

Anesthetic Management of a Severe Bronchospasm

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Bronchospasm Management¹

Learning Objectives:

- ✓ The learner will be able to define a bronchospasm.
- ✓ The learner will be able to recognize situations in which there is an increased risk of bronchospasm and implement methods to decrease this risk.
- ✓ The learner will be able to identify perioperative events indicative of a bronchospasm and apply appropriate interventions in a step-wise manner based on severity.

Defining Bronchospasm¹

Contraction of bronchial smooth muscle that results in reversible narrowing of medium and small airways.

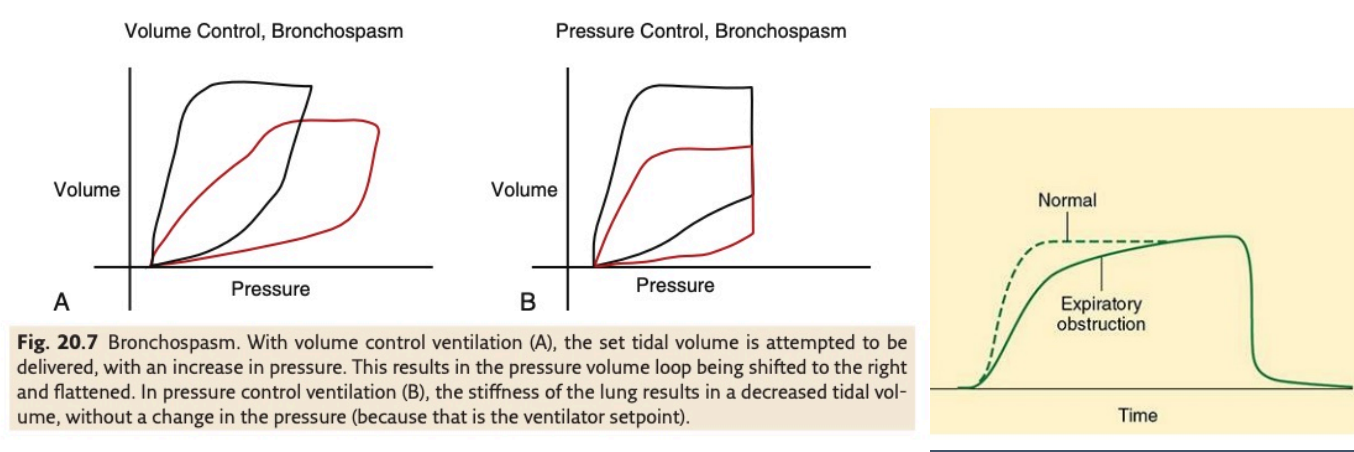
- Fast facts⁷: *Incidence*: ~0.2% - GA, ~6% - asthmatics // *Occurrence*: most frequent = induction // *How*: mechanical or pharmacological // *Quick recognition avoid complications* → ↓SaO₂, ↑PaCO₂, hypotension (↑ITP), barotrauma, CV

Physiology²

- Bronchial tone maintained by PNS
 - PNS overactive/↑ cGMP → vagal activation (sensitive to histamine, noxious stimuli) → bronchoconstriction
 - Noxious stimuli: cold air, inhaled airway irritants, airway manipulation⁶ (especially when airway reflexes are not adequately depressed)
- Chemical mediators/Immune mediated degradation of bronchial mast cells → bronchoconstriction
 - Histamine, bradykinin, leukotriene, prostaglandins, platelet activating factor

Presenting Characteristics¹

- ↑ PIP
- Wheezing → usually heard on exhalation
 - Severe → possible absence of gas movement = no audible wheezing
- Upward sloping EtCO₂ waveform (figure 2)
 - Severe → may be diminished or absent
- ↓ PaO₂ and SpO₂
- ↓ TV, inability to achieve adequate TV's despite mechanical ventilation parameters (figure 1)
- ↑ PaCO₂ and EtCO₂ gradient
- Poor lung compliance/difficult mask ventilation
- Hypotension



- 100% FiO₂
- Quickly assess compliance with manual ventilation. Call for help.
 - Mechanical ventilation → adjust RR and I:E as needed (maximize E) - avoid auto-PEEP (hyperinflation/air trapping)
- Differentials/Verify diagnosis
 - Auscultate, verify ETT position/patency, soft suction ETT → clear potential obstruction, ✓ pilot balloon
 - Aspiration, kinked/obstructed ETT, pneumothorax, foreign body, amniotic fluid embolism, pulmonary edema, PE, endobronchial intubation (mainstem), anaphylaxis, breath stacking, carcinoid syndrome
- Mild bronchospasm:
 - Increase anesthetic depth: ↑ concentration of non-pungent gas, propofol, opioids, ketamine²
 - B2 agonist: albuterol 4-8 puffs (repeat as needed) note: manual + pressure breaths to ensure it's getting to lungs
 - Combo therapy: Ipratropium bromide + albuterol
- Moderate to severe bronchospasm:
 - Add to differentials: silent aspiration possible → suction ETT
- Bronchospasm not resolving → SEVERE**
 - Inform surgeon
 - B2-agonists: albuterol 4-8 puffs
 - IV bronchodilator therapy:
 - Epinephrine IV → 0.1 mcg/kg bolus then titrate infusion² of 5-20 ng/kg/min if not resolving
 - MgSO₄ IV → 2g
 - Corticosteroids → methylprednisolone 125 mg IV bolus
 - Stop surgical stimulation
 - Cancel case or proceed? Can we extubate?²
 - No → Transfer to ICU
 - Yes → optimize, lidocaine 1.5 mg/kg IV, albuterol puffs via ETT, continue epi if needed, deep extubation², continue bronchodilator therapy in PACU
 - Heliox (lower density = improve airflow)

Case Study

- **Pt:** 53 y/o M, 139 kg presenting for bilateral lower extremity debridement
- **PMHx:** DM2, CAD, PVD w/stents, HTN (poorly controlled/on b-blockers), HLD, HFpEF, CVA
- **Plan:** GA/ETT (CMAC in room), prone, extubate
- **Timeline of Events:** In room – 2 V/50 F → LA by surgeon → induction with 50 F/100 lido/200 prop → bag mask ✓ → 50 roc → bag masking difficult → intubation 1- DL → intubation 2 - CMAC → suctioned secretions, pt light → bag mask + ↑ depth → intubation 3 - CMAC → ✓ placement = wheezy + mainstem → pull back tube → ↑ PIP, ↓ SpO₂, poor compliance - bronchospasm high on differential → severe bronchospasm management → called for help after interventions not improving SpO₂ → IV + a-line, increased epi dose → case canceled once stable → transport to ICU intubated → close call airway emergency in ICU → CXR
- **Tx:** 100% FiO₂, manual vent, deepened anesthetic (sevo, propofol, rocuronium), bronchodilator therapy - albuterol + epi, fluids
 - ICU: Neb tx, corticosteroid: Solu-Medrol
- **What went wrong:** appropriate anesthetic depth not achieved before intubation (↑ dose of propofol and rocuronium, bag mask with sevo on), didn't optimize initial intubation attempt with CMAC, could have treated HTN earlier⁴, esmolol?³, optimize transport, verify EtCO₂⁵

Name	Total	12:30	12:45	13:00	13:15	13:30
Medications						
lidocaine 2% PF Inj Syr 5 mL iv	5 mL		5 mL			
midazolam 2 mg/2 mL PF Inj iv	2 mg	2 mg				
fentanyl 100 mcg/2 mL Inj iv	100 mcg	50 mcg	50 mcg			
propofol 200 mg/20 mL Inj iv	350 mg	200 mg	50 mg	50 mg		
ROPivacaine 0.5% PF Inj 20 mL PERINEURAL	40 mL	40 mL				
EPINEPHRINE 1 mg/10 mL Inj Syr iv	130 mcg		20 mcg	20 mcg	40 mcg	30 mcg
rocuronium 50 mg/5 mL Inj iv	100 mg		50 mg	50 mg		
albuterol -FA 90 mcg/inh Aer 6.7 gm Inhalation	12 puff		4 puff	4 puff	4 puff	
esmolol 100 mg/10 mL Inj iv	100 mg		30 mg	30 mg	40 mg	
Intake						
Isolated fingers 1000 mL other	800 mL					
Monitors						
EKG - Anes	SR					
SpO ₂ - Anes %	96	100	100	97	72	87
Min Vent - Anes mL/min	1.17	1.16	11.27	3.31	3.33	1.74
Ventilation Mode - Anes	SV	SV	MAN	MAN	MAN	MAN
RR - Anes BR/min	11	6	23	13	10	9
TV - Anes mL	217	204	393	244	402	163
FIP - Anes mL/50	0	3	5	25	29	31
FEEP - Anes mmHg	0	0.14	0.7	1.3	3.3	15.3

Dx: Acute Hypoxic Respiratory Failure 2/2 bronchospasm

Identify Increased Risk¹

- Patient comorbidities:
 - Asthma → thorough Hx³, inhaler use², imaging/diagnostics
 - COPD
 - Recent URI → pediatric pts ↑ risk
 - Smoker^{2,3}
- Perioperative Events
 - Mechanical airway manipulation/irritation → oral airway, LMA, ETT, endobronchial intubation
 - Pungent anesthetics gases, soda lime dust
 - Aspiration, PE, anaphylaxis
 - Light anesthesia, inadequate pain management²
- Drugs
 - β2-antagonists (nonselective) → labetalol, propranolol
 - Anticholinesterases
 - Common drug allergies (anaphylaxis) → abx, NMBs, latex, adenosine, contrast dye
- Histamine releasing drugs²: morphine, demerol, protamine, atracurium, thiopental

Prevention¹

- **Cancel elective surgery if: active bronchospasm, recent URI, exacerbations of asthma or COPD
- ↑ risk and urgent surgery:
 - Supplemental O₂
 - RA if possible → avoid airway stimulation but note: high spinal/epidural may potentiate bronchospasm
 - LMA + GA → LMA > ETT but pt still needs to be deep
 - Induction: ketamine IV 1-2 mg/kg (bronchodilator)
 - Adjunct ketamine infusion at 0.25 mg/kg/hr
- Optimize patients with risk factors before surgery: preop treatment with bronchodilators/steroids
 - Inhaled B2-agonists: 4-8 puffs albuterol, albuterol neb tx
 - Glucocorticoid therapy (prednisone, dexamethasone), leukotriene modifiers, mast-cell stabilizers²
- Get them DEEP before intubation → blunt reflex bronchospasm²
 - **Larger dose of propofol → +30-50 mg if ↑ risk
 - Lidocaine IV 1-1.5 mg/kg 1-3 mins before intubation
 - Ventilate with sevo before intubation (AVOID pungent agents), 5 minutes
 - NMBs, opioids
- Know your risks! Thorough preop exam and H&P³!
- Auscultate!⁵ Throughout the perioperative period!
- Diagnostics²: FVLs → early detection/tx, CXR
- Vent²: PEEP, adjust I:E → ↑ E & ↓ air trapping, TVs 6 mL/kg

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