


# Ambulatory Anesthesia for the Obese Patient


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## Ambulatory Anesthesia for the Obese Patient

### Disclosures


- I have nothing to disclose



## Ambulatory Anesthesia for the Obese Patient

At the conclusion of this presentation, the attendee will be able to:


- Identify the common anatomic and physiologic alterations present in obese patients
- Utilize current, evidence-based practice to risk stratify obese patients for ambulatory surgery
- Formulate safe, efficacious anesthetic plans for obese patients in the ambulatory surgical setting



## Ambulatory Anesthesia for the Obese Patient

### Case

- TBA




## Ambulatory Anesthesia for the Obese Patient

### What is obesity?

- According to the WHO and NIH:
 

Body Mass Index	Classification
≤ 18.5	Underweight
18.5 - 25	Normal weight
25 - 30	Overweight
30 - 35	Class I Obesity
35 - 40	Class II Obesity (Severe)
≥ 40	Class III Obesity (Morbid)
- Health risk from any BMI increases if patient has gained more than 11 lbs. since the age of 25, or their waist circumference is ≥ 40 in

*Obes Res. 1998;6 Suppl 2:515*



### Determining body mass index from weight and height

BMI, kg/m <sup>2</sup>	Good weights					Overweight					Obesity			
	19	20	21	22	23	24	25	26	27	28	29	30	35	40
58"	91	96	100	105	110	115	119	124	129	134	138	143	167	191
59"	94	99	104	109	114	119	124	128	133	138	143	148	173	198
60"	97	102	107	112	118	123	128	133	138	143	148	153	179	204
61"	100	106	111	116	122	127	132	137	143	148	153	158	185	211
62"	104	109	115	120	126	131	136	142	147	153	158	164	191	218
63"	107	113	118	124	130	135	141	146	152	158	163	169	197	225
64"	110	116	122	128	134	140	145	151	157	163	168	174	202	232
65"	114	120	126	132	138	144	150	156	162	168	174	180	210	240
66"	118	124	130	136	142	148	155	161	167	173	179	186	216	247
67"	121	127	134	140	146	153	159	166	172	178	185	191	223	255
68"	125	131	138	144	151	158	164	171	177	184	190	197	230	262
69"	128	135	142	149	155	162	169	176	182	189	196	203	236	270
70"	132	139	146	153	160	167	174	181	188	195	202	209	243	278
71"	136	143	150	157	165	172	179	186	193	200	208	215	250	286
72"	140	147	154	162	169	177	184	191	199	206	213	221	258	294
73"	144	151	159	166	174	182	189	197	204	212	219	227	265	302
74"	148	155	163	171	179	186	194	202	210	218	225	233	272	311
75"	152	160	168	176	184	192	200	208	216	224	232	240	279	319
76"	156	164	172	180	189	197	205	213	221	230	238	246	287	328

### Ambulatory Anesthesia for the Obese Patient

Category	Percentile
Underweight	BMI < 5 <sup>th</sup>
Normal weight	BMI ≥ 5 <sup>th</sup> to < 85 <sup>th</sup>
Overweight	BMI ≥ 85 <sup>th</sup> to < 95 <sup>th</sup>
Class I Obesity	BMI ≥ 95 <sup>th</sup>
Class II Obesity	BMI ≥ 120 percent of 95 <sup>th</sup> percentile or ≥ BMI 35
Class III Obesity	BMI ≥ 140 percent of 95 <sup>th</sup> percentile or ≥ BMI 40

*Pediatrics. 2012 Dec;130(6):1136-40*

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### Ambulatory Anesthesia for the Obese Patient

#### Anatomic and Physiologic Alterations Present in Obese Patients

- **Anatomic Implications of Obesity include:**
  - Impact on choice of anesthetic
  - Relaxation
  - Anticipated difficult mask ventilation or intubation
  - Increased risk of hypoventilation/hypercapnia
  - Redundant tissue

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### Ambulatory Anesthesia for the Obese Patient

#### Anatomic and Physiologic Alterations Present in Obese Patients

- **Physiologic Alterations are Primarily Respiratory and Cardiovascular and result from:**
  1. Physical impingement of lung volumes
  2. Restriction of chest movement
  3. Increased metabolic requirements of excess tissue

*Respirology. 2012 Jan;17(1):43-9*

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### Ambulatory Anesthesia for the Obese Patient

#### Anatomic and Physiologic Alterations Present in Obese Patients

#### Respiratory

1. Increased work of breathing:
  - Increased respiratory rate
  - Decreased FRC and ERV
2. Disordered ventilation to perfusion matching:
  - Small airways remain closed during spontaneous ventilation leading to increased shunt fraction
3. Increased O<sub>2</sub> consumption

*Chest. 2006 Sep;130(3):827-33*

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### Ambulatory Anesthesia for the Obese Patient

#### Anatomic and Physiologic Alterations Present in Obese Patients

#### Respiratory

- **Consequences of these changes include:**
  1. Faster desaturation during apnea
  2. Increased O<sub>2</sub> requirement
  3. Hypoventilation with supine spontaneous ventilation

*Br J Anaesth. 2000 Jul;85(1):91-108*

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### Ambulatory Anesthesia for the Obese Patient

#### Cardiovascular

#### Respiratory

```

graph LR
    Obesity([Obesity]) --> WOB[↑'d WOB]
    Obesity --> VQ[↑'d V/Q Mismatch]
    Obesity --> O2[↑'d O2 Consumption]
    
```

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### Ambulatory Anesthesia for the Obese Patient

#### Anatomic and Physiologic Alterations Present in Obese Patients

**Cardiovascular**

1. Increased circulating blood volume
2. Decreased SVR
3. Increased CO
4. Right and Left Ventricular Hypertrophy

*Am J Med Sci. 1993;306(2):117*

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### Ambulatory Anesthesia for the Obese Patient

**Cardiovascular**

- ↑'d CO
- ↓'d SVR
- ↑'d Circulating Blood Volume
- LVH
- RVH

**Respiratory**

- ↑'d WOB
- ↑'d V/Q Mismatch
- ↑'d O<sub>2</sub> Consumption

Obesity

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### Ambulatory Anesthesia for the Obese Patient

**Systemic**

- ↑'d Central Blood Volume
- ↑'d LV Stroke Volume
- ↑'d C.O.
- Eventual LV Dilatation
- LVH
- ↑'d LV Wall Stress
- ↑'d MC O<sub>2</sub> Demand
- Systolic +/- Diastolic Dysfunction

**Pulmonary**

- OSA/Obesity Hypoventilation Syndrome
- Chronic hypoxia and/or hypercapnia
- ↑'d SNS tone
- ↓'d FRC, resulting in ↑'d PVR
- Pulmonary HTN
- Pulmonary Venous Congestion
- RV Enlargement and/or hypertrophy

Excess Adipose Tissue

Obesity Cardiomyopathy

LV/RV Failure

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### Ambulatory Anesthesia for the Obese Patient

#### Anatomic and Physiologic Alterations Present in Obese Patients

**Factors Influencing Ventricular Remodeling Include:**

- Severity and duration of obesity
- Severity and duration of systemic hypertension
- Elevated SNS tone/Activation of the RAAS
- Insulin resistance with hyperinsulinemia
- Leptin resistance with hyperleptinemia
- Adiponectin Deficiency
- Lipotoxicity
- Lipoapoptosis

*Prog Cardiovasc Dis 2014; 56:391*

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### Ambulatory Anesthesia for the Obese Patient

#### Risk Stratification for Obese Patients undergoing Ambulatory Surgery

**The Obesity Paradox**

- Otherwise healthy overweight and class I obese patients had comparable or decreased morbidity and mortality compared with patients of normal BMI (except VTE)
- However, outcomes were worse for underweight and more severely obese patients, and for obese patients with other comorbidities

*Ann Surg. 2009;250(1):166*

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### Ambulatory Anesthesia for the Obese Patient

#### Risk Stratification for Obese Patients undergoing Ambulatory Surgery

**Common comorbidities include:**

1. Obstructive Sleep Apnea (OSA)
2. Obesity Hypoventilation Syndrome (OHS)
3. Hypertension
4. Heart Disease
5. Diabetes
6. Metabolic Syndrome
7. Kidney Disease

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**Ambulatory Anesthesia for the Obese Patient**

**Risk Stratification for Obese Patients undergoing Ambulatory Surgery**

1. OSA

- Repetitive episodes of apnea or reduced inspiratory airflow due to upper airway obstruction during sleep
- Increased sensitivity to the respiratory depressant effects of sedatives and opioids and a greater tendency to obstruct the airway during sedation
- Diabetes, HTN, pHTN, CAD and arrhythmias

*J Clin Sleep Med. 2009;5(3):263*

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**Ambulatory Anesthesia for the Obese Patient**

**STOP-Bang questionnaire**

<input type="checkbox"/> Yes	<input type="checkbox"/> No	<b>Snoring?</b> Do you snore loudly (loud enough to be heard through closed doors, or your bed partner elbows you for snoring at night)?
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<b>Tired?</b> Do you often feel tired, fatigued, or sleepy during the daytime (such as falling asleep during driving)?
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<b>Observed?</b> Has anyone observed you stop breathing or choking/gasping during your sleep?
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<b>Pressure?</b> Do you have or are being treated for high blood pressure?
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<b>Body mass index more than 35 kg/m<sup>2</sup>?</b>
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<b>Age older than 50 years old?</b>
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<b>Neck size large? (measured around Adam's apple)</b> For male, is your shirt collar 17 inches or larger? For female, is your shirt collar 16 inches or larger?
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<b>Gender = Male?</b>

**Screening**

- Low risk: 0-2
- Intermediate risk: 3-4
- High risk: 5-8

*UpToDate, 2017*

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**Ambulatory Anesthesia for the Obese Patient**

**Risk Stratification for Obese Patients undergoing Ambulatory Surgery**

Postoperative complications in patients with obstructive sleep apnea syndrome undergoing hip or knee replacement: A case-control study  
Raksh M Datta, Javed Parvizi, Aron D Hansson, Peter C Day  
1184 words  
1 September 2001  
Mayo Clinic Proceedings  
80(9)  
927  
Volume 76, Issue 9, ISSN 0025-6196

- Retrospective, case-controlled, single center study involving 202 patients undergoing THR or TKR
- Lower incidence of serious postoperative complications (cardiac events, unplanned ICU transfer, or need for urgent respiratory support) in patients who used CPAP at home prior to surgery versus no CPAP

*Mayo Clin Proc. 2001; 76(9)*

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**Ambulatory Anesthesia for the Obese Patient**

**Risk Stratification for Obese Patients undergoing Ambulatory Surgery**

2. OHS

- Awake alveolar hypoventilation not attributed to other conditions
- Usually associated with OSA
- Sensitive to respiratory-depressant effects of sedatives and opioids
- Supplemental O2 may increase hypercapnia, leading to difficulty with weaning from mechanical ventilation

*Chest. 2011;139(5):1018*

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**Ambulatory Anesthesia for the Obese Patient**

**Risk Stratification for Obese Patients undergoing Ambulatory Surgery**

3. Hypertension

- Associated with labile BP during anesthesia, cardiac, neurological and renal complications
- Baseline blood pressure measurements should be recorded prior to the day of surgery
- Non-urgent surgery should be postponed in instances of poorly managed HTN or if systolic  $\geq 170$ ; diastolic  $\geq 110$

*Med Clin North Am. 1993;77(2):349*

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**Risk Stratification for Obese Patients undergoing Ambulatory Surgery**

4. CAD, CHF and AF all more common in obesity

**Cardiovascular Evaluation and Management of Severely Obese Patients Undergoing Surgery**

A Science Advisory From the American Heart Association

Paul Poirier, MD, PhD, FRCPC, FAHA, Chair; Martin A. Alpert, MD, FAHA; Lee A. Fleisher, MD, FAHA; Paul D. Thompson, MD, FAHA; Harvey J. Sugerman, MD; Lora E. Burke, PhD, MPH, RN, FAHA; Picard Marcoux, MD, PhD; Barry A. Franklin, PhD, FAHA; on behalf of the American Heart Association Obesity Committee of the Council on Nutrition, Physical Activity and Metabolism, Council on Cardiopulmonary Perioperative and Critical Care, Council on Cardiovascular Surgery and Anesthesia, Council on Cardiovascular Disease in the Young, Council on Cardiovascular Nursing, and Council on Clinical Cardiology

*Circulation. 2009;120(1):86*

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**Ambulatory Anesthesia for the Obese Patient**

**Risk Stratification for Obese Patients undergoing Ambulatory Surgery**

Cardiovascular Evaluation and Management of Severely Obese Patients Undergoing Surgery  
A Science Advisory From the American Heart Association

- 2009 AHA scientific advisory on obesity:
  - Patients with at least 1 risk factor for CAD (DM, smoking, HTN, hyperlipidemia) or poor exercise tolerance should have 12-lead ECG prior to surgery
  - Chest radiograph (PA and lateral) should be obtained for severely obese patients (BMI ≥ 40)

*Circulation. 2009;120(1):86*


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**Risk Stratification for Obese Patients undergoing Ambulatory Surgery**

5. Diabetes
6. Metabolic Syndrome
  - the co-occurrence of metabolic risk factors for both DM and CAD (abdominal obesity, hyperglycemia, dyslipidemia and HTN)
7. Kidney Disease
  - Risk largely mediated by the presence of DM and HTN

*Epidemiology. 2003;14(4):479*


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**Ambulatory Anesthesia for the Obese Patient**

**Risk Stratification for Obese Patients undergoing Ambulatory Surgery**

Common comorbidities include:

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3. Hypertension
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5. Diabetes
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7. Kidney Disease

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**Ambulatory Anesthesia for the Obese Patient**

**Risk Stratification for Obese Patients undergoing Ambulatory Surgery**

The Inappropriate Ambulatory Surgery Patient

- Unstable ASA Physical Status 3 and 4
- Malignant Hyperthermia
- Complex Morbid Obesity
- Complex OSA
- Acute Substance Abuse

*Anesthesiology. 2014 Sep;121(3):667-8*


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**Ambulatory Anesthesia for the Obese Patient**

**Formulating Safe Anesthetic Plans for Obese Patients in the Ambulatory Setting**

Implications of Obesity on Anesthetic Planning

- Anatomic and physiologic concerns
- Pharmacologic concerns
- Special equipment needs
- Induction, maintenance, emergence
- Positioning concerns
- Regional anesthesia
- Management of pain and anxiety
- Post-anesthetic care unit management

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**Ambulatory Anesthesia for the Obese Patient**

**Obesity and Pharmacology**

Obesity-related increases in lean body weight, CO, blood volume and regional blood flow can affect:

1. Peak plasma concentration
2. Renal clearance:
  - Changes in GFR, tubular secretion and tubular reabsorption are observed in obesity. Degree varies with specific drug
3. Hepatic elimination:
  - Hepatic metabolic pathways are generally enhanced in obesity. Degree varies with specific drug

*Clin Pharmacokinetics. 2010;49(2):71*


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**Ambulatory Anesthesia for the Obese Patient**

**Obesity and Pharmacology**

- The Volume of Distribution ( $V_d$ ) is the principal determinant of a drug's loading dose
  - The  $V_d$  of lipophilic drugs is generally increased in obesity; less lipophilic drugs generally have little to no change in  $V_d$

*Clin Pharmacokinet. 2010;49(2):71*


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**Ambulatory Anesthesia for the Obese Patient**

**Obesity and Pharmacology**

- The Volume of Distribution ( $V_d$ ) is the principal determinant of a drug's loading dose
  - The  $V_d$  of lipophilic drugs is generally increased in obesity; less lipophilic drugs generally have little to no change in  $V_d$
- The Elimination half-life ( $t_{1/2}$ ) impacts dosing interval and continuous infusion dosing
  - The  $t_{1/2}$  of a drug is directly proportional to its  $V_d$  and inversely proportional to its clearance

*Clin Pharmacokinet. 2010;49(2):71*


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**Ambulatory Anesthesia for the Obese Patient**

**Obesity and Pharmacology**

- Pharmacodynamic changes also occur in obese individuals with certain drugs
  - Therapeutic windows may be narrowed
  - Side-effects may be exaggerated
    - Difficult to predict

*J Pharm Sci. 1999;88(1):1*

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**Ambulatory Anesthesia for the Obese Patient**

**Obesity and Pharmacology**

Weight for Dosing (DW)

1. Total Body Weight (TBW)
2. Lean Body Weight (LBW):
  - Calculated by subtracting body fat weight from total body weight
  - Typically 60-90% of TBW
3. Ideal Body Weight (IBW):
  - Describes the average weight based on age, height and gender

*Obesity. 2009;17(5):889*

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**Ambulatory Anesthesia for the Obese Patient**

**Obesity and Pharmacology**

Ideal Body Weight (IBW):

- Males = 50 kg + 2.3 kg per inch over 5 feet
- Females = 45.5 kg + 2.3 kg per inch over 5 feet

*Obesity. 2009;17(5):889*


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**Obesity and Pharmacology – Sedative/Hypnotics**

Drug	Weight for Dosing (DW)	Notes
Propofol (bolus)	LBW	
Propofol (maintenance infusion)	LBW	Titrate to clinical endpoint
Midazolam	TBW	Dose incrementally until clinical endpoint is reached
Dexmedetomidine	Unknown	No specific dosing recommendations available. Titrate to clinical endpoint

*Obesity. 2009;17(5):889*


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**Obesity and Pharmacology- Opioids**

Drug	Weight for Dosing (DW)	Notes
Synthetic Opioids (e.g. fentanyl, sufentanil, remifentanyl)	LBW	Supra-therapeutic plasma levels noted with TBW dosing
Morphine	IBW	
Hydromorphone	IBW	

*Obesity. 2009;17(5):889*


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**Obesity and Pharmacology – NMBs**

Drug	Weight for Dosing (DW)	Notes
Non-depolarizers	IBW	
Succinylcholine	TBW	Superior intubating conditions noted with 1 mg/kg TBW

*Obesity. 2009;17(5):889*

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**Ambulatory Anesthesia for the Obese Patient**

**Obesity and Pharmacology – NMBs**

Drug	Weight for Dosing (DW)	Notes
Non-depolarizers	IBW	
Succinylcholine	TBW	Superior intubating conditions noted with 1 mg/kg TBW

- **“LBW for induction agents, IBW for NDNMBs, TBW for Sch”**

*Obesity. 2009;17(5):889*

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**Ambulatory Anesthesia for the Obese Patient**

**Formulating Safe Anesthetic Plans for Obese Patients in the Ambulatory Setting**

**Special Equipment Needs**

- Move quickly to ultrasound to assist with vascular access
- Designated OR table weight limits may not remain valid if patient is shifted or table is unlocked
- Check patient positioning frequently throughout case

[http://www.apsf.org/newsletters/html/2013/spring/07\\_tabletipdanger.htm](http://www.apsf.org/newsletters/html/2013/spring/07_tabletipdanger.htm)

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**Ambulatory Anesthesia for the Obese Patient**

**Formulating Safe Anesthetic Plans for Obese Patients in the Ambulatory Setting**

**Preparation for Induction**

- Morbid obesity does not correlate with GERD
- Reverse Trendelenberg position with head elevated
- Preoxygenation performed with manually applied PEEP
- Nasal cannula at 10 LPM for passive apneic oxygenation during laryngoscopy

*Obes Surg. 2013 Nov;23(11):1939-41*

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**Ambulatory Anesthesia for the Obese Patient**

**Formulating Safe Anesthetic Plans for Obese Patients in the Ambulatory Setting**

**Lung Protective Ventilation Strategy**

- Set tidal volume to 6 to 8 ml/kg IBW
- Adjust RR to normocapnia
- Keep  $F_iO_2$  below 0.5 to 0.8
- Use recruitment maneuvers every 30 minutes (10 – 20 seconds duration, plateau pressure 40 cm  $H_2O$ )
- Institute PEEP 6 to 8 cm  $H_2O$

*N Engl J Med. 2013;369(5):428*

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### Ambulatory Anesthesia for the Obese Patient

#### Formulating Safe Anesthetic Plans for Obese Patients in the Ambulatory Setting

##### Reversal of NMB

- Sugammadex (2 mg/kg, dosed at IBW + 40%) shown to be superior to neostigmine in terms of recovery from NMB and TOF ratio in PACU

*Br J Anaesth. 2012 Feb;108(2):236-9*

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### Ambulatory Anesthesia for the Obese Patient

#### Formulating Safe Anesthetic Plans for Obese Patients in the Ambulatory Setting

##### Post-Anesthesia Care Unit Management

- Use of Incentive Spirometry
- Use of Non-invasive Ventilation

*Anesth Analg. 2010;110(5):1360*

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### Ambulatory Anesthesia for the Obese Patient

#### Formulating Safe Anesthetic Plans for Obese Patients in the Ambulatory Setting

##### Pain Management

- Local anesthetic wound infiltration
- NSAIDs
- Acetaminophen
- Ketamine
- Gabapentin
- Clonidine/Dexmedetomidine

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