Procedures for Enteral and Parenteral Moderate Sedation and Emergency Management

Joseph A. Giovannitti, Jr., DMD
Professor and Chair,
Department of Dental Anesthesiology
University of Pittsburgh School of Dental Medicine
ASDA's Institute for the Management of Pain and Anxiety (IMPA)
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Disclosures

- No financial disclosures
- Representing the American Society of Dentist Anesthesiologist's Institute for the Management of Pain and Anxiety
  - ASDA/IMPA

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Overview

Presented by the ASDA's Institute for the Management of Pain and Anxiety

Cutting-Edge Education for the Cutting-Edge Dental Professional

- Spectrum of Pain Control
- Overview of enteral sedation
- Useful drugs for adult and pediatric enteral sedation
- Useful drugs for adult moderate sedation
- Emergency management and patient rescue

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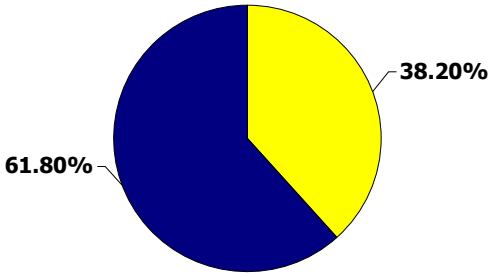
Dentists Use of Sedation on Their Patients in Their Primary Practice



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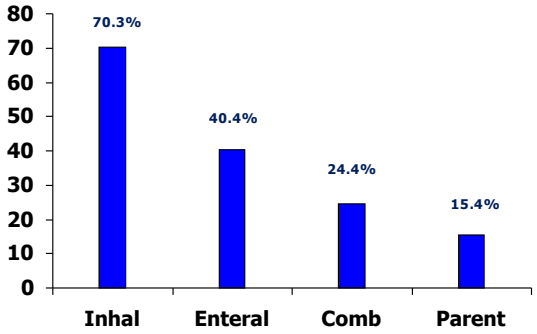
Route of Administration



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Universal Fears

- Pain
- The Unknown
- Helplessness, dependency
- Bodily change, mutilation
- Death

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"PAIN IS A THING OF THE MIND, AND THE MIND CAN BE CONTROLLED"

- Mr. Spock
Chief Science Officer
Starship Enterprise (NCC-1701)

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Objectives of Sedation

Mood alteration	Consciousness maintained	Cooperation
Stabilization of vital signs	Pain threshold elevated	Amnesia

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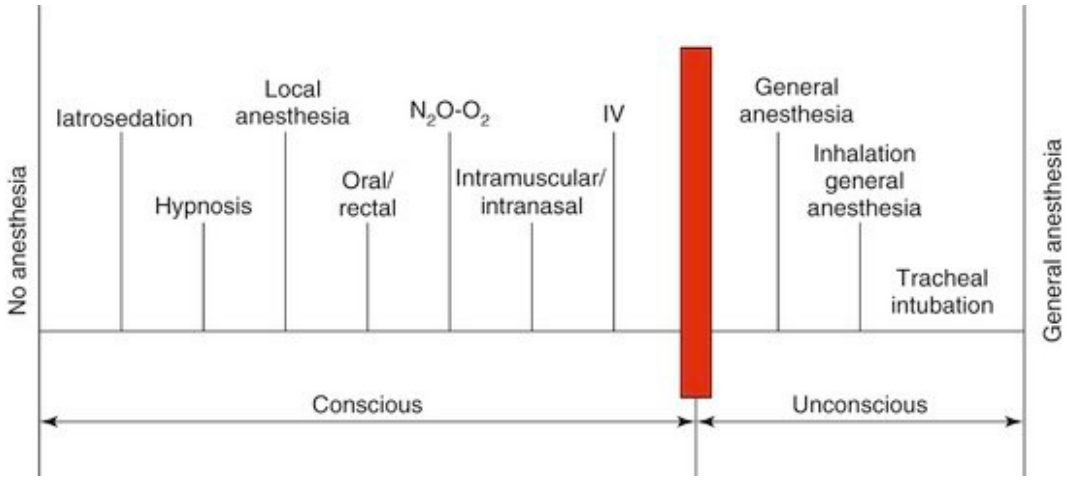
Spectrum of Pain Control



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ADA 2016

Because sedation and general anesthesia are a continuum, it is not always possible to predict how an individual patient will respond. Hence, practitioners intending to produce a given level of sedation should be able to diagnose and manage the physiologic consequences (rescue) for patients whose level of sedation becomes deeper than initially intended.

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Advantages of Moderate Sedation

- Eliminates or diminishes fear and anxiety
- Altered time perception
- Reduced incidence of medical emergencies
- Effective time management
- Improved quality of dental care

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Indications for Moderate Sedation

- Psychological considerations
- Medical history considerations
- Procedural requirements
- Special considerations

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Contraindications for Moderate Sedation

- Severe intellectual and/or physical disability
- Extreme behavioral management problem
- Prior history of adverse experiences
- Severe dental phobia
- Lack of proper facilities or trained personnel

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Minimal Sedation

- A minimally depressed level of consciousness, produced by a pharmacological method, that retains the patient's ability to independently and continuously maintain an airway and respond normally to tactile stimulation and verbal command. Although cognitive function and coordination may be modestly impaired, ventilatory and cardiovascular functions are unaffected.

- Patients whose only response is reflex withdrawal from repeated painful stimuli would not be considered to be in a state of minimal sedation.

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Minimal Sedation via the Enteral Route

- Minimal sedation may be achieved by the administration of a drug, either singly or in divided doses, by the enteral route to achieve the desired clinical effect, not to exceed the maximum recommended dose (MRD).
- The administration of enteral drugs exceeding the maximum recommended dose during a single appointment is considered to be moderate sedation and the moderate sedation guidelines apply.
- Nitrous oxide/oxygen when used in combination with sedative agent(s) may produce minimal, moderate, deep sedation or general anesthesia.
- If more than one enteral drug is administered to achieve the desired sedation effect, with or without the concomitant use of nitrous oxide, the guidelines for moderate sedation must apply.

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Moderate Sedation

- A drug-induced depression of consciousness during which patients respond purposefully to verbal commands, either alone or accompanied by light tactile stimulation. No interventions are required to maintain a patent airway, and spontaneous ventilation is adequate. Cardiovascular function is usually maintained.
- In accord with this particular definition, the drugs and/or techniques used should carry a margin of safety wide enough to render unintended loss of consciousness unlikely.

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Deep Sedation

- A drug-induced depression of consciousness during which patients cannot be easily aroused but respond purposefully following repeated or painful stimulation. The ability to independently maintain ventilatory function may be impaired. Patients may require assistance in maintaining a patent airway, and spontaneous ventilation may be inadequate. Cardiovascular function is usually maintained

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General Anesthesia

- A drug-induced loss of consciousness during which patients are not arousable, even by painful stimulation. The ability to independently maintain ventilatory function is often impaired. Patients often require assistance in maintaining a patent airway, and positive pressure ventilation may be required because of depressed spontaneous ventilation or drug-induced depression of neuromuscular function. Cardiovascular function may be impaired.

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History of Permitting

- 1970's
  - Deaths in dental offices of untrained dentists administering GA to dental patients led to the passage of legislation requiring a 'permit' from state dental boards after demonstration of education and clinical proficiency
- Present
  - GA regulated in all 50 states
  - GA permit required in 45 states

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With Introduction of GA Permits:

Doctors unable to qualify for GA ceased

- ↓ deaths associated with GA

Began to employ IV, IM sedation (unregulated)

- ↑ deaths from parenteral sedation

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History of Permitting

States began to require permits for the administration of parenteral sedation:

- Intravenous (IV)
- Intramuscular (IM)

Present

- Parenteral sedation regulated in all states
- Parenteral sedation permit required in 45 states

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History of Permitting

- Following introduction of parenteral sedation permits
  - Number of deaths from parenteral sedation decreased
- Doctors no longer able to administer parenteral sedation began to administer oral sedatives in an attempt to achieve sedation levels equal to that seen parenterally

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History of Permitting

- It was assumed that orally administered agents were somehow inherently safer and not likely to produce the misadventures and catastrophic accidents responsible for patient deaths
- The number of deaths associated with oral sedation increased

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DENTAL ANESTHESIOLOGY: A 2017 Guide to the Rules and Regulations of the United States of America

Sean G. Boynes, DMD, MS www.adsahome.org

- General anesthesia
  - 50 states regulate
  - 45 issue permits
- Parenteral conscious sedation
  - 50 states regulate
  - 45 issue permits
- Enteral conscious sedation
  - 27 states regulate and issue permits
    - 23 in 2008
- Inhalation sedation (N20-02)
  - 50 states regulate
  - 11 issue permits
- Anesthesia-specific CE
  - 2 states in 2004
  - 29 states in 2017

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Enteral Sedation

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Enteral Sedation

- **Dosing for minimal sedation via the enteral route** – minimal sedation may be achieved by the administration of a drug, either singly or in divided doses, by the enteral route to achieve the desired clinical effect, not to exceed the maximum recommended dose (MRD).
- The administration of enteral drugs exceeding the maximum recommended dose during a single appointment is considered to be moderate sedation and the moderate sedation guidelines apply.
- If more than one enteral drug is administered to achieve the desired sedation effect, with or without the concomitant use of nitrous oxide, the guidelines for moderate sedation must apply.

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Enteral Sedation

- Enteral
  - Any technique of administration in which the agent is absorbed through the GI tract or oral mucosa
    - Oral
    - Rectal
    - Sublingual
    - Intranasal

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Advantages of Oral Sedation

Ease of administration	Low cost	Decreased incidence of adverse reactions
Decreased severity of adverse reactions	Decreased severity of allergic reactions	Duration of action may extend postoperatively

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Disadvantages of Oral Sedation

Reliance on patient compliance	Delayed onset	Erratic and/or incomplete absorption	Inability to titrate
Inability to readily alter level of sedation	Prolonged duration of action	Usually not effective for severe anxiety	Duration of action may extend postoperatively

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Therapeutic Suggestions for Oral Sedation

Verbal and written instructions	Bedtime dose encouraged	Administer well in advance of need	Maintain NPO status prior to premedication
Patient must be accompanied by responsible adult	Prescribe or dispense only amount of drug required	Doctor administered dose recommended	Recovery and assistance may be required

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Uptake and Distribution of Enteral Medications

Absorption	Gastric emptying times	First-pass effect	Sublingual administration
Blood flow to sites of action	Metabolism	Drug interactions	CYP enzyme activity

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Drug Response Variations

- Age
  - Children
  - Elderly
- Genetics
  - CYP enzymes
- Disease states
- Anxiety level
  - Physiological antagonism
- Drug interactions
  - Potentiation by CNS depressants
  - Antagonism by CNS stimulants
- Normal biologic variation
- Pharmacokinetic factors

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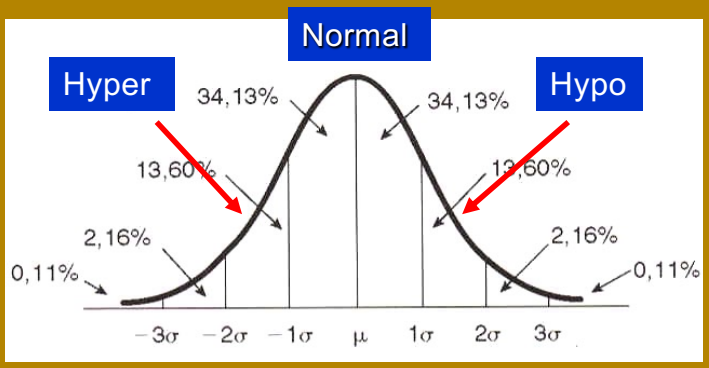
Normal Biologic Variation

Dose-Response Curve:

70% respond appropriately
15% hyper-respond (sensitive)
15% hypo-respond (resistant)



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Therapeutic Index

The ratio of the toxic dose of a drug to its therapeutic dose

- The higher the index, the safer the drug

Benzodiazepines have a high therapeutic index

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Benzodiazepines

- Facilitate binding of GABA
- Favorable therapeutic index
- Anterograde amnesia
- Drug variability
  - Onset
  - Duration
  - Metabolism
  - Sedation vs. hypnosis

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Benzodiazepines

- Specificity of effect
- Well absorbed by the oral route
- High margin of safety/therapeutic index
- Effective as single agents
- Specific reversal agent available
  - Flumazenil

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Useful Benzodiazepines

- Alprazolam
  - Antianxiety
- Diazepam
  - Antianxiety
- Lorazepam
  - Antianxiety
  - Sedative-hypnotic
- Midazolam
  - Sedative/hypnotic
- Oxazepam
  - Antianxiety
- Triazolam
  - Sedative/hypnotic

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The Fab Four

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Diazepam (Valium)

- Dosage
  - 2 – 10 mg adults
  - 0.15 – 0.3 mg/kg children
- Onset
  - 1 hour
  - 2 hours peak
- Duration
  - 1 – 3 hours
- Contraindications
  - Allergy
  - Acute narrow angle glaucoma
- Precautions
  - Sedation intensified with CYP3A4 and CYP2C19 inhibitors
- Availability
  - 2, 5, 10 mg tablets
  - 10 mg/5 ml syrup
- Active metabolites
- Pregnancy category
  - D
- Classification
  - Antianxiety

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Lorazepam (Ativan)

- Dosage
  - 2 – 4 mg adult
  - Well tolerated in the elderly
- Onset
  - 1 – 2 hours
- Duration
  - 2 – 4 hours
- Contraindications
  - Allergy
  - Acute narrow angle glaucoma
- Precautions
  - Oversedation
  - Depressive disorders
  - Psychosis
- Availability
  - 0.5, 1, 2 mg tablets
- No active metabolites
- Pregnancy category
  - D
- Classification
  - Antianxiety
  - Sedative/hypnotic

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Triazolam (Halcion)

- Dosage
  - 0.25-0.5mg adults
- Onset
  - 1 hour
- Duration
  - 1 hour
- Contraindications
  - Pregnancy
- Precautions
  - Excessive sedation possible in elderly
- Availability
  - 0.125, 0.25 mg tablets
- No active metabolites
- Pregnancy category
  - X
- Classification
  - Sedative/hypnotic

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Midazolam (Versed)

- Dosage
  - 0.25-1.0 mg/kg children
  - Max 20 mg
- Onset
  - 15-30 minutes
- Duration
  - 30 min-1 hour
- Contraindications
  - Allergy
  - Acute narrow angle glaucoma
- Precautions
  - Sedation intensified by CYP3A4 inhibitors
- Availability
  - 2 mg/ml syrup
- No active metabolites
- Pregnancy category
  - D

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Oxazepam (Serax)

- Dosage
  - 10-30 mg adults
- Onset
  - 1 hour
- Duration
  - 2-4 hours
- Contraindications
  - Allergy
- Precautions
  - Same as other BNZ
- Availability
  - 10, 15, 30 mg capsules
  - 15 mg tablets
- No active metabolites
- Pregnancy category
  - D
- Classification
  - Antianxiety

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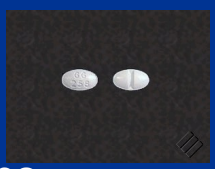
Alprazolam (Xanax)



- Dosage
  - 0.25-1.0 mg adults
- Onset
  - 1 hour
- Duration
  - 1-2 hours
- Contraindications
  - Allergy
  - Acute narrow angle glaucoma
- Precautions
  - Sedation intensified with CYP3A4 inhibitors
- Availability
  - 0.25, 0.5, 1 mg tablets
- No active metabolites
- Pregnancy category
  - D
- Classification
  - Antianxiety

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Diazepam/Clonidine

.15-.3 mg/kg / 0.2 mg

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Non-Benzodiazepine Sedative/Hypnotics

- Zolpidem (Ambien)
- Zaleplon (Sonata)
- Ezopiclone (Lunesta)

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Non-Benzodiazepine Sedative/Hypnotics

Chemically unrelated to other sedative/hypnotics

Pharmacologically similar to BNZ

GABA receptor agonist

- Sedation, amnesia
- Less memory and cognitive impairment than BNZ

Biotransformed by several CYP enzymes in addition to CYP3A4

- CYP3A4 inhibitors and inducers have a lesser effect

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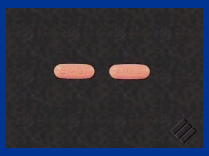
Zolpidem (Ambien)



- Dosage
  - 5-10 mg
- Onset
  - 1 hour
- Duration
  - 2-3 hours
- Contraindications
  - Allergy
- Precautions
  - Reduce dose in elderly
- Availability
  - 5, 10 mg tablets
- No active metabolites
- Pregnancy category
  - B
- Classification
  - Sedative/hypnotic

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Zaleplon (Sonata)

- Dosage
  - 5-10 mg
- Classification
  - Sedative/hypnotic

Ezopiclone (Lunesta)

- Dosage
  - 2-3 mg
  - 1-3 mg in elderly
- Classification
  - Sedative/hypnotic

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Melatonin Receptor Agonists

- Ramelteon (Rozerem)
  - 8 mg
- Melatonin
  - Secreted by pineal gland according to the light/dark cycle
  - Activation of melatonin receptors promotes sleep
- Uses
  - Jet lag
  - Insomnia
  - Preoperative sedation
  - Anxiolysis

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Pediatric Enteral Sedation

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"Why do we have to have all these kids?"

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The Pediatric Patient

- Anxious and fearful
- Lack of past experience
- Poor coping skills
- No incentive/benefit to cooperate

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Potential Damage to the Pediatric Psyche

Fear of the unknown	Surprise	Pain
"Shots"	Physical restraint	Parental separation

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Pediatric Stress and Anxiety

50% - 75% of children undergoing surgery develop anxiety

Associated with emergence delirium and postoperative behavioral problems

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Goals of Pediatric Sedation

Facilitate	Facilitate the provision of quality dental care
Minimize	Minimize the extremes of disruptive behavior
Promote	Promote a positive psychological response to treatment
Promote	Promote child welfare and safety
Return	Return the child to a physiologic state in which safe discharge is possible

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Pediatric Sedation

The first option for sedation is NO SEDATION!

10% - 15% of children will require sedation

Approximately 10,000 sedations per month

< 6 years of age or those with developmental delay have an increased risk profile

True moderate (conscious) sedation < 36 months is not reliable

- Deep sedation may be required

10% - 30% of enteral sedations will fail

Sedation/anesthesia is often objectionable to parents

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Frankl Scale

An assessment of pediatric behavior

Graded 1 - 4

Worst - Best

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Frankl 1

- Definitely negative
- Refusal of
- treatment
- Crying forcefully
- Fearful
- Overt evidence of extreme negativism

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Frankl 2

- Negative
- Reluctant to accept treatment
- Evidence of negative attitude
  - Not pronounced

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Frankl 3

- Positive
- Accepting of treatment
- May be cautious
- Willing to comply with dentist
- May have some reservations

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Frankl 4

- Definitely positive
- Good rapport with the dentist and team
- Interested in dental procedures
- Laughs and enjoys the situation

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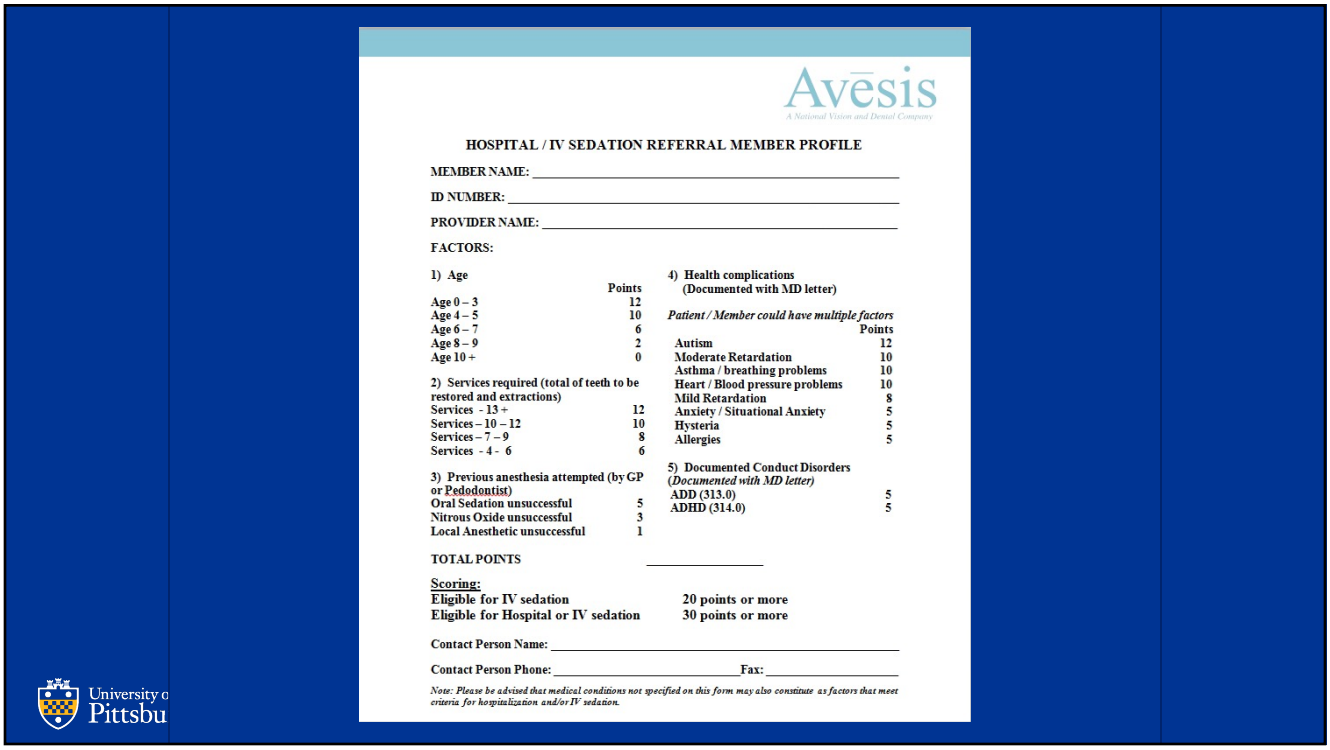

Avēsis
A National Vision and Dental Company

HOSPITAL / IV SEDATION REFERRAL MEMBER PROFILE

MEMBER NAME: _____

ID NUMBER: _____

PROVIDER NAME: _____

FACTORS:

1) Age

	Points
Age 0 – 3	12
Age 4 – 5	10
Age 6 – 7	6
Age 8 – 9	2
Age 10 +	0

2) Services required (total of teeth to be restored and extractions)

Services - 13 +	12
Services – 10 – 12	10
Services – 7 – 9	8
Services - 4 - 6	6

3) Previous anesthesia attempted (by GP or Pedodontist)

Oral Sedation unsuccessful	5
Nitrous Oxide unsuccessful	3
Local Anesthetic unsuccessful	1

4) Health complications (Documented with MD letter)

Patient / Member could have multiple factors

	Points
Autism	12
Moderate Retardation	10
Asthma / breathing problems	10
Heart / Blood pressure problems	10
Mild Retardation	8
Anxiety / Situational Anxiety	5
Hysteria	5
Allergies	5

5) Documented Conduct Disorders *(Documented with MD letter)*

ADD (313.0)	5
ADHD (314.0)	5

TOTAL POINTS _____

Scoring:

Eligible for IV sedation	20 points or more
Eligible for Hospital or IV sedation	30 points or more

Contact Person Name: _____

Contact Person Phone: _____ Fax: _____

Note: Please be advised that medical conditions not specified on this form may also constitute as factors that meet criteria for hospitalization and/or IV sedation.

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Useful (?) Drugs In Pediatric Sedation

- Nitrous oxide
- Chloral hydrate
- Meperidine
- Morphine
- Diphenhydramine
- Hydroxyzine
- Promethazine
- Diazepam
- Midazolam
- Triazolam
- Ketamine
- Dexmedetomidine
- Sufentanil
- Remifentanil
- Propofol

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Oral Administration

- Chloral hydrate
- Meperidine
- Morphine
- Diphenhydramine
- Hydroxyzine
- Promethazine
- Diazepam
- Midazolam
- Triazolam
- Ketamine

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Intranasal Administration

- Midazolam
- Dexmedetomidine
- Ketamine
- Sufentanil

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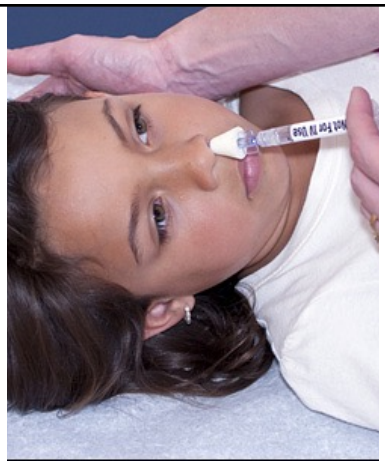

Intranasal Sedation

- Midazolam 0.5 mg/kg
- Dexmedetomidine 1-2 mcg/kg
- Midazolam/ketamine
- Dexmedetomidine/ketamine
- Sufentanil/dexmedetomidine

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Inhaled (Nebulized) Administration

- Ketamine
- Dexmedetomidine

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Nebulized Sedation

Ketamine 2 mg/kg

Dexmedetomidine
2 mcg/kg

Dexmedetomidine/ketamine
(1 mcg/kg and 1 mg/kg)

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Zanaty OM, El Metainy SA. A comparative evaluation of nebulized dexmedetomidine, nebulized ketamine, and their combination as premedication for outpatient pediatric dental surgery. Anesth & Analg 2015;121:167-71.

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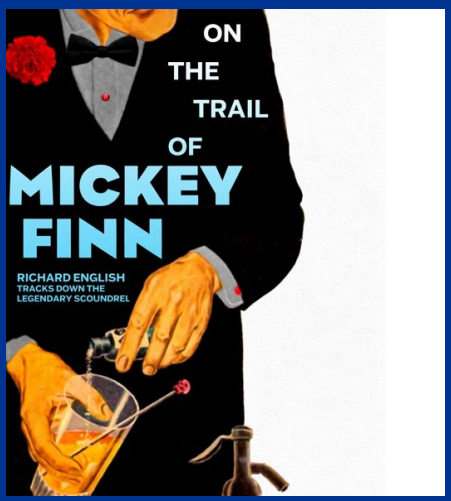
Chloral Hydrate

- Varied efficacy
- Dosage
  - 20 - 40 mg/kg
  - 1000 - 1500 mg maximum
- Trichloroethanol
- Adverse effects
- Myocardial sensitization
- Metabolite known carcinogen

- No longer being manufactured
  - Available through compounding pharmacies



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Single Oral Agents

Diazepam

- .3 - .5 mg/kg

Midazolam

- .2 – 1 mg/kg
- 20 mg maximum

Triazolam

- .125 - .5 mg
- Sublingual administration increases bioavailability

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Diphenhydramine (Benadryl)

- Dosage
  - 50-100 mg adults
  - 1.5 mg/kg children
- Onset
  - 1 hour
- Duration
  - 4-6 hours
- Contraindications
  - Allergy
- Precautions
  - Anticholinergic actions
- Availability
  - 25, 50 mg tabs and caps
  - 12.5/5 ml syrup
- No active metabolites
- Pregnancy category
  - B

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Hydroxyzine (Vistaril)

- Antiemetic/antihistaminic
- CNS depression-bronchodilator, anxiolytic
- Analgesia-dry mouth
- Onset 15-30 minutes, working time 45 minutes, duration 2-4 hours
- Availability
  - 10, 25, 50, 100 mg tabs
  - 10 mg/5 ml syrup
  - 25 mg/5 ml syrup
- Usually used with demerol or chloral hydrate
- Dosage
  - 1.1-2.2 mg/kg

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Promethazine (Phenergan)

- Dosage
  - 25-50 mg adults
  - 1.1-2.2 mg/kg children
- Onset
  - 1 hour
- Duration
  - 3-4 hours
- Contraindications
  - Allergy
- Precautions
  - Same as for other oral sedatives
- Availability
  - 12.5, 25, 50 mg tabs
  - 6.25 mg/5 ml syrup
  - 25 mg/5 ml syrup
  - 12.5, 25, 50 mg rectal suppositories
- No active metabolites
- Pregnancy category
  - C

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Oral "Cocktails"

- **Meperidine/promethazine**
  - 1-2 mg/kg / 0.5 mg/kg
- **Meperidine/hydroxyzine**
  - 1-2 mg/kg / 1 mg/kg
- **Meperidine/chloral hydrate/hydroxyzine**
  - 1-2 mg/kg / 10 mg/kg / 1 mg/kg
- **Morphine/midazolam/hydroxyzine**
  - 1 mg/kg / 0.5 mg/kg/ 1 mg/kg
- **Midazolam/ketamine**
  - .4-.7 mg/ kg / 4-7 mg/kg

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Success of Moderate Sedation

- Best success rate for sedation in children is 60-80%
- 20-40% will be failures
- There will always be failures when minimal/moderate sedation is employed
- Reports of serious morbidity and mortality in the dental office are based upon attempts to manage disruptive behavior with increasing dose

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Moderate Sedation for Adults

Useful Drugs for Intravenous Sedation

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Opioids

"Among the remedies which it has pleased Almighty God to give to man to relieve his sufferings, none is so universal and so efficacious as opium."

-Sydenham, 1680

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Opioid Receptors - 1973

- μ1
  - Analgesia (supraspinal, spinal)
  - Miosis
  - Urinary retention
  - Nausea and vomiting
  - Pruritis
- μ2
  - Sedation
  - Respiratory depression
  - GI motility decrease
- κ
  - Analgesia (supraspinal, spinal)
  - Sedation
  - GI motility decrease
  - Psychotomimesis
- σ
  - Dysphoria
  - Psychotomimesis
- δ
  - Analgesia (supraspinal, spinal)
  - Alterations of affective behavior
- Primary site of opioid activity
  - CNS
  - Bowel

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Analgesia and Sedation

- Analgesia, drowsiness, changes in mood, mental clouding without loss of consciousness
- Relieves most types of pain regardless of origin or intensity
- Increases pain threshold
- Affective pain response is altered

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Respiratory Effects

- Primary and continuous depressant of respiration
  - Depresses central ventilatory drive
  - Dependency on hypoxic drive
- Dose-dependent depression
- Decreases rate, tidal volume, minute volume

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Factors Affecting Opioid-Induced Respiratory Depression

- High dose
- Elderly
  - Fewer receptors, more sensitive
  - Higher plasma concentrations on a weight basis
- Other CNS depressants
- Renal insufficiency

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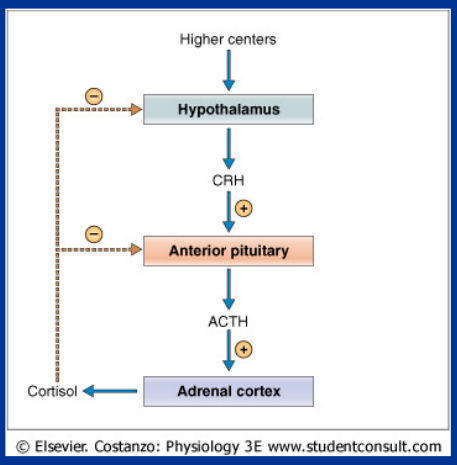
Effect on Cardiovascular Stress Response

- Attenuation
  - μ-receptor mediated action on the hypothalamic-pituitary-adrenal axis
    - Prevent ACTH release
    - Attenuate surgical stress response
  - Reduction in sympathetic tone
  - Enhance vagal and parasympathetic tone
- Hypotension and bradycardia



83

GI Effects

- Decrease gastrointestinal motility
  - Antidiarrheal effects
  - Constipation
- Reduce esophageal sphincter activity
- Delayed gastric emptying
  - " Full stomachs" regardless of NPO status with preoperative parenteral opioids
- Stimulate the CTZ
  - δ –receptor mediated nausea and vomiting

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Muscle Rigidity

- Increases muscle tone
  - Vocal cord closure
  - Chest-wall rigidity
  - Decrease pulmonary compliance
  - Decrease FRC
  - Increase ICP
- Usually associated with high doses and rapid administration
- Pretreatment with benzodiazepines

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Allergic Reactions

- True allergic reactions rare
- Histamine-related wheal and flare reactions
- Dilation of cutaneous blood vessels
  - Face, neck, upper thorax flushing
- Pruritus
  - Histamine release
  - Non-histamine releasing opioids also produce pruritis
    - μ-receptor mediated
  - Facial itching common

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Relative Potencies

	Meper	Morph	Fent	Sufent	Alfent	Remifent
Comparative Potency	0.1	1	75-125	500-1000	10-25	250
Peak Effect (min)	5-7	20-30	3-5	3-5	1.5-2	1.5-2
Duration (hr)	2-3	3-4	0.5-1	0.5-1	0.2-0.3	0.1-0.2
Half-life (hr)	3-4	2-4	1.5-6	2.5-3	1-2	0.15-0.3

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Phenylpiperidine Series

- Meperidine
- Fentanyl
- Sufentanil
- Alfentanil
- Remifentanil

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Meperidine (Demerol®)

- Dose 80-100 mg
- Onset 3 minutes
- Duration 45 min-1.5 hours
- Sedation
- Analgesia
- Dysphoria
- Nausea and vomiting
- Control of postop shivering
- Atropine-like effect
  - Tachycardia
  - Antisialogogue

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Fentanyl (Sublimaze®)

- Dose 25 mcg - 100 mcg
- Onset 30 seconds
- Duration 30 minutes
- Analgesia
- No euphoria
- Respiratory depression
- Bradycardia

90

Sufentanil (Sufenta®)

- Ultrapotent
- Sedation doses
  - Dilute to final concentration of 5 mcg/ml
  - 5 mcg sufentanil is equivalent to 50 mcg fentanyl
- Dose 2.5 mcg – 10 mcg
- Onset 30 seconds

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Alfentanil (Alfenta®)

- Less potent than fentanyl
- Sedation doses
  - 500 mcg alfentanil is equivalent to 50 mcg fentanyl
- Dose 250 mcg – 1000 mcg
- Onset 30 seconds

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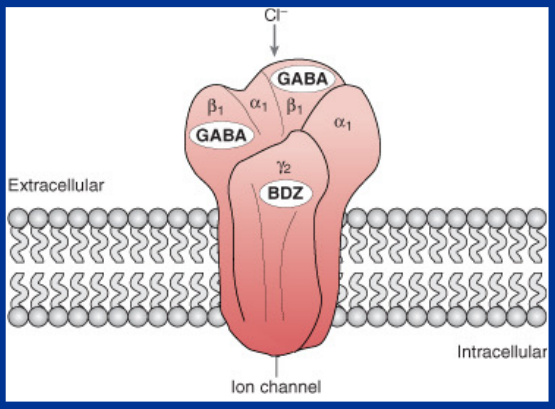
Benzodiazepines

- Benzodiazepine receptor
  - Facilitates GABA-mediated chloride ion influx
- Favorable therapeutic index
- Anxiolysis
- Sedation
- Amnesia
- Anti-convulsant
- Muscle relaxation



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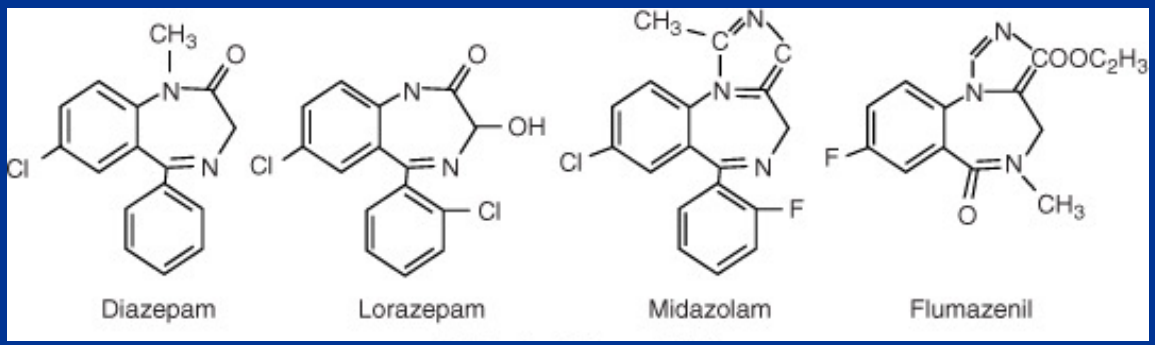
Benzodiazepines



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Diazepam

- High lipid solubility
- Elimination half-life ranges from 22-100 hours
- Active metabolites (hangover effect)
  - Nordiazepam
  - Desmethyldiazepam
  - Oxazepam
- Soluble in propylene glycol
  - Water insoluble
  - Venous irritation (phlebitis) and pain on injection
  - Poor uptake after IM injection
- Dosing titrated to clinical endpoint

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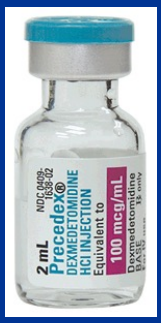
Midazolam

- Water soluble
  - No venous irritation or phlebitis
  - Improves IM uptake
- High lipid solubility when injected
  - Closure of benzodiazepine ring at physiologic pH
- No active metabolites
- Elimination half-life 2.5 hours
- CYP 3A4 inhibitors intensify and prolong the effects of benzodiazepines
- Dosing titrated to clinical endpoint

96

Alpha-2 Receptor Agonist

- Dexmedetomidine
- α2/α1-receptor selectivity
  - Dexmedetomidine
    - 1600/1
  - Clonidine
    - 220/1



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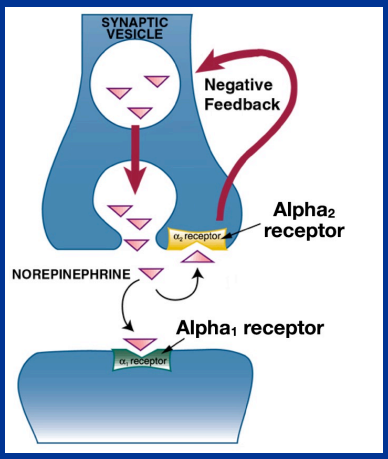
α2 Adrenergic Receptor

- Adrenergic receptors
  - Regulate release of neurotransmitters
  - Control epinephrine, norepinephrine release
  - Modulate sympathetic response "negative feedback loop"



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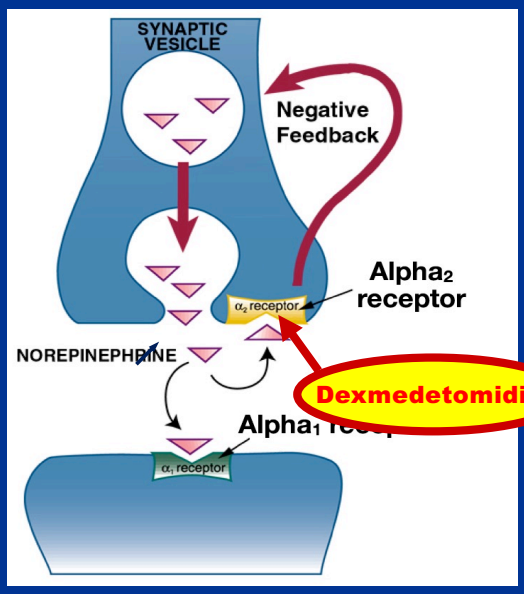
Mechanism of Action



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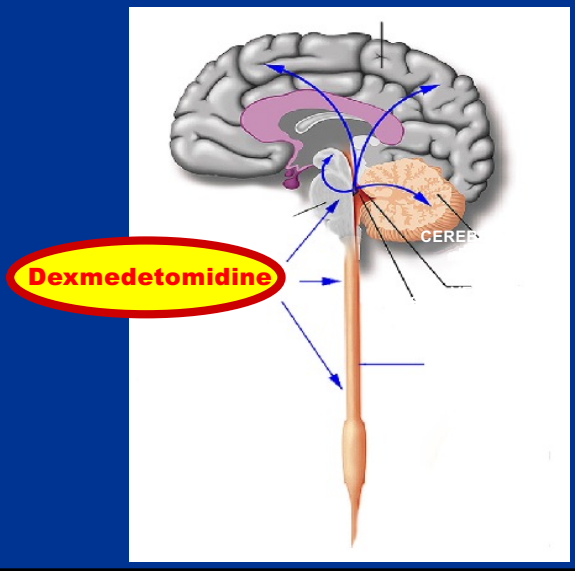
Mechanism of Action

- Sites of action
  - Brain (locus ceruleus)
  - Spinal cord
  - Autonomic nerves
- CNS
  - Sedation/hypnosis
  - Anxiolysis
  - Analgesia
- Autonomic nerves
  - ↓ Sympathetic activity
    - ↓ BP, ↓ HR



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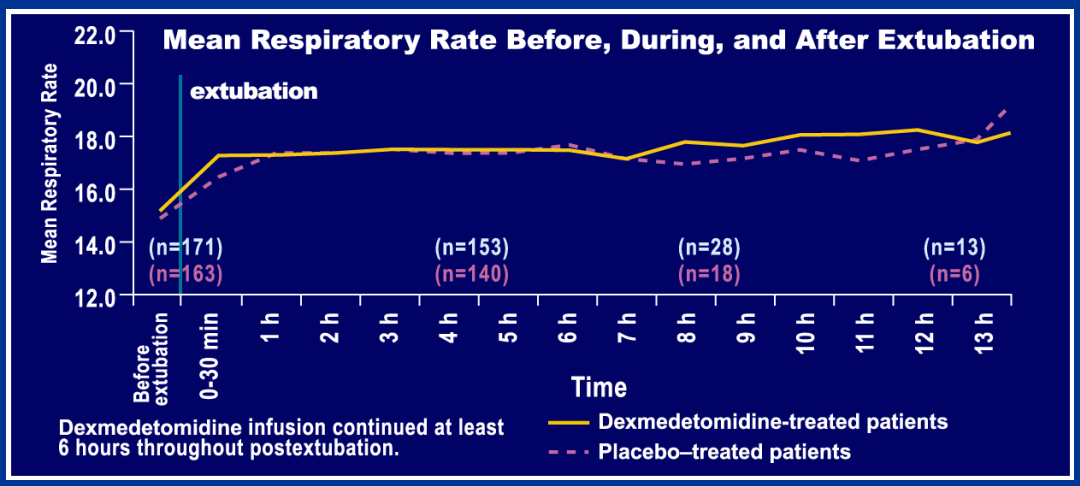
Respiratory Effects



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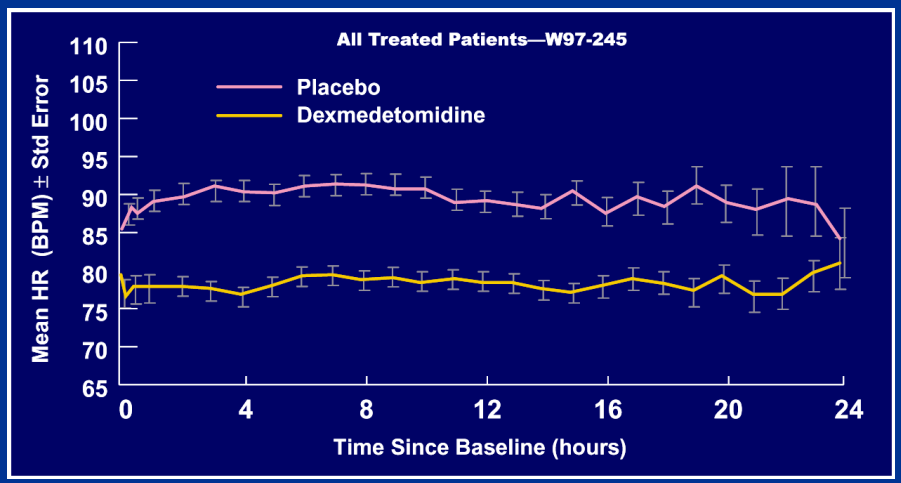
Cardiovascular Effects



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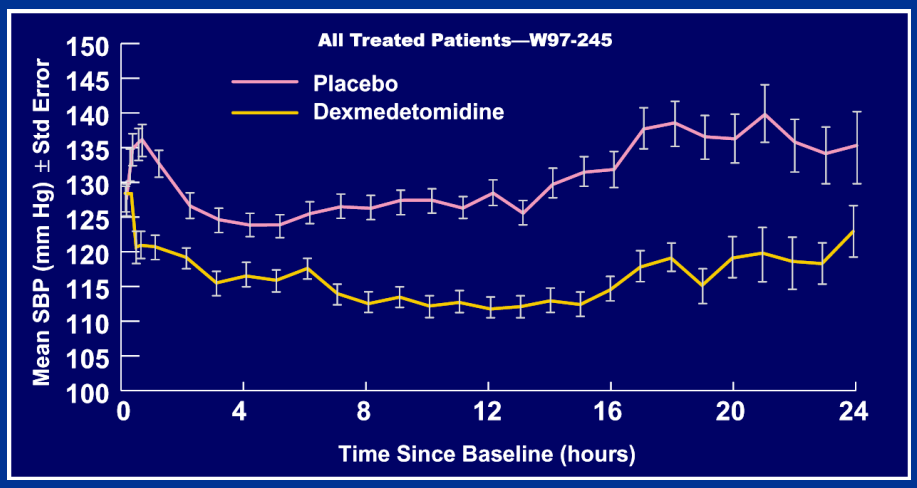
Cardiovascular Effects



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Dexmedetomidine

Dexmedetomidine may potentiate the effects of other agents

- Opioids
- Sedatives/hypnotics
- Anesthetics
- Vasoactive agents

Use in conjunction with other sedatives for moderate sedation

- 0.25 mg/kg given in divided doses for desired effect to enhance sedation and smooth maintenance and emergence

104

Emergency Management and Patient Rescue

Bringing Them Back from the Precipice

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Who is Susceptible to the Perils of Deep Sedation When Moderate Sedation is the Intent?

BMI > 35	Pediatric patients	Elderly patients	Down Syndrome patients
COPD patients	Obstructive sleep apnea patients	Opioid tolerant patients	Any patient!

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AIRWAY MANAGEMENT

Preventing Anesthesia Morbidity and Mortality

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Potential Causes of Office Anesthesia Deaths

- Laryngospasm
- Aspiration
- Asthma
- Allergic reaction
- Bronchospasm
- Obesity related (airway)
- OSA
- Limited mouth opening
- Anesthetic overdose
- Pulmonary embolism

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Airway Management

- Potential for difficult airway should be anticipated
  - 90% of patients
- Unexpected problems
  - 10% of patients

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Cardinal Signs of a Difficult Airway

- Mallampati classification III/IV
- Body mass index > 35
- History of snoring or obstructive sleep apnea
- Thyromental distance < 6 cm
- Limited mouth opening
- Receding mandibular profile
- Limited range of motion of the head and neck
- Neck circumference > 17 inches (male) > 16 inches (female)
- Craniofacial deformity
- Enlarged tonsils

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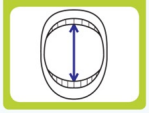
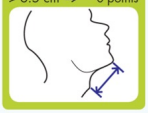
Simplified Airway Risk Index
SARI

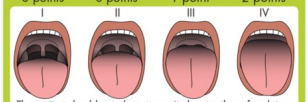
Mouth opening
< 4 cm → 1 point
≥ 4 cm → 0 points



Thyromental distance
< 6.0 cm → 2 points
6.0 - 6.5 → 1 point
> 6.5 cm → 0 points



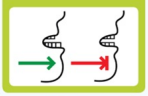
Mallampati
0 points | 0 points | 1 point | 2 points
I | II | III | IV



The patient should not phonate, as it elevates the soft palate

Neck movement
< 80° → 2 points
80 - 90° → 1 point
> 90° → 0 points

Ability to prognath
Yes → 0 points
No → 1 point



Weight
< 90kg → 0 points
90-110kg → 1 point
> 110kg → 2 points

History of difficult intubation
Definite → 2 points
Questionable → 1 point
None → 0 points

The points are summarized into the SARI score.
A score of ≥ 4 indicates difficult direct laryngoscopy according to the Simplified Airway Risk Index.

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Mallampati Class IV

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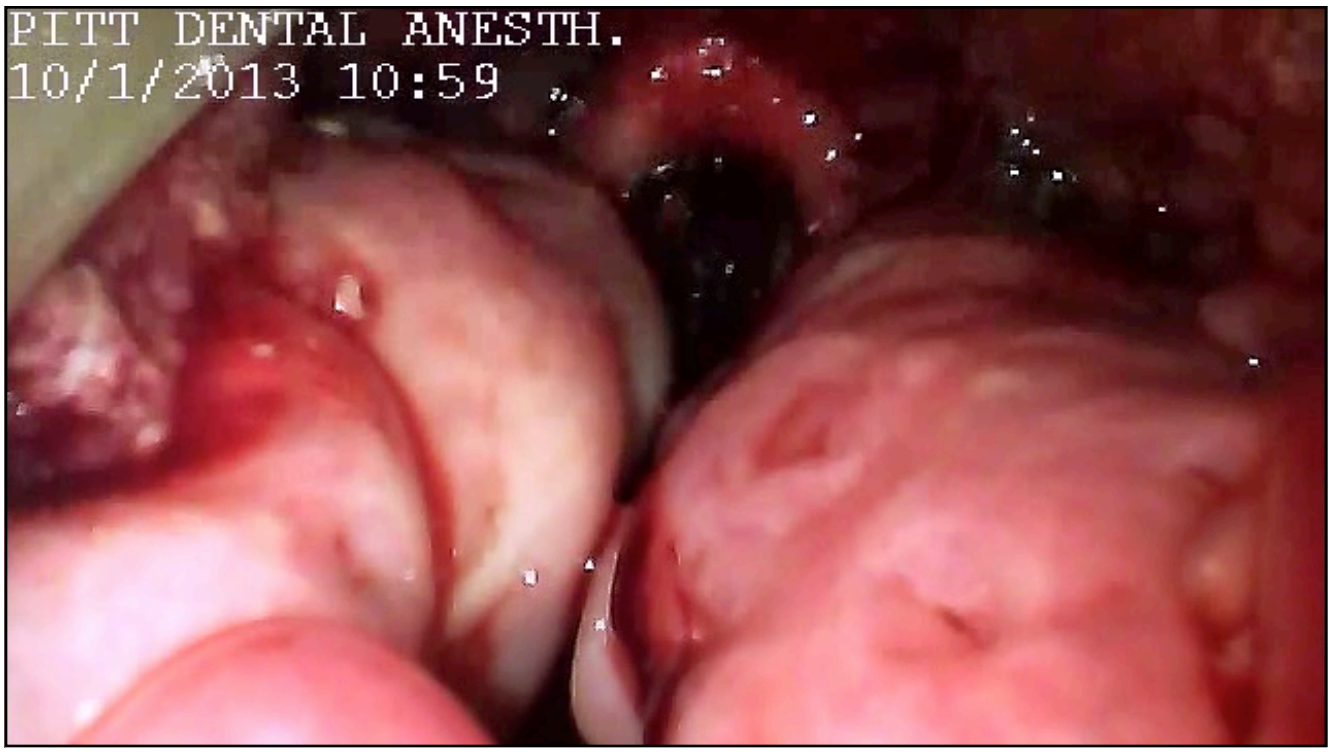

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Recognizing Airway Obstruction

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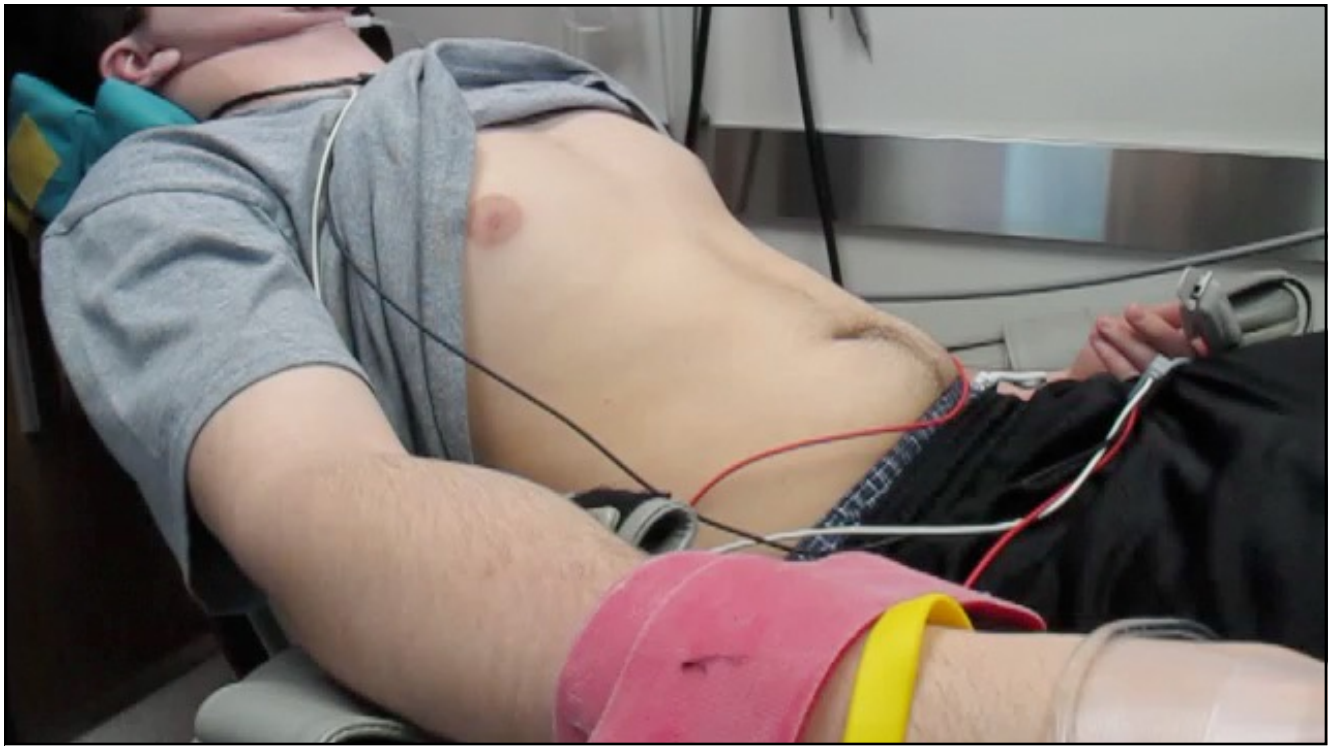

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Pretracheal Stethoscope

- Pretracheal positioning allows for easier recognition of respiratory sounds
- Patient-specific sizes available
- Practitioner is tethered to the patient

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Bluetooth Pretracheal Stethoscope

- Bluetooth technology untethers the practitioner
- May be synced with remote speaker

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Pretracheal Stethoscope

Auscultation can provide real-time information of airflow and airway patency

Breath Sounds	Interpretation
Snoring	Airway blockage by tongue/soft tissues
Gurgling	Fluids in throat/excess secretions
Wheezing	Bronchospasm
No Breath Sounds	Complete laryngospasm, bronchospasm, or obstruction

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Utility of Carbon Dioxide Monitoring

- Is the patient breathing?
- How well is the patient breathing?
  - Adequacy of ventilation
- Diagnose airway obstruction
- Diagnose bronchospasm
- Determine adequacy of chest compressions

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Utility of Carbon Dioxide Monitoring

- Capnography can detect airway obstruction and respiratory depression earlier than clinical exam and pulse oximetry
- May prevent oxygen desaturation

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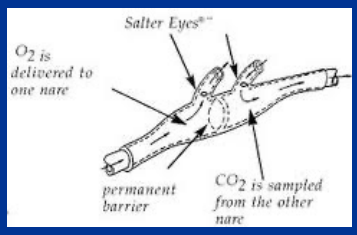
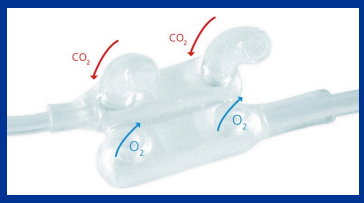
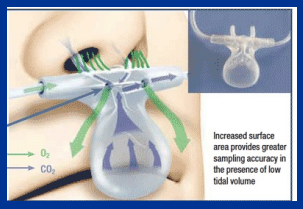
Sampling Devices







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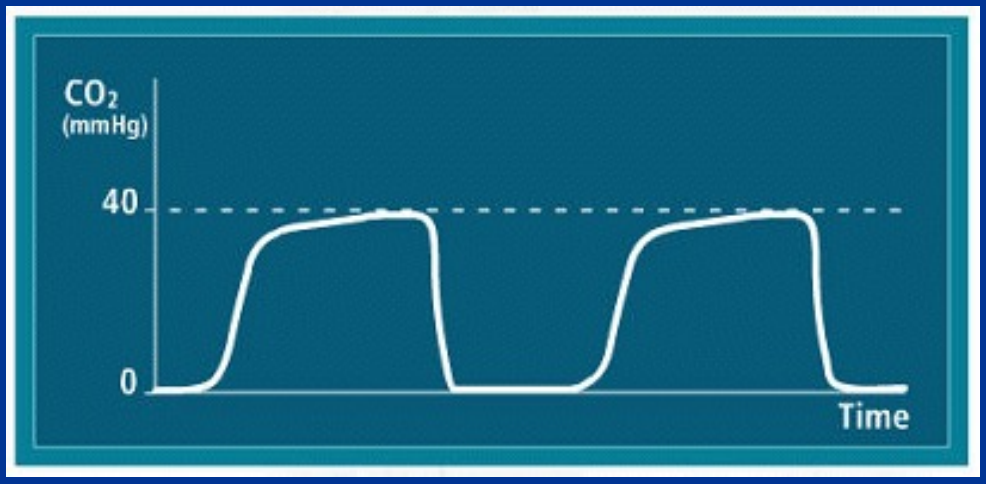
Capnogram



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mindray
02:28 PM
ECG
62
PVCs 0
ST-II 0.07
Pleth
SpO2
100
PR 62
CO2
45
20
5
Gas
N2O %
O2 %
AA %
MAC
0.00
Age 40
Temp
NIBP
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Basic Airway Maneuvers

- Head tilt/chin lift
- Jaw thrust
- Triple airway maneuver

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Head Tilt/Chin Lift

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Jaw Thrust

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Triple Airway Maneuver

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Dental Assistants

The Unsung Heroes of Airway Management

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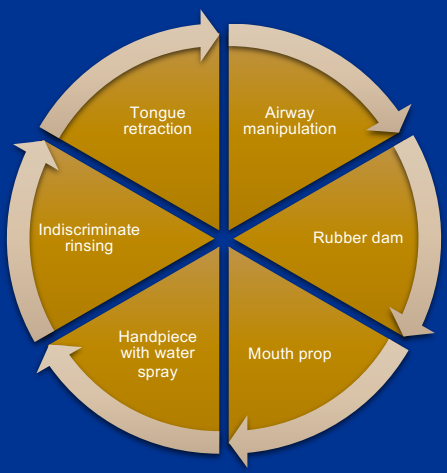
Dentistry as an Airway Insult



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Airway Management Equipment

- Nasal cannulas
- Bag-valve-mask device (BVM)
- Nasopharyngeal airways
- Oropharyngeal airways
- i-gel supraglottic airways

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Nasal Cannula

- FiO2 increases by 4% above room air per liter of flow
- Example
  - 3 l/m x 4% = 12%
  - FiO2 = 12% + 21% = 33%
- Patients cannot tolerate flows > 8 l/m

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Bag-Valve-Mask (BVM) Ventilation

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Nasopharyngeal Airways

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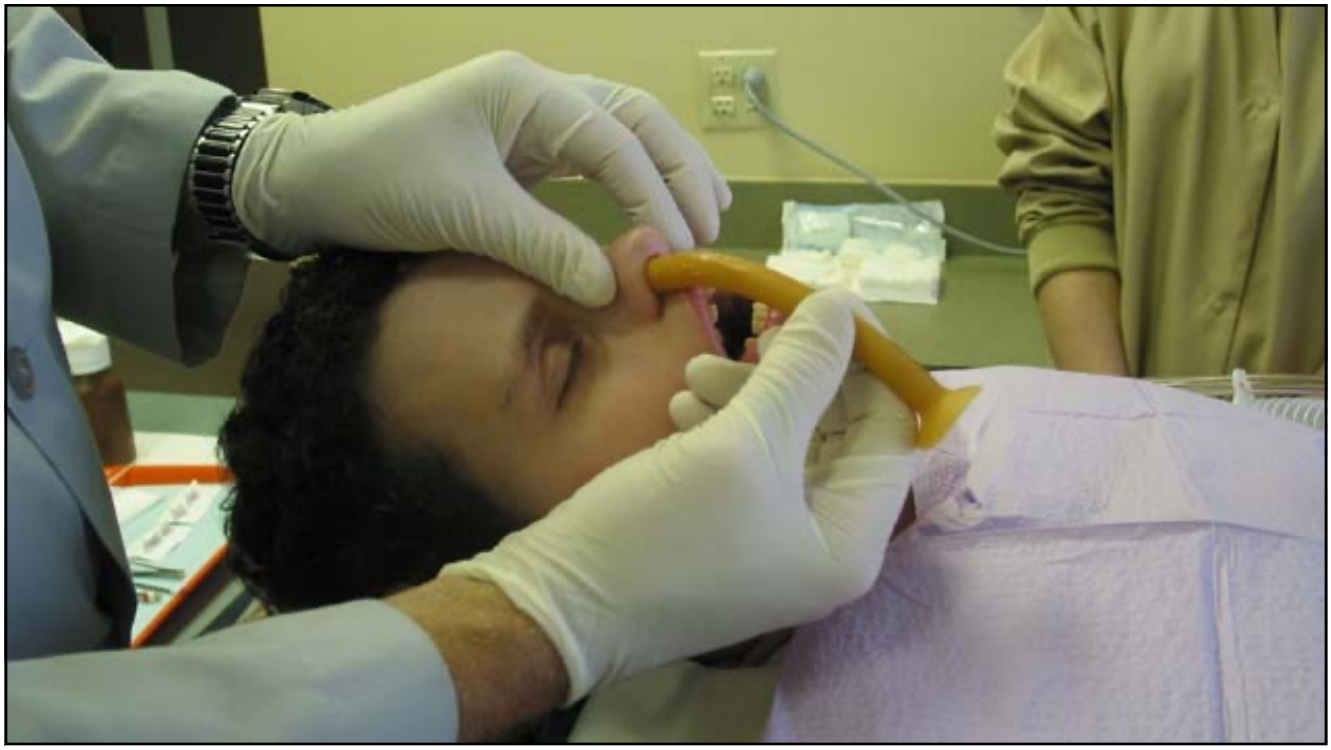

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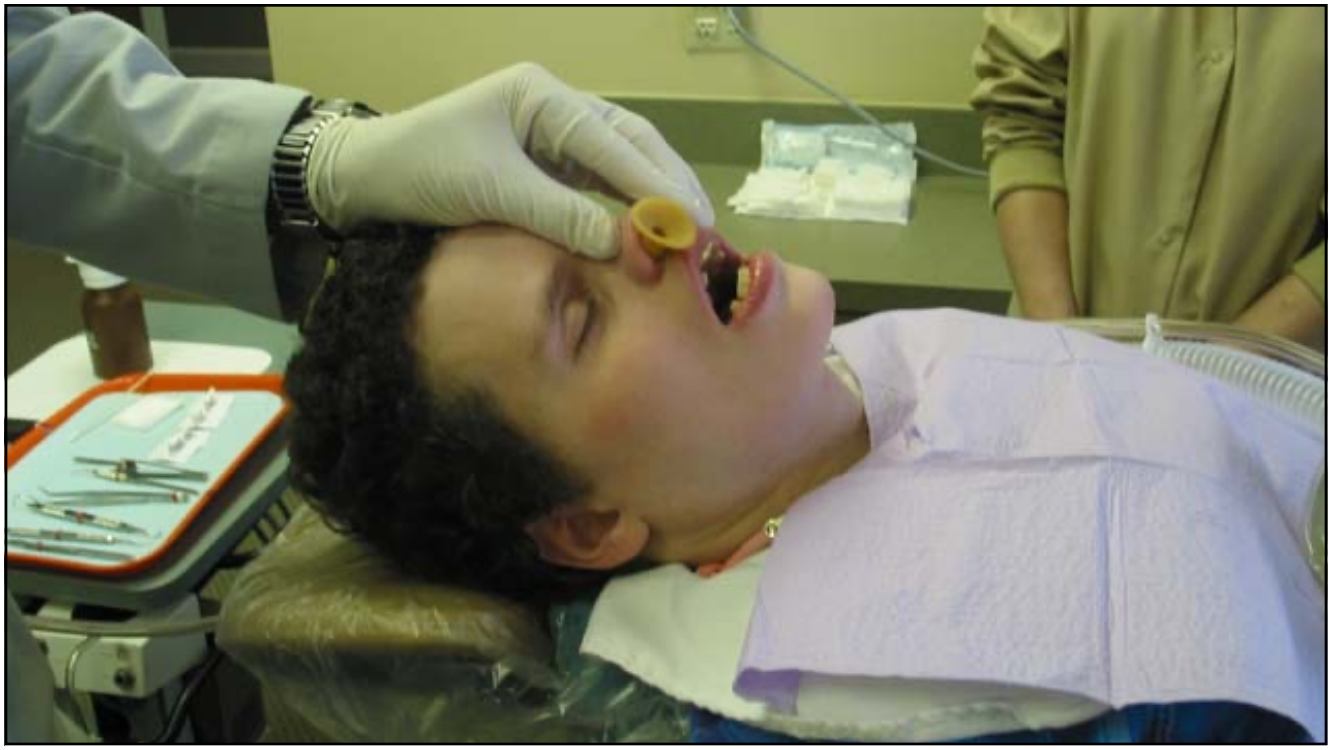

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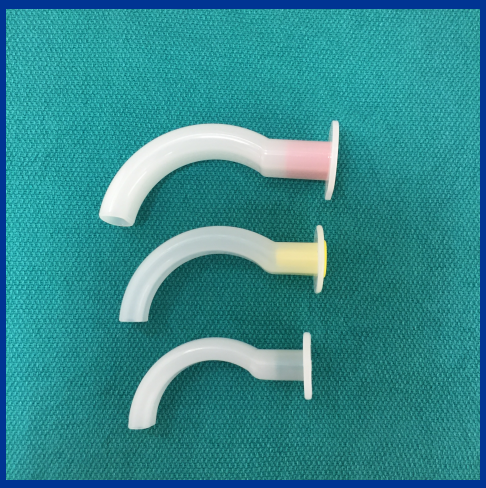
Oropharyngeal Airways



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Oropharyngeal Airway Insertion

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i-gel Supraglottic Airway

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i-gel Supraglottic Airway Insertion

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Respiratory Emergencies

Laryngospasm

Bronchospasm

NPPE

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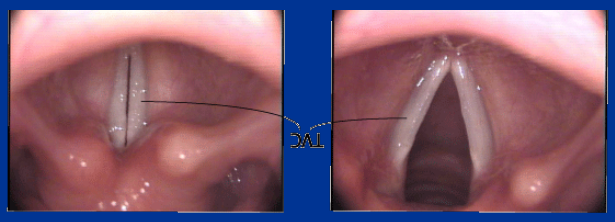
Laryngospasm

- Spasm of the vocal cords
- Secondary to direct stimulation at the glottis
  - Water, irrigation, bleeding
  - Foreign body
  - Pain
- Treatment
  - Deep suctioning
  - Airway maneuvers
  - Larson maneuver
  - Sustained positive pressure oxygen to the airway
  - Reversal
  - Succinylcholine/rocuronium



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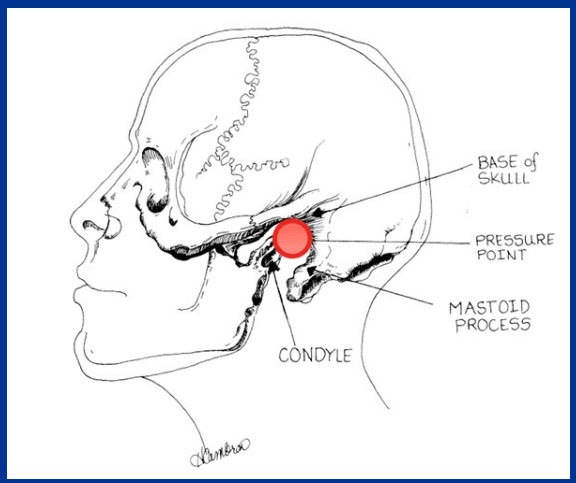
Larson Maneuver



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Predisposing Factors

- Asthma
- COPD
- Chronic bronchitis
- URI
- Smoker
- Progression to deep sedation

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Preventing Laryngospasm

- Maintain consciousness
- Avoid stimulation of vocal cords
  - Secretions
  - Blood
  - Airway adjuncts

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Complications of Laryngospasm

- Hypoxia
- Negative pressure pulmonary edema (NPPE)
- Cardiac arrest

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Laryngospasm and Chest Compression

- 4-year study of 3-12 year olds having elective tonsillectomy
- First 2 years of study
  - Laryngospasm treated with100% O2 and positive pressure ventilation via face mask
- Following 2 years of study
  - Laryngospasm treated with 100% O2 and gentle chest compression
- Al-Metwalli R, Mowafi H. Gentle chest compression relieves extubation laryngospasm in children. J Anesth. 2010: 24: 854-857.

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Laryngospasm and Chest Compression

- 1226 children studied

- Chest compression group
  - 46/594 (7.8%) laryngospasm
- Standard group
  - 52/632 (8.2%) laryngospasm

Al-Metwalli R, Mowafi H. Gentle chest compression relieves extubation laryngospasm in children. J Anesth. 2010: 24: 854-857.

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Laryngospasm and Chest Compression

- 34/46 (73.9%)chest compression group were successfully treated
  - NONE of chest compression group had gastric distension
- 20/52 (38.4%) standard group were successfully treated
  - 45/52 (86.5%) standard group developed gastric distension

Al-Metwalli R, Mowafi H. Gentle chest compression relieves extubation laryngospasm in children. J Anesth. 2010: 24: 854-857.

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Management with Succinylcholine

Adult

- 20 mg up to 0.5 mg/kg IV
- 4 mg/kg IM
- Based on ideal body weight

Onset

- 30-60 seconds IV
- 2-3 minutes IM

Duration

- 4-6 minutes IV
- 10-30 minutes IM

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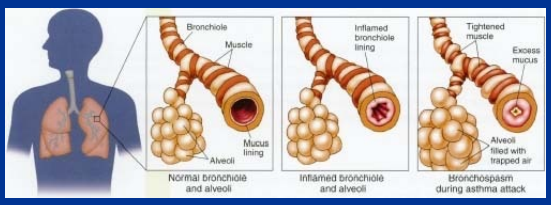
Bronchospasm

- Constriction of the bronchial airways
- Result of debris in airway, laryngospasm, prolonged airway obstruction, or exacerbation of asthma



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Bronchospasm Signs and Symptoms

- Cough
- Wheezing
- Dyspnea
- Increased anxiety
- Difficulty catching breath
- Patient uses accessory muscles of respiration

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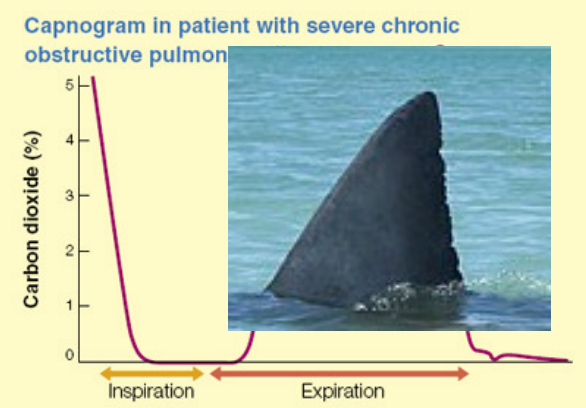
Small Airway Obstruction

- Acute bronchospasm
- Mucus plugging
- Partial airway obstruction
- Kinked ET tube
- Prolonged expiratory phase
- Asthma
- COPD



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Bronchospasm Management

100% O_2 with PEEP	Consider reversal agents	Administer albuterol via BVM (10-12 puffs) with PEEP
0.3-0.5 mg epinephrine (1:1000) intramuscularly	Titrate 10 mcg epinephrine IV until effective	Administer albuterol via nebulizer if non-emergent

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Negative Pressure Pulmonary Edema (NPPE)

- Non-cardiogenic pulmonary edema
- Closed upper airway is the initiating event
- Increased work of breathing generates a large negative intrathoracic pressure
  - -50 to -100 cmH2O
    - Normal is -3 to -10 cmH2O
- Fluid shifts from the capillaries into the pulmonary interstitial spaces
- Flooding of alveoli

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Anesthetic Causes of NPPE

- Laryngospasm
- Foreign body
- Endotracheal tube obstruction
- Bronchospasm
- Prolonged breathing against a partially obstructed airway
  - Increased work of breathing
  - Pediatric patients

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Anesthetic-Related Aspiration Pneumonia

- Inhalation of oropharyngeal or gastric contents
- Oropharyngeal bacteria
  - Aspiration pneumonia
- Gastric contents
  - Aspiration or chemical pneumonitis
  - Mendelson's syndrome
    - Chemical burns to tracheobronchial tree
    - Inflammatory cell reaction release of cytokines

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Risk Factors: Individuals With Chronically Impaired Airway Reflexes

- Alcoholism
- Drug overdose
- Deep sedation/GA
- Seizures
- Stroke
- MS
- CP
- ALS
- Down syndrome
- Parkinson's
- Myasthenia gravis
- GERD

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Clinical Presentation

Chemical Pneumonitis

- Acute onset
- Respiratory distress
- Wheezing or cough
- Pink, frothy sputum

Aspiration Pneumonia

- Subacute or insidious onset
- Non-specific symptoms
- Shortness of breath
- Dyspnea on exertion

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Treatment

Chemical Pneumonitis

- Airway maintenance
- Clearance of secretions
- Supplemental oxygen
- Immediate transport
- Intubation with mechanical ventilation and PEEP
- Routine use of steroids and prophylactic antibiotics not recommended

Aspiration Pneumonia

- Antibiotics if failure to resolve within 48 hours

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Cardiovascular Issues

Acute Coronary Syndromes

Hypotension

Hypertension

Dysrhythmias

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MI

- Chest pain, tightness, pressure, lasting more than 15 minutes and not alleviated by NTG
- Radiating pain to the shoulders, neck, arms, or jaw
- Diaphoresis, nausea, vomiting
- Stress, anxiety, impending doom
- ST-segment elevation or new LBBB
  - STEMI
- ST-segment depression
  - NSTE-ACS
- Manage with OANM
  - Oxygen, aspirin, nitroglycerine, morphine

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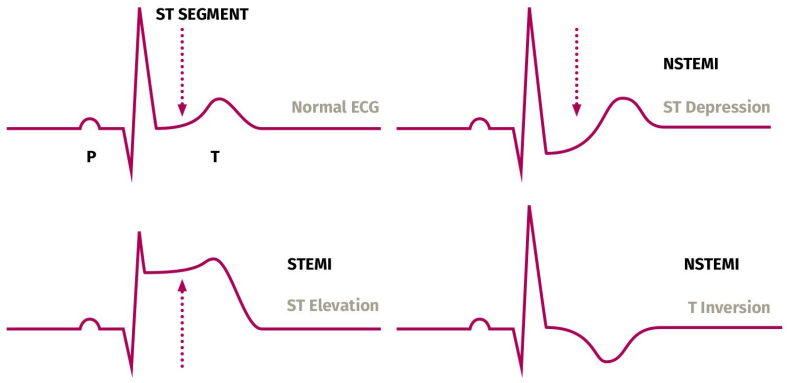
Acute Coronary Syndromes



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Acute Coronary Syndromes

Oxygen
- If SpO2 < 90%

Aspirin
- 160 – 325 mg non-enteric coated orally, crushed or chewed

Nitroglycerin
- Contraindicated if SBP < 90 mmHg or > 30 mmHg below baseline
- Bradycardia < 50
- Tachycardia > 100
- Phosphodiesterase inhibitor

Nitroglycerine dose
- SL .4 mg repeat x 2
- Spray 1 or 2 sprays x 2

Morphine
- 2 – 4 mg IV

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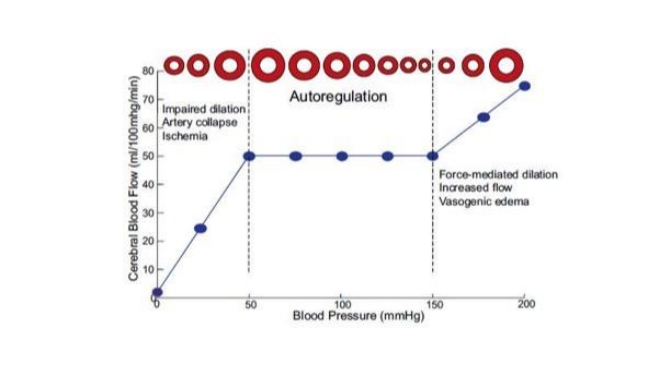
End-Organ Autoregulation

Process by which tissues control their own blood flow

- Requires minimum threshold
- Insufficient pressure gradient for perfusion below minimum threshold



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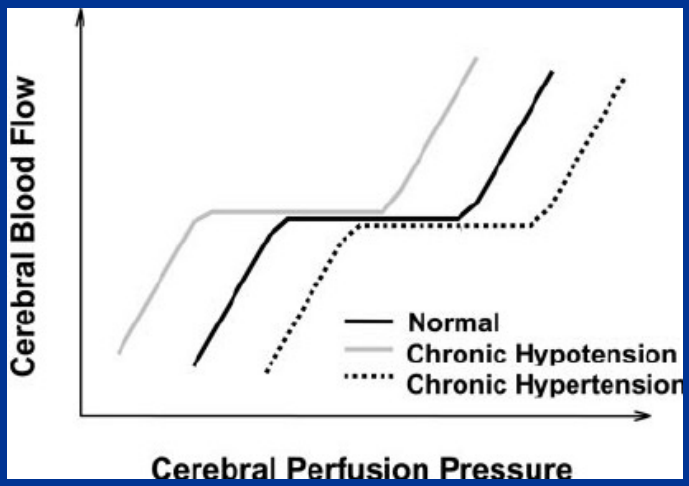
Detrimental Effects of Hypotension in Patients with Hypertension



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Etiology of Intraoperative Hypotension

- Effect of anesthetic agents
- Hypovolemia
  - Blood loss or dehydration (NPO status)
- Position of surgical technique
  - Upright or beach chair--> cerebral ischemia
- Cardiac etiology (pump failure)
- Pathologic maldistribution of blood flow (shock or anaphylaxis)
- No widely accepted definition of intraoperative hypotension,
  - A decrease of SBP > 20% is often chosen to define perioperative hypotension

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Complications of Intraoperative Hypotension

- Acute kidney injury
- Myocardial injury
- Stroke
- Delirium
- Mortality

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Relationship Between Intraoperative MAP and Clinical Outcomes After Noncardiac Surgery

- 33,330 noncardiac surgeries
- Evaluated association between intraop MAP <55 mmHg and postop acute kidney injury, myocardial injury, cardiac complications
- Even short durations (1-5 min) of an intraoperative MAP of <55 mmHg are associated with AKI and myocardial injury
- Risk escalates rapidly and there is no safe duration for MAP <55 mmHg
- 30 day mortality was associated with more than 20 min of MAP <55 mmHg

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Walsh M, Devereaux PJ, Garg AX, et al. Relationship between intraoperative mean arterial pressure and clinical outcomes after noncardiac surgery: toward an empirical definition of hypotension. Anesthesiology 2013;119(3):507-515

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Hypotension During Anesthesia

Patients with no cardiovascular impairments

- 2/3 MAP

Patients with cardiovascular impairments

- Maintain MAP as close to baseline as possible
- 80% of baseline MAP

Semi-reclining or sitting position

- Cerebral pressure may be 12-16 mmHg lower than arm

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Hypotension Treatment

Order of Treatment:

- Check pulse and monitors
- Fluids
- Treat with IV vasopressor/inotrope
- Consider Trendelenburg position
- Decrease depth of anesthesia

Indication for vasopressor/inotrope

- >30mmHg lower than baseline systolic BP
- MAP < 60 mmHg
- MAP < 80% of baseline

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Management of Hypotension

- Normal to slow heart rate
  - Ephedrine 5-10 mg to effect
- Normal to fast heart rate
  - Phenylephrine 100 mcg to effect
- Epinephrine 10 mcg to effect

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Hypertension

Most common reason for postponing surgery

Risk of perioperative cardiac catastrophe

DBP > 110 associated with dysrhythmia, myocardial ischemia and infarction, renal failure, neurological complications

MAP > 120% of baseline may lead to bleeding, CVA, myocardial ischemia and infarction

MAP < 80% of baseline may lead to end-organ malperfusion

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Management of Hypertension

Differential

- Pain
- Hypercarbia
- Emergence phenomenon
- Bladder distention

Normal to slow heart rate

- Hydralazine 10-20 mg to effect

Normal to fast heart rate

- Labetalol 5 mg to effect
- Metoprolol 1mg to effect

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Dysrhythmias

Bradycardia that causes hypotension	• Atropine 0.5 mg – 1.0 mg IM
Irregular rhythms	• Abort procedure if more than 5 irregular beats per minute and refer to physician for evaluation • Amiodorone 150 mg IV over 10 minutes • 150 mg in 100 ml D5W
Tachyarrhythmias (SVT)	• Adenosine 6 mg fast IV push with flush • For both narrow and wide complex tachycardia

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Reversal

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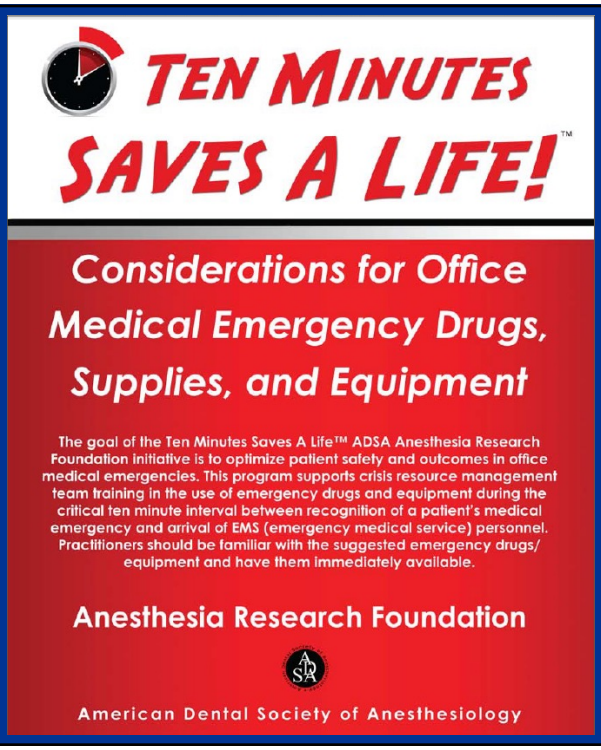

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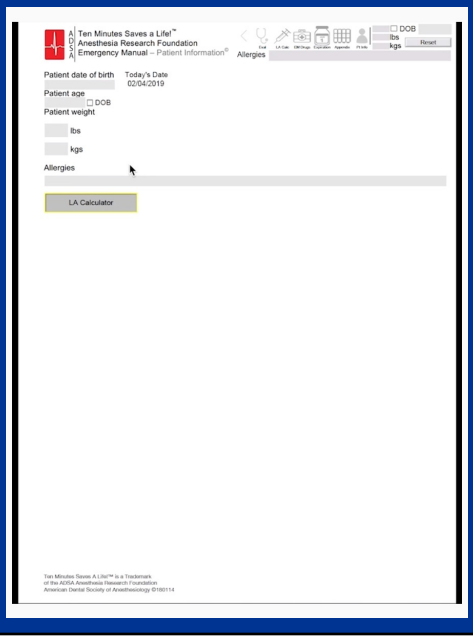
Ten Minutes Saves a Life



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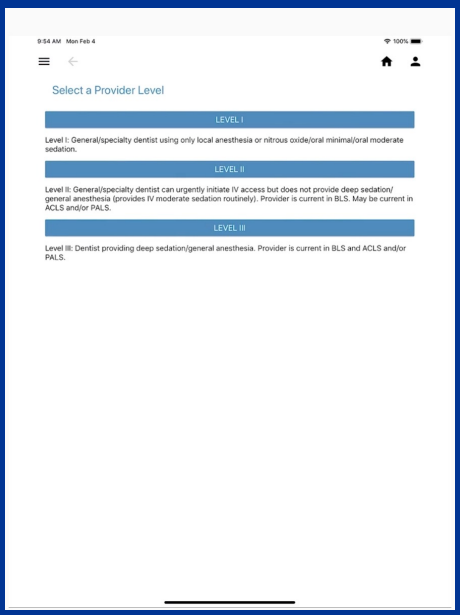

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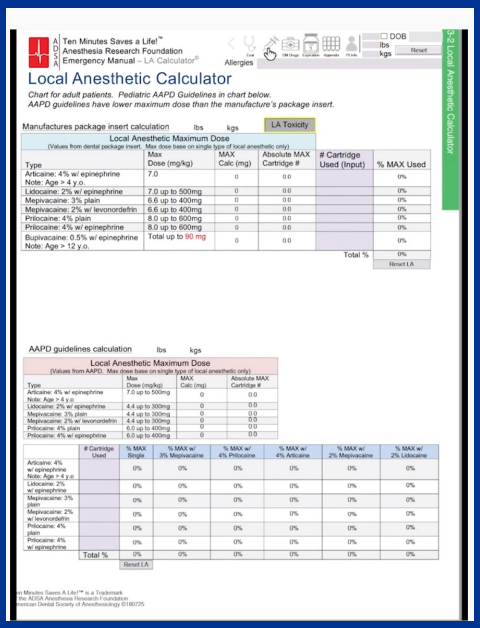

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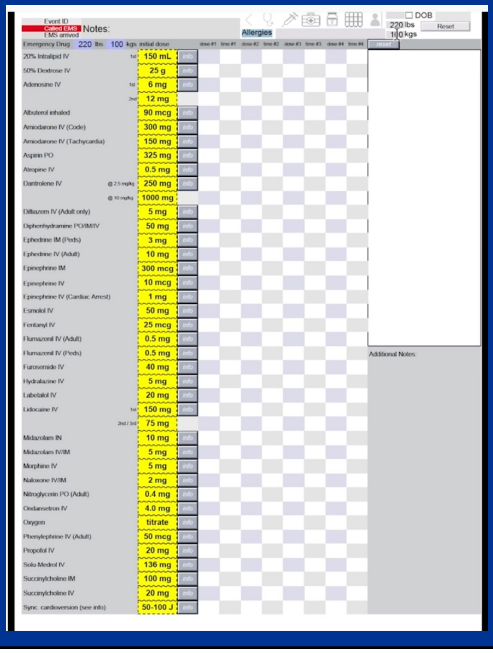

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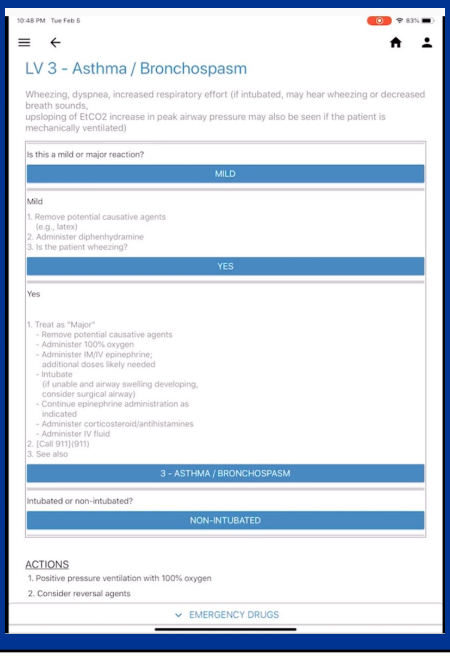

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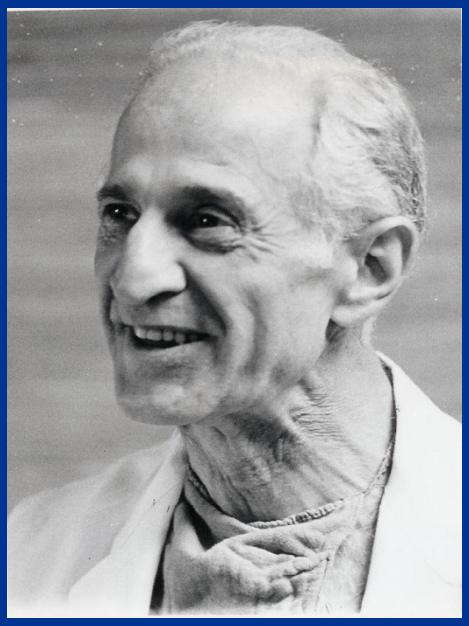
"No one ever died in a conscious state."

Dr. Leonard M. Monheim



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