

Sedation in Bronchoscopy

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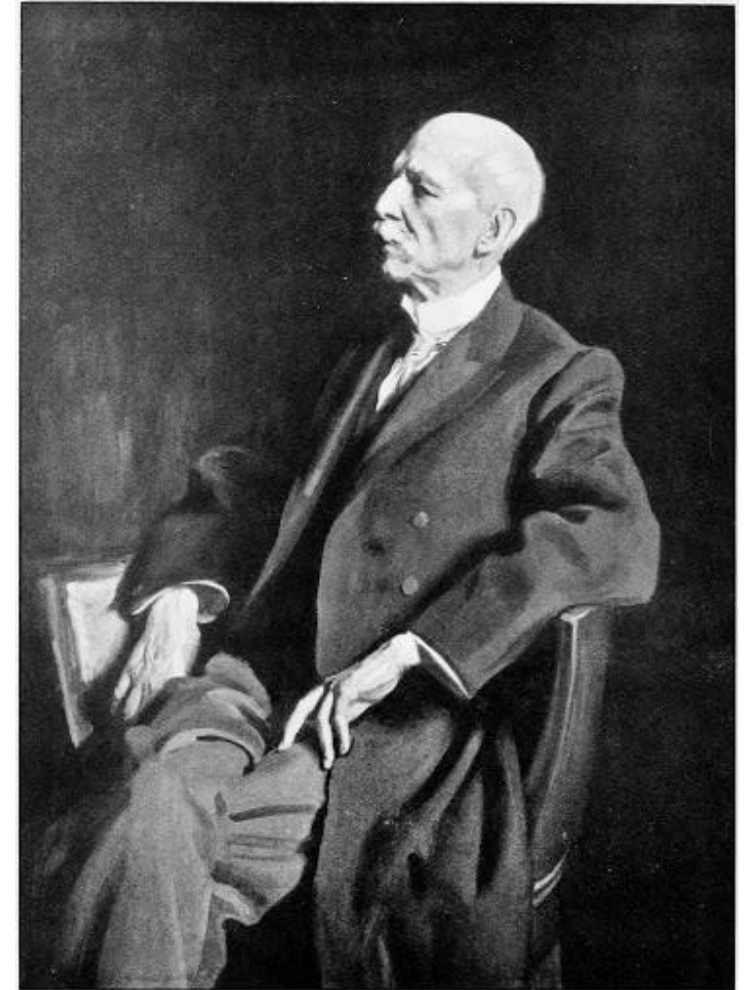
Manuel Garcia - 1895

Spanish music teacher and singer

Look at “voice box” of his students with a dental mirror

First known attempt to directly visualize vocal cords and proximal airways

*“I convinced myself that one can pass the vocal cords intentionally with a middle-sized esophagoscope into the **cocainized** trachea and right down to the bifurcation; this experience should be eventually fructified”*



Objectives

- Discussion of levels of sedation based on ASA.
- Use of moderate, deep and general anesthesia for flexible bronchoscopy.
- Use of local anesthesia.
- Potential complications from sedatives.

American Society of Anesthesiologists (ASA) – Levels of Sedation

Definitions

Minimal sedation/anxiolysis

- Normal response to verbal stimulation
- Airway is maintained
- Unaffected spontaneous ventilation
- Unaffected cardiovascular function

Definitions

Moderate Sedation (Conscious Sedation)

- Purposeful* response to verbal or tactile stimulation
- Airway is maintained
- Adequate spontaneous ventilation
- Cardiovascular system is usually maintained

*Reflex withdrawal from a painful stimulus is NOT considered a purposeful response

Definitions

Deep Sedation

- Purposeful* response after repeated or painful stimulation
- Intervention may be required to maintain airway patency
- Spontaneous ventilation may be inadequate
- Cardiovascular system is usually maintained

*Reflex withdrawal from a painful stimulus is NOT considered a purposeful response

Continuum of Depth of Sedation



	Minimal sedation/anxiolysis	Moderate sedation/analgesia ('Conscious sedation')	Deep sedation/analgesia
Responsiveness	Normal response to verbal stimulation	Purposeful* response to verbal or tactile stimulation	Purposeful* response after repeated or painful stimulation
Airway	Unaffected	No intervention required	Intervention may be required
Spontaneous ventilation	Unaffected	Adequate	May be inadequate
Cardiovascular function	Unaffected	Usually maintained	Usually maintained

Moderate, deep and general anesthesia for bronchoscopy



all for you

Benefits of Sedation

- **Bronchoscopy can be performed without sedation**
 - No difference in complication rates
- **Patient satisfaction and procedure tolerance are significantly improved**
- **Can be performed in office setting**

Disadvantages of Sedation

- Proceduralist-administered moderate sedation
- Risk of hypoventilation (COPD, OSA)
- Cardiovascular physiology can be affected

Pre-Sedation Assessment

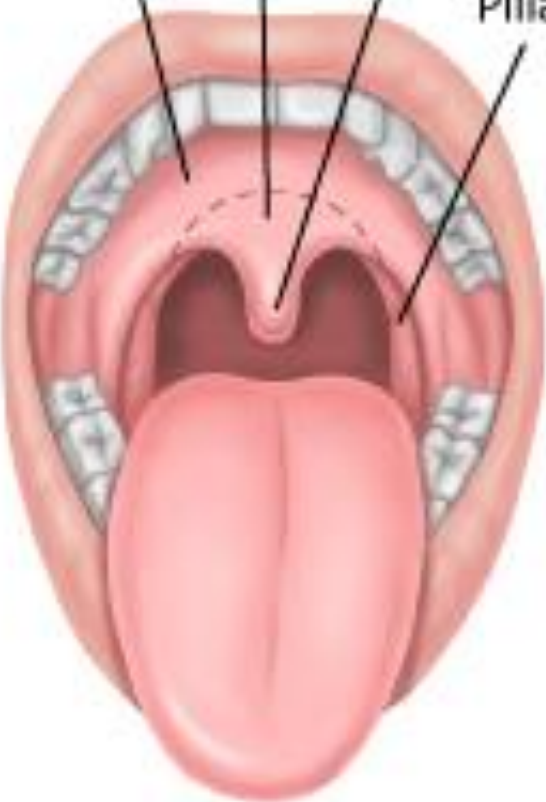
- **Risk Assessment (ASA status)**
- **Proposed sedation plan**
 - Age, Weight, Height
 - Cardiac, Liver and Renal function
 - Current medications namely CNS depressants
 - Medication of choice
- **Previous history of airway problems or anesthesia complications**
- **Airway Evaluation (Mallampati Score)**
- **NPO Status**

ASA Physical Status Classification System

- Indicates the patient's overall preoperative health
- Does not predict intraoperative/postoperative risk

ASA Class	Description
ASA 1	Healthy person
ASA 2	Mild systemic disease
ASA 3	Severe systemic disease
ASA 4	Severe systemic disease that is a constant threat to life
ASA 5	A moribund person who is not expected to survive without the operation
ASA 6	A declared brain-dead person whose organs are being removed for donor purposes

Hard
palate Soft
palate Uvula
Pillar



Class I



Class II



Class III



Class IV

3.7x more likely to have difficult intubation

Moderate Sedation

Flexible Bronchoscopy

- **Suggested circumstances**
 - Short duration cases (<20 minutes)
 - High risk ventilatory or airway compromise
 - Brief diagnostic procedures (Airway exam, BAL, Biopsies)
- **Pharmacological options**
 - Rapid onset, short acting pharmacokinetics

Deep Sedation

Flexible Bronchoscopy

- **Should overall be limited in use due to lack of benefits with increased risks**
- **Suggested Circumstances**
 - Longer duration procedures with critical portions
 - Protected airway (i.e. ICU patient on mechanical ventilation)
- **Pharmacological options**
 - Rapid onset, medium acting pharmacokinetics

General Anesthesia

Flexible Bronchoscopy

- **Can be used in all circumstances**
- **Suggested circumstances**
 - Long duration procedure (>45 minutes)
 - High risk ventilatory compromise patient (COPD, CO₂ Retention)
 - Hypoxia (>6 liters/min supplemental oxygen via Nasal Canula)
 - High tolerance to sedative medication (Alcohol use, chronic opioids)
- **Pharmacological options**
 - Total intravenous anesthesia via infusions
 - Minimize anesthetic inhalant use due to room contamination

Pharmacology of Sedation

Pre-medication

- Anti-cholinergic drugs (atropine, glycopyrrolate, diphenhydramine)
- Labetalol
- Dextromethorphan

[1] Cowl CT, Prakash UB, Kruger BR. The role of anticholinergics in bronchoscopy. A randomized clinical trial. Chest 2000

[2] Malik JA, Gupta D, Agarwal AN, et al. Anticholinergic premedication for flexible bronchoscopy: a randomized, double-blind, placebo-controlled study of atropine and glycopyrrolate. Chest 2009

[3] Rodeo A, MD, M. Simoff. Diphenhydramine as an Adjunct to Conscious Sedation in Bronchoscopy. Chest 2016

[4] Fox BD, Krylov Y, Leon P, et al. Benzodiazepine and opioid sedation attenuate the sympathetic response to fiberoptic bronchoscopy. Prophylactic labetalol gave no additional benefit. Results of a randomized double-blind placebo-controlled study. Respir Med 2008

[5] Schwarz Y, Greif J, Lurie O, et al. Dextromethorphan premedication reduces midazolam requirement: objective and subjective parameters in peribronchoscopy. Respiration 2007

Anesthetics

- Benzodiazepines
- Opioids
- NMDA receptor antagonists (Ketamine)
- GABA Agonists (Propofol)
- α_2 receptor agonist (Dexmedetomidine)

Benzodiazepines

- **Midazolam**

- Drug of choice for anxiolytic or moderate sedation
- Induces retrograde and anterograde amnesia

- Onset: 30 to 60 seconds, peak effect 3-5 minutes
- Duration: dose dependent (up to 2 hours)
- Metabolism: Hepatic
- Adverse Effects: Bradypnea, ↓Tidal Volume, Hypotension

Benzodiazepines

- **Diazepam**
 - **Onset:** 4-5 minutes, peak effect 8 minutes
 - **Duration of action:** 1-3 hours
 - **Metabolism:** Hepatic
 - **Adverse Effects:** Respiratory Depression, Hypotension

- **Lorazepam**
 - Onset 10-15 minutes with 8 hour duration of action

Opioids

- **Fentanyl**

- Used in combination with benzodiazepines
- Anti-tussive and sedative properties

- **Onset & Peak:** 5 minutes
- **Duration:** 1-2 hours
- **Metabolism:** Hepatic
- **Adverse Effects:** Respiratory Depression

Opioids

- **Morphine**
 - **Onset:** 5-10 minutes, Peak 15-30 minutes
 - **Duration:** 1-6 hours
 - **Metabolism:** Renal
 - **Adverse Effects:** Respiratory Depression, Histamine release (itching, hypotension, bronchospasm)

GABA Agonists

- **Propofol**
 - Exclusive to anesthesiology only for procedural sedation at many institutions
 - **Onset:** 30 seconds , Peak 2 minutes
 - **Duration:** 3-5 minutes
 - **Metabolism:** Hepatic
 - **Adverse Effects:** Respiratory Depression, Hypotension, Bradycardia

NMDA receptor antagonists

- **Ketamine**

- Produces a cataleptic-like state without amnesia
- Does not suppress respiratory drive

- **Onset & Peak:** 30 seconds
- **Duration:** 5-10 minutes
- **Metabolism:** Hepatic
- **Adverse Effects:** Delirium, irrational behavior, hypersalivation

α_2 receptor agonist

- **Dexmedetomidine**
 - Has sedative but not amnestic properties
 - Does not affect respiratory drive

 - **Onset:** 5-10 minutes
 - **Duration:** 60-120 minutes
 - **Metabolism:** Hepatic
 - **Adverse Effects:** Bradycardia

Summary of Drugs

Drug	Onset (mins)	Peak (min)	Duration (mins)	Metabolism	Adverse Effects
Midazolam	0.5 - 1.0	3 - 5	Up to 120 (2 hours)	Hepatic	Bradypnea, ↓Tidal Volume, Hypotension
Diazepam	4 - 5	8 - 10	Up to 180 (3 hours)	Hepatic	Bradypnea, ↓Tidal Volume, Hypotension
Lorazepam	10 - 15	10 - 15	Up to 480 (8 hours)	Hepatic	Bradypnea, ↓Tidal Volume, Hypotension
Fentanyl	5	5	Up to 120 (2 hours)	Hepatic	Bradypnea, ↓Tidal Volume, Hypotension
Morphine	5 - 10	15 - 30	Up to 360 (6 hours)	Renal	Respiratory Depression, Histamine release
Propofol	0.5	2	5 - 10	Hepatic	Respiratory Depression, Hypotension, Bradycardia
Ketamine	0.5	10	5 - 10	Hepatic	Delirium, Irrational behavior, Hypersalivation
Dexmedetomidine	5 - 10	10 - 20	Up to 120 (2 hours)	Hepatic	Bradycardia

Potential Major Sedative Complications



all for you

Major complications

- **Shock/Cardiac arrest**

- Negative inotropic effects (Propofol)
- Negative chronotropic effects (Dexmedetomidine)
- Vasodilatory effects (Opioids, Benzodiazepines)

- **Respiratory arrest**

- CO₂ narcosis leads to further hypoventilation and eventually a comatose state

Reversal Agents

- **Benzodiazepines**
 - Flumazenil IV (0.2 mg over 15 seconds)
- **Opioids**
 - Naloxone (0.04 to 0.1 mg every 2 to 3 minutes)

Adverse Effect Treatments

- **Propofol induced hypotension**
 - Epinephrine infusion/bolus

- **Dexmedetomidine induced bradycardia**
 - Atropine

Topical Anesthetics

General Comments

- Airway response to manipulation is significant despite a fully anesthetized patient
- When used as adjunct, reduces the total dose of sedative agents
- Not without risk

- Caines

- Blocks both initiation and conduction of nerve impulses by decreasing ionic flux through the neuronal membrane

- **Benzocaine (20%)**

- **Tetracaine (1%)**

Narrow therapeutic range

High toxicity potential

- Lidocaine (1-10%)

Wide safety margin,
Minimal tissue toxicity

Lidocaine

- **Multiple administration techniques:**
 - Soaked cotton pledgets
 - Dropper instillation
 - Aerosol spray, nebulization
 - Transcricoid or transtracheal injection
 - Local nerve block
 - “spray-as-you-go technique”

Lidocaine

- **Onset:** 1 – 2 minutes
- **Duration:** 10-20 minutes
- **Metabolism:** Hepatic
- **Adverse effects:** Seizures, Bradycardia, **Methemoglobinemia**
- **Maximum topical dose:** 7 mg/kg

Symptomology

Amount	Signs/Symptoms
<2%	Normal
3-15%	Asymptomatic, Cyanosis at 5-10%
20-30%	Fatigue, tachypnea, dyspnea, tachycardia Anxiety, dizziness, confusion Nausea, vomiting
>40%	Severe symptoms can occur. Seizure, coma Arrhythmia Hyperlactatemia Death



Detection

- **“Refractory Hypoxemia”**
 - Pulse oximeter reports SpO₂ of ~82-86%
 - Despite high PaO₂ or FiO₂ 1.0
- **Cyanosis-saturation gap**
 - Cyanosis does not manifest at SpO₂ of >80%
- **Brown/Blue blood**



Left: Chocolate-brown arterial blood with >40% methemoglobin (despite PaO₂ 300mm).
Right: Same patient after administration of methylene blue.

Wolak E et al. Am J Crit Care 2005; 14: 104-108.

Diagnosis

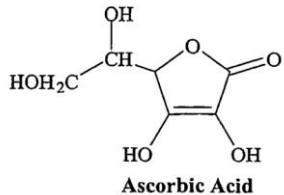
- **Arterial/Venous blood gas**
 - Formal blood gas analyzer can measure methemoglobin level
 - Typically shows elevated PaO₂ but low SpO₂
- **Point of care (iSTAT) is not ideal**
 - Measures PaO₂ and *calculates* SaO₂ (falsely elevated)

Treatment



Methylene Blue

- 20-30% and Symptomatic
- 1-2 mg/kg IV over 5 minutes
- Can repeat every 60 minutes



Ascorbic acid (vitamin C)

- Used when MB is contraindicated (G6PD Deficiency)
- Refractory cases
- 1.5-3 gm IV q6h

Local Anesthetic Systemic Toxicity

- Extremely rare with mucosal administration
- CNS inhibition, seizures, cardiovascular excitation, and in extreme cases, cardiovascular inhibition and arrest
- Treatment
 - Lipid Rescue Therapy



Summary

- Depth of sedation is continuum rather than states
- Most basic bronchoscopies can be safely and efficiently performed under moderate sedation
- Local anesthetics will reduce the cumulative sedative anesthetic necessary
- Major complications of sedation include cardiopulmonary failure. It is important to be prepared to provide reversal agents when warranted

Thank You

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