2022 SAMBA ANNUAL MEETING
MAY 11 – 14, 2022

Small Adults, Big Problems: Pediatric Crisis at the Ambulatory Surgery Center!

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Disclosures

- I have NONE!

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Learning Objectives

- **Identify early characteristics and recommend a process for rapid identification of pediatric emergencies including local anesthesia toxicity, operating room fire, anaphylaxis, and airway obstruction**
- **Review life-threatening emergencies and their management at Ambulatory Surgery Center**
- **Identify and update knowledge on current guidelines for the management of pediatric emergencies**

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Pediatrics at ASC

- 22.5 million procedures and surgeries were performed at ambulatory surgery centers. less than 1% transfer rate!
- Increasing number of pediatric cases at Ambulatory Surgery Centers
- Pediatric anesthesiology is inherently higher risk than adult anesthesia due to differences in the physiology in children
- Anesthesia providers performed most of these cases without specialty training in pediatric

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Emergency

- Despite proper staffing, equipment and careful patient selection
- Can cause serious disruption to a surgical schedule
- Advances in anesthetic care are allowing more complex cases and patients with comorbidities
- Limited staff and resources, make ASC's more vulnerable to inadequate response

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Local Anesthetic Systemic Toxicity (LAST)

- Ramesh and Boretsky discovered that 68% of LAST events occurred under general anesthesia
- Children less than 3 years old make up 71% of the reported pediatric LAST cases
- Highest reported blocks being penile, caudal, and local infiltration
- Bupivacaine was used in 67% of the reported LAST cases

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LAST Diagnosis

- *Classically neurologic signs precede the cardiovascular signs, but not always*
- *CNS: apnea, seizure, altered level of consciousness*
- *CV: EKG (wide QRS, ST segment changes, peaked or inverted T), significant bradycardia, asystole, v tach, hypotension, cardiac arrest*

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LAST Treatment

- Request Intralipid kit
- Secure airway, ventilation with 100% oxygen, Confirm & monitor EKG, BP, and SaO2
- Seizure treatment: Midazolam 0.05-0.1 mg/kg IV
- Treat hypotension with small doses of Epinephrine 1 mcg/kg

Intralipid Dosing

- Bolus Intralipid 20% 1.5 mL/kg over 1 min
- Start infusion 0.25 mL/kg/min
- Repeat bolus every 3-5 min up to 4.5 mL/kg total dose until circulation is restored
- MAX total Intralipid 20% dose: 10 mL/kg over first 30 min

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Recommendations

- Utilize ultrasound
- Lowest effective dose of LA
- Incremental injections and frequent aspirations
- Full monitors for >10 minutes after the nerve block
- Ultrasound will not eliminate the risks due to artifacts and loss of needle visualization

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Anaphylaxis in children

- Anaphylaxis is a systemic allergic reaction of sudden onset after exposure to an allergen
- The incidence of anaphylactic reactions is less than the adult population with an incidence of 1:37000 pediatric anesthetics
- Antibiotics, Neuromuscular blocking agents, Chlorhexidine, and latex are the most frequently cited triggers

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Clinical Features

- I (Mild) Cutaneous signs
- II (Moderate) Measurable but not life-threatening symptoms
- III (Life threatening) Life threatening symptoms: Severe hypotension, tachycardia or bradycardia, arrhythmias Bronchospasm, high airway pressure
- IV (Cardiac arrest) Cardiac and/or respiratory arrest Most commonly presents as pulseless electrical activity

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Symptoms	Differential diagnoses
Cutaneous signs: Hives, flushing, erythema, urticaria, angioedema	Direct histamine release
	Venous obstruction
	Head down position
	C1-esterase deficiency
	Mastocytosis
	Cold-induced anaphylaxis
Hypotension	Hypovolemia
	Peripheral vasodilation by drugs/ neuraxial blockade
	Sepsis
	Embolism: thrombotic, air, amniotic
	Vasovagal
	Cardiogenic shock
High airway pressure/Respiratory compromise: Wheeze, stridor, dyspnea	Circuit malfunction
	Misplaced/kinked airway device
	Tension pneumothorax
	Asthma/Bronchospasm
	Airway foreign body
	Aspiration

Australia and New Zealand College of Anaesthetists. Perioperative Anaphylaxis Management Guidelines

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Management of Anaphylaxis

- Timely recognition, removal of triggering agent, and administration of fluid and epinephrine are the mainstays of treatment
- Arrange for transfer to a hospital with to the potential for recurrence even if the initial episode has been treated satisfactorily
- Refer to a specialized anesthetic allergy testing center for follow-up

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SPA Pedi Crisis

Anaphylaxis — **Rash, bronchospasm, hypotension**

- Increase O_2 to 100%, evaluate ventilation
- Remove suspected trigger(s)
  - If latex is suspected, thoroughly wash area
- If HYPOtensive, turn off anesthetic agents

Common causative agents:
- Neuromuscular blockers
- Latex
- Chlorhexidine
- IV colloids
- Antibiotics

Indications	Treatments
To restore intravascular volume	NS or LR, 10-30 mL/kg IV/IO, **rapidly**
To increase BP and reduce mediator release	• EPINEPHrine 1-10 MICROgrams/kg IV/IO, as needed or 10 MICROgrams/kg IM q5-15 min as needed • May need EPINEPHrine infusion 0.02-1 MICROgrams/kg/min IV • If BP remains low, give Vasopressin 10 MILLIunits/kg IV
To reduce histamine-mediated effects	DiphenhydrAMINE 1 mg/kg IV/IO (MAX 50 mg) or Famotidine 0.25 mg/kg IV (MAX 20 mg)
To reduce mediator release	MethylPREDNISolone 2 mg/kg IV/IO (MAX 100 mg)
To reduce bronchoconstriction	Albuterol (Beta-agonists) 4-10 puffs, repeat as needed

- Send tryptase within 3 hours
- Consider Differential (partial):
  - Severe bronchospasm from URI or underlying condition: go to 'Bronchospasm' card
  - Air, fat, thrombotic, or cement embolus: go to 'Air Embolism' card
  - Sepsis: support BP, antibiotics

https://pedsanesthesia.org/wp-content/uploads/2020/11/SPAPediCrisisChecklistsNov2020.pdf

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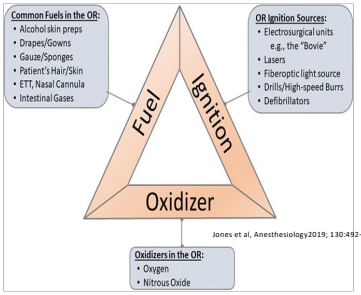
Operating Room Fire

- 650/year
- Media attention and increasing number of surgical liability claims
- 8% of fires in <16yrs



Jones et al, Anesthesiology2019; 130:492–501

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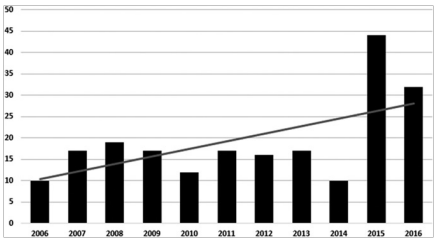
Annual incidence of operating Room Fires Surgical Devices



Anesthesiology. 2019;130(3):492-501. doi:10.1097/ALN.0000000000002598

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Surgical Fires

Equipment involved
- 70%: Electrosurgical device
- 10%: Laser
- 20% Other: Fiberoptic light source, defibrillator, high speed burrs, etc.

Oxidizer and fuels
- 75%: Oxygen enriched atmosphere
- 4%: Alcohol based prep solutions

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Comparison of Alcohol *vs.* Non–Alcohol-based Preps

Drying Time	Non–Alcohol-based Fires	Alcohol-based Fires	*P* value
None	0% (0/40)	22% (13/60)	<0.001
3 min	0% (0/40)	10% (6/60)	0.08

All fires with the alcohol-based prep were ignited after the "drying time" with a 2-s activation of a standard monopolar "Bovie" pencil. No fires were ignited with a non–alcohol-based prep. Reproduced from Jones *et al.*[62]

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Operating Room Fires

- Tonsillectomy, Eye surgery, and Head Neck surgery
- Monitored Anesthesia Care
- Fire risk assessment during surgical timeouts
- Complete elimination of fire risk is impossible as these components are key to a successful surgery

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Prevention Strategy

- Fraction of inspired oxygen (FiO2) less than 30% for any open delivery system
- Avoid nitrous oxide
- Use a sealed gas delivery system-cuffed endotracheal tube (ETT)
- Flammable skin prep must dry before draping
- Minimize drapes around the airway
- Gauze and sponges moistened
- Close communication between surgeon and anesthesiologist
- Monitor inspired and exhaled oxygen
- For laser procedures, use a laser-resistant tracheal tube and cuff filled with saline or indicator dye

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Fire in the Airway

For a fire in the airway or breathing circuit, ASAP:

- Remove the tracheal tube
- Stop the flow of all airway gases
- Disconnect breathing circuit
- Remove all flammable and burning materials from airway
- Pour saline or water into the patient's airway

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Fire in the Airway

After the airway or breathing circuit fire is extinguished:

- Reestablish ventilation by mask
- Avoid supplemental O_2 & N_2O, if possible
- Extinguish and examine ETT to assess for fragments
- Consider rigid bronchoscopy to assess injury & remove debris

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Non-Airway Fire

For a fire elsewhere on or in the patient, immediately

- Stop the flow of all airway gases
- Remove all drapes, flammable and burning material from the patient
- Extinguish all burning materials in, on or around the patient with saline or water
- Assess for smoke inhalation injury if patient not intubated

ASA Practice Advisory for the Prevention & Management of OR Fires. Anesthesiology 2013; 118 (2): 271-90

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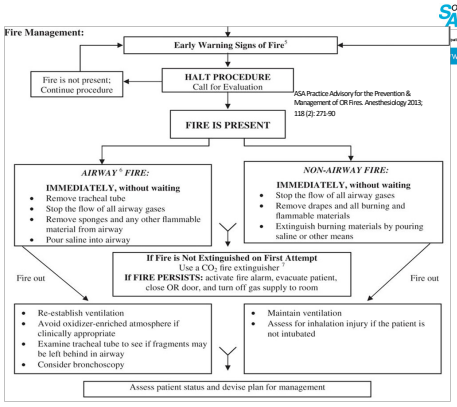

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Laryngospasm

- Reflex glottic closure due to activation of glottic musculature
- Usually activated during the excitation stage (Stage 2) of general anesthesia
- Protective airway mechanism
- Paradoxical motion of chest wall and abdomen

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When Does Laryngospasm Occur?

Schreiner M: Anesth 85:475-80,1996

- -Induction 72%
- -Emergence 23%
- -Other 5%

Flick R: Ped Anesth 18:289-96,2008

- -Induction 46%
- -Emergence 44%
- -Maintenance 10%

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Laryngospasm: Is it really a crisis??

Pediatric Closed Claims Database (CCDB)

- *Airway obstruction including LS was the most common respiratory event*

Pediatric Perioperative Cardiac Arrest (POCA) Registry

- *LS was the most common respiratory cause of Anesthesia Related Cardiac Arrest (ARCA) (11/53 = 21%)*

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Laryngospasm: Risk Factors

- Age
- Prematurity
- URI
- Comorbidities
- Airway surgery
- Inexperienced provider
- Environmental smoke

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Laryngospasm Risk Factors: URI Symptoms

	Bronchospasm			Laryngospasm			All complications		
	Present	<2 weeks	2–4 weeks	Present	<2 weeks	2–4 weeks	Present	<2 weeks	2–4 weeks
Clear runny nose	1·98 (1·32–2·98; 0·001*)	1·10 (0·60–2·03; 0·74)	1·05 (0·50–2·22; 0·90)	1·98 (1·48–2·69; <0·0001)	2·04 (1·45–2·87; <0·0001)	1·16 (0·65–1·94; 0·67)	1·49 (1·26–1·75; <0·0001)	1·37 (1·13–1·66; 0·0017)	0·95 (0·72–1·27; 0·74)
Green runny nose	1·93 (0·87–4·28; 0·107)	2·36 (1·12–4·93; 0·023†)	0·75 (0·31–1·80; 0·51)	4·40 (2·97–6·52; <0·0001)	6·62 (4·80–9·12; <0·0001)	0·49 (0·01–0·63; 0·015§)	3·12 (2·56–3·80; <0·0001)	3·37 (2·79–4·07; <0·0001)	0·23 (0·12–0·42; <0·0001)
Dry cough	1·67 (0·96–2·91; 0·071)	2·09 (1·15–3·81; 0·015‡)	0·57 (0·18–1·76; 0·33)	2·16 (1·59–3·10; <0·0001)	2·14 (1·38–3·36; 0·001)	0·53 (0·22–1·27; 0·16)	1·71 (1·41–2·07; <0·0001)	1·88 (1·53–2·31; <0·0001)	0·31 (0·17–0·56; 0·0001)
Moist cough	3·27 (2·13–5·01; <0·0001)	4·00 (2·55–6·28; <0·0001)	0·27 (0·07–1·10; 0·069)	3·89 (2·89–5·23; <0·0001)	6·53 (5·01–8·53; <0·0001)	0·68 (0·01–0·58; 0·012¶	3·05 (2·64–3·51; <0·0001)	3·42 (2·94–3·98; <0·0001)	0·45 (0·30–0·68; 0·0001)
Fever	4·20 (2·04–8·66; <0·0001)	1·99 (0·76–5·27; 0·16)	0·77 (0·25–2·38; 0·65)	2·34 (1·14–4·80; 0·020‖)	5·28 (3·47–8·02; <0·0001)	0·57 (0·22–1·51; 0·26)	2·89 (2·19–3·81; <0·0001)	2·92 (2·28–3·81; <0·0001)	0·54 (0·32–0·89; 0·017**)

Data are relative risk compared with no symptoms (95% CI; p value). p values that are no longer significant after correction by the step-down Bonferroni method are indicated. For all other p values after correction, see webappendix p 8. *p=0·052 after correction. †p=0·067 after correction. ‡p=0·73 after correction. §p=0·57 after correction. ¶p=0·48 after correction. ‖p=0·66 after correction. **p=0·58 after correction.

Von Ungern-Sternberg: Lancet 376;773-83, 2010

Table 5: Risk factors for perioperative bronchospasm, laryngospasm, or all complications according to timing of symptoms and respiratory adverse events

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Mitigate Risk Factors

- Sevoflurane
- IV induction
- Use face mask when appropriate, over LMA or ETT

When ETT required:

- Insure adequate depth before DL with deep anesthesia
- Awake extubation

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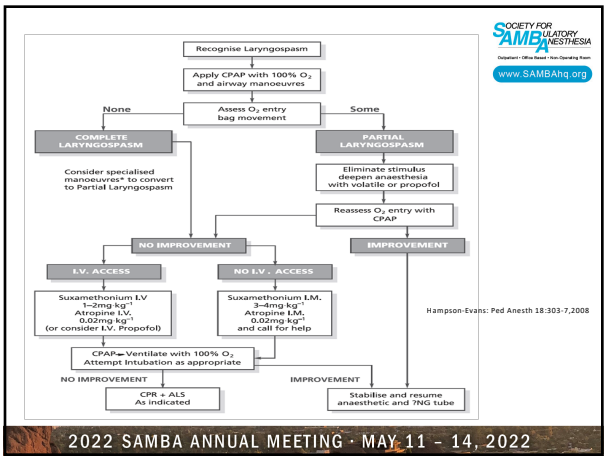

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Emergency Preparedness

- Preparation for emergencies in the ambulatory surgery setting is requirement for accreditation agencies
- Simulation-based training increases emergency response preparedness through practice using "real-life" scenario
- Crisis checklist, mobile app, cognitive aids, and emergency manuals

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Response Goal

- Unique for each Center
- Effective preparedness includes creating a standard response algorithm, role delegations for staff, and requires consistent simulation-based drills
- Stabilize the patient for transfer to a higher-acuity facility for further testing, medications, and interventions

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Recommendations

- Frequently scheduled simulation drills to optimize response to rare events
- Debrief, provide feedback, and performance evaluation
- Emphasize importance of communication, teamwork, and documentation

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Thank You!

SAMBA 2023 Annual Meeting

May 17-20, 2023

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