiol 2018; 31:320-326

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Morbidity-Respiratory

- Perioperative respiratory adverse events (PRAE) occur more commonly in obese children
- Significant associations between obesity and PRAE for hypoxemia, upper airway obstruction and difficult bag-mask ventilation
- Obesity and BMI were significant predictors for overall PRAE, whereas difficult laryngoscopy, laryngospasm, bronchospasm, major coughing and the need for supplemental oxygen were identified but not significantly associated with PRAE.
- Adverse respiratory events can occur even if the airway was not instrumented or manipulated.

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ORIGINAL ARTICLE

Perioperative outcomes of severely obese children undergoing tonsillectomy

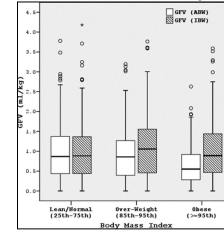
Stephen J. Gleich¹, Michael D. Olson², Juraj Sprung¹, Toby N. Weingarten¹, Darrell R. Schroeder³, David O. Warner¹ & Randall P. Flick¹

- OSA and a high BMI exhibit a 3.8 times greater risk of developing intraoperative laryngospasm
- If the nadir of saturation during sleep is less than 85%, these children may demonstrate increased sensitivity to opioids, increasing their risks for a PRAE and apnea after a typical opioid dose
- Subclinical pulmonary hypertension and borderline right ventricular heart failure may complicate management

Gleich et al. *Pediatric Anesthesia*, Vol. 22, No. 12, (Dec 2012): 1171-8

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Overweight/Obesity and Gastric Fluid Characteristics in Pediatric Day Surgery: Implications for Fasting Guidelines and Pulmonary Aspiration Risk



Gastric Fluid Volume and BMI in Pediatric Same Day Surgery Patients

Cook-Sather SD, et al. *Anesth Analg* 2009;109:727-36

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Effect of Drug Dosing

- The traditional approach to drug dosing in infants and children is to administer a dose based on the child's total body weight (TBW).
- In the obese child, this approach may result in substantive under dosing or overdosing and undesirable sequelae

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Effect of Drug Dosing

Drugs partition into the fat mass and the fat-free mass (FFM)

- Lipophilic drugs have preferential affinity for the fat mass
 - loading doses of these drugs are commonly based on the TBW
- Hydrophilic drugs have preferential affinity for the FFM
 - the dosing adjustment for hydrophilic drugs in obesity is 30–40% greater than the lean body mass

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Perioperative considerations for airway management and drug dosing in obese children

Jerrold Lerman^{a,b} and Karin Becke^c

- A scalar is a metric that may be used to estimate a drug dose for a given individual to yield a predictable response
- BSA and BMI have been used as scalars in the past, but these vary with age and sex in children.

Lerman et al. *Curr Opin Anesthesiol* 2018; 31:320-326

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Effect on Drug Dosing

Dosage of IV anesthetics in obese children

In general**:

- TBW for lipophilic drugs
- IBW for hydrophilic drugs

****There are exceptions**

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Scalars for drug dosing in obese children

Drug	Loading dose scalar	Maintenance dose scalar
Anesthetics		
Propofol	IBW	TBW allometry or ABW
Etomidate	LBW	
Ketamine	IBW	
Benzodiazepines	ABW/IBW	IBW
Synthetic opioids (Fentanyl)	TBW	IBW
Remifenantil	LBW/IBW	
Morphine	IBW	IBW
Nondepolarizing relaxants	IBW	IBW
Succinylcholine	TBW	
Sugammadex	ABW or TBW	
Neostigmine	TBW	

Lerman et al. Curr Opin Anaesthesiol 2018, 31:320-326

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Opioids should be titrated to effect:

- Patients with even mild obstructive symptoms can be extremely sensitive to the effect of opioids. So, we do not give them fixed doses of opioids during surgery.
- Titrate the dose of whichever opioids you choose to use, either fentanyl or morphine and guide dosing by the response is in terms of respiratory rate and end-tidal CO₂ changes.

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Solubility of Inhaled Anesthetics

- Solubility (partition) coefficient: the extent to which a gas will dissolve in a given solvent
- Predicts the speed of induction, recovery, and change in anesthetic depth for an inhalant
- Ideal inhaled anesthetics should have low blood/gas and low tissue/blood solubility
- Low solubility means rapid induction and emergence and more precise control

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Effect of Drug Dosing

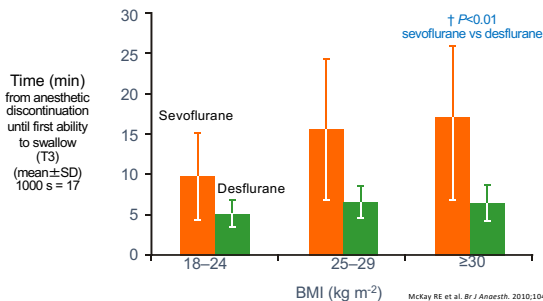
Inhalational anesthetics, unlike intravenous drugs, strictly partition along lipophilic and hydrophilic lines

Solubility of Inhalational Anesthetics

	Sevoflurane	Desflurane	Isoflurane	Enflurane	Halothane	Nitrous oxide
Blood:gas partition coefficients	0.65	0.42	1.46	1.9	2.4	0.46
Brain:blood partition coefficients	1.2	1.3	1.4	1.4	1.9	1.1
Muscle:blood partition coefficients	3.1	2.0	2.9	1.7	3.4	1.2
Fat:blood partition coefficients	47.5	22.2	44.9	56	51.1	2.3

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Time to Swallow Shorter for Desflurane than for Sevoflurane



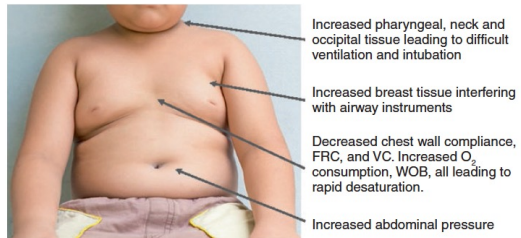
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Effect of Drug Dosing-Inhalational Anesthetics

- Of the inhalational anesthetics, sevoflurane provides hemodynamic stability and minimal airway irritability, and can be used for both induction and maintenance.
- Desflurane has lower blood-lipid solubility and may provide faster restoration of protective airway reflexes and a more rapid recovery profile than sevoflurane when used in intubated obese children.

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Difficult Airway & Ventilation



Increased pharyngeal, neck and occipital tissue leading to difficult ventilation and intubation

Increased breast tissue interfering with airway instruments

Decreased chest wall compliance, FRC, and VC. Increased O_2 consumption, WOB, all leading to rapid desaturation.

Increased abdominal pressure

Valatrucha and Hammallah, 2019

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Technical Challenges

Airway Management



Mask Airway:
-Challenging

Intubation:
-Usually OK

Supraglottic Airway:
-Usually OK

*Moon TS, et al. J Anesth (2019) 33: 96
Tsun Y, et al. Arch Med Sci 2017;13:183-190*

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Technical Challenges



IV access can be challenging...

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Technical Challenges

Where else to look:



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Vein illumination devices



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DVT Prophylaxis

- Obese patients (BMI > 95th percentile) to have significantly higher risk of VTE *
- Our practice: All patients 10-17 years who are expected to have a surgical procedure lasting at least **60 minutes** have sequential compression devices (SCD) placed at induction of anesthesia unless there are contraindications to mechanical prophylaxis.

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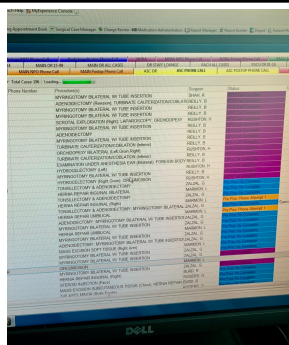
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Orthopedic Surg/Sports ...
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Anesthesia
Pediatric Ambulatory Ints.

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Children's National ASC Guidelines for Obese Children

- ASA Class 2
- No co-morbidity
 - No reactive airway disease
 - No syndromes
 - No OSA



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Chest
Volume 134, Issue 6, December 2008, Pages 1169-1175

Original Research
Sleep Medicine

Sleep-Disordered Breathing, Obesity, and Airway Inflammation in Children and Adolescents

• OSAS is reported in 13% to 59% of obese children compared with 1% to 2% of normal weight children

Verhulst et al. Chest 2008; 134:1169-75.

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Pediatric Anesthesia
Pediatric Anesthesia ISSN 1155-5645

ORIGINAL ARTICLE

Perioperative outcomes of severely obese children undergoing tonsillectomy

Stephen J. Gleich¹, Michael D. Olson², Juraj Sprung¹, Toby N. Weingarten¹, Darrell R. Schroeder³, David O. Warner¹ & Randall P. Flick¹

¹ Department of Anesthesiology, Mayo Clinic, Rochester, MN, USA

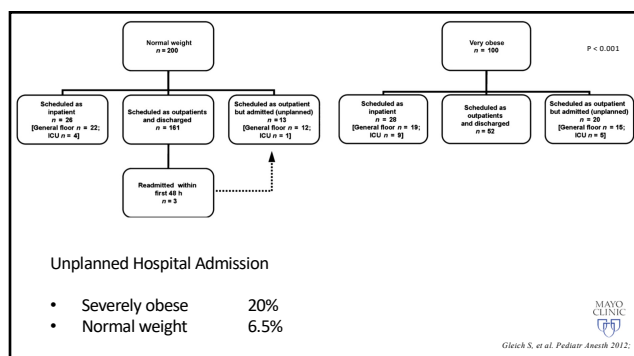
100 severely obese children (BMI ≥ 98th percentile) between ages 2 and 18 years

Severe Perioperative Events

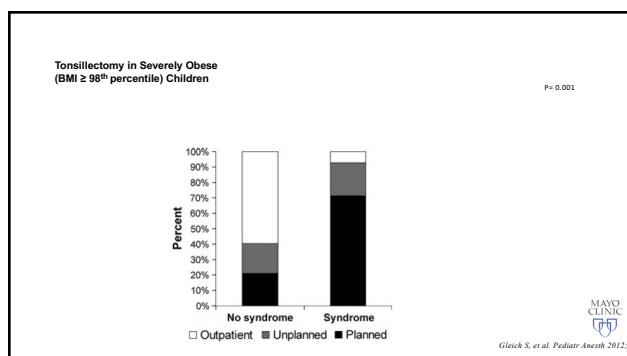
- Severely obese 15%
- Normal weight 2%

Gleich S, et al. Pediatr Anesth 2012.

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Management of T & A patients

- Preop patient education
 - Normal NPO rules, liberal clear liquids 2 hours before surgery time
- Intraoperative
 - IV Tylenol
 - Dexamethasone
 - Ondansetron
 - IV hydration
 - Judicious use of narcotics
- Postoperative
 - Up in chair by 1 hour post op
 - Typically discharged by 2 hours post op
 - No narcotics at home

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Conclusion

- Well-defined evidence-based selection criteria for pediatric patients undergoing surgery in a free-standing ASC will ensure safety of ambulatory surgery.
- Very obese children pose logistical and medical challenges
- Some teenagers with high BMI may simply have a high muscle mass, however, and may be considered on an individual basis.
- The role of the medical director at an ASC is extremely important developing and enforcing patient selection guidelines.

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Conclusion

- Comorbidities affect multiple organ systems with respiratory and pharmacologic issues contributing to the perioperative risk.