A Novel Approach to Differential Diagnosis and Crisis Management in the Operating Room

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It's Go Time!

Learning Outcomes

- Discuss a methodology to assess and treat anesthesia emergencies
- Describe the signs and symptoms and treatment of an ……..
- Describe the signs and symptoms and treatment for ……
- Describe the signs and symptoms and management of ……..
- Describe the signs and symptoms and management of ……..

A Cognitive Template for Management of Perioperative Adverse Events

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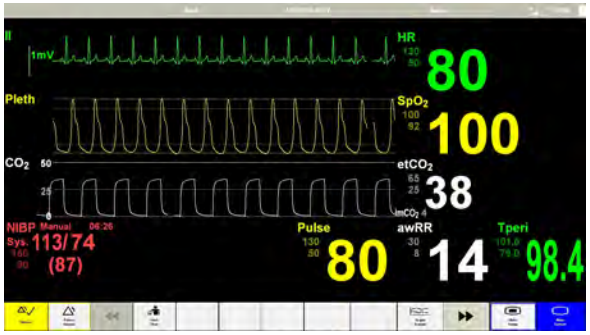
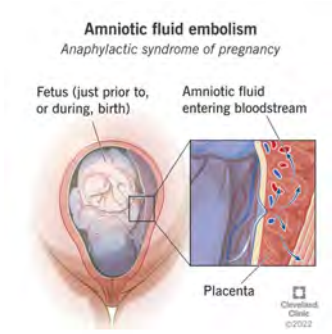
AANA Journal • April 2023 • Vol. 91 No. 2

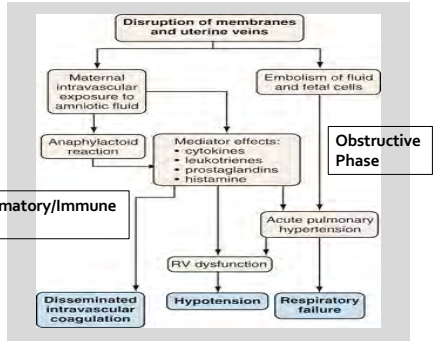
1. **Verification:**
   Does the adverse event represent artifact or is the value correct?
2. **Generic Response:**
   What are the general steps that will likely initiate *appropriate therapy* for the adverse event regardless of the etiology?
3. **Identification of precipitating incident:**
   Cause and Effect – What event preceded the adverse event?
4. **Formulate a broad differential diagnosis:**
   "Front Shelf" and "Back Shelf" diagnoses
5. **Formulate a narrowed differential diagnosis:**
   Overlapping signs and symptoms and clinical condition
6. **Targeted Response:**
   Specific treatment(s)

Dilation and Evacuation



AFE Pathophysiology





AFE-Signs and Symptoms

Signs or symptoms	Frequency
Hypotension	100%
Fetal distress	100%
Pulmonary edema or ARDS	93%
Cardiopulmonary arrest	87%
Cyanosis	83%
Coagulopathy	83%
Dyspnea	49%
Seizure	48%
Uterine atony	23%
Bronchospasm	15%
Transient hypertension	11%
Cough	7%
Headache	7%
Chest pain	2%

ARDS = adult respiratory distress syndrome.

Adapted from Clark SL, Hankins GD, Dudley DA, Dildy GA, Porter TF. Amniotic fluid embolism analysis of the national registry. Am J Obstet Gynecol 1995;172:1158-67.

Thomas's Case

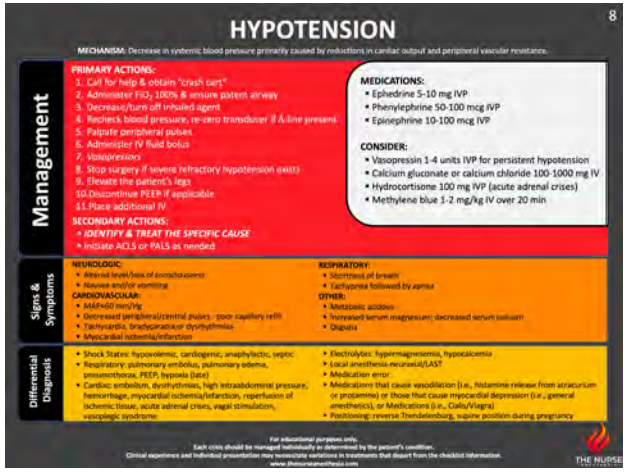
- Amniotomy occurs, then……..
- Normotensive (first 15 min post AFE)
- Tachycardia-70-120 BPM-**Light??**
- Tachypnea (LMA)-**Light??**
- Hypoxia (LMA)50-60%-Laryngospasm/bronchospasm-**Light??**
- Hypocapnia-12-14 mm/Hg
- Fibrinogen <60 mg/dL, normal 200-400mg/dl

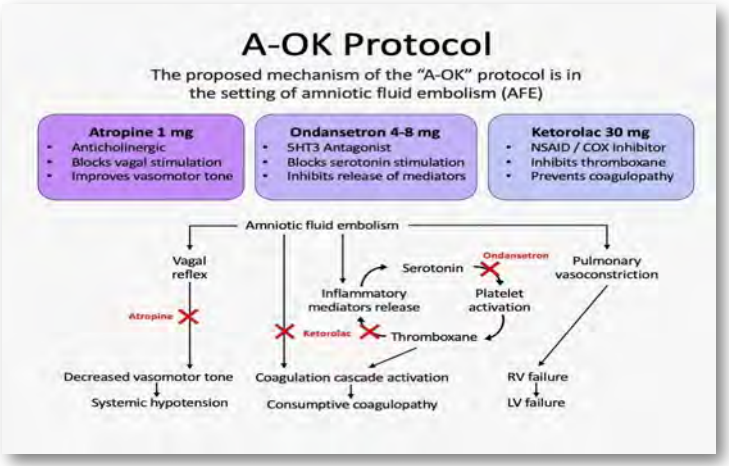
AFE-Differential Diagnosis

Differential Diagnosis of AFE		
Nonobstetric	**Obstetric**	**Anesthetic**
Myocardial infarction Pulmonary embolism Aspiration Sepsis Anaphylaxis	Placental abruption Eclampsia Uterine rupture Hemorrhage	High neuraxial blockade Local anesthetic systemic toxicity Medication error

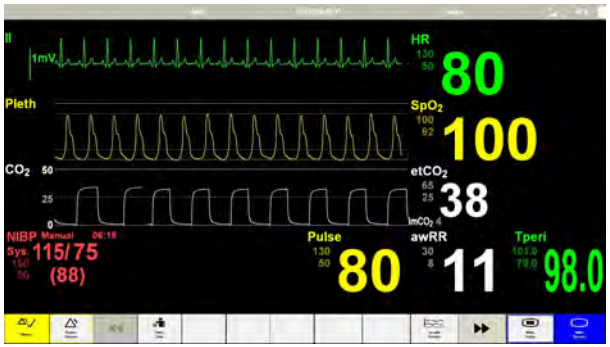
Case #1-Dilation and Evacuation (AFE)

1. **Verification (Artifact)**-No
2. **Generic response**-100% FiO2, manual ventilation, auscultate
3. **Identification of cause**-Amniotomy immediately prior to event
4. **Broad differential dx**-Severe hypoxia, CHF, MI, AFE
5. **Narrowed differential dx**-AFE
6. **Targeted treatment**-See TNA Checklist- **Hypotension**





Circumcision-22 year old



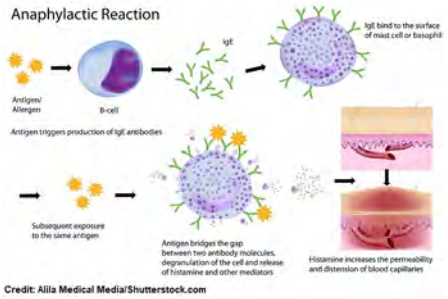
Anaphylaxis-Onset

- Food allergy: 30-35 min
- Insect stings: 10-15 min
- IV medications-within 5 min
- Cause and effect!!!!!

Diana's Case

- Onset of first symptom-3 min
- Initial symptoms:
  - *Heart rate increases from 80 to 150 BPM*
  - *Blood pressure decreases from 110/60 to 80/40*
- What is the first diagnosis that we would all make with only this information?

Anaphylaxis-Pathophysiology



- Antigen sensitizes IgE antibodies causing degranulation of mast cells & basophils resulting in the release of histamine & other inflammatory mediators.
- A large histamine release causes dramatic vasodilation & severe hypotension.

Examples:

- Drug sensitization: neuromuscular blockers, antibiotics, Sugammadex
- Others: latex, venom, foods

Causes of perioperative anaphylaxis

- Neuromuscular blocking agents: 50-70%
  - Rocuronium - 56%
  - Succinylcholine - 21%
  - Vecuronium - 11%
  - Cisatracurium/Atracurium - 12%
- Latex: 15-20%
- Antibiotics: 12-15%
  - Most often β-lactam antibiotics (i.e., amoxicillin, ampicillin, cephalosporins and penicillin)
  - Cross reactivity very rare
- Other: 5-10% (i.e., IV contrast, iodine)

Anaphylaxis Signs & Symptoms - *Sudden onset/rapid progression*

Airway

- Bronchospasm:
  1. Desaturation
  2. Increased PIP
  3. Sloped expiratory $EtCO_2$ waveform
  4. Wheezing
- Angioedema
- Pulmonary edema

Circulation

- Severe hypotension*
- Compensatory tachycardia*
- Reduced preload = Decreased CO & Decreased $EtCO_2$
- New onset cardiac dysrhythmias
- Cardiovascular collapse

Anaphylaxis Signs and Symptoms

https://allergyfacts.org.au/__interest/urticaria/

- Skin/mucosal flushing, rash, itching, hives

Present Case

New onset rash of the face/neck/chest

Anaphylaxis-Differential Diagnosis

Font Shelf

- Deep plane of anesthesia
- Volume depleted
- Bronchospasm (wheezing, hypertension)
- Medication error

Back Shelf

- All shock states (except neurogenic)
- Pulmonary embolism
- Congestive heart failure
- Air/CO2 gas embolism
- Aspiration

Anaphylaxis-Definitive Diagnosis

- Tryptase is a major protein contained within mast cell granules.
- Tryptase levels:
  1. Increase within 30 minutes
  2. Peak in 1-2 hours after an anaphylaxis
  3. Back to normal within 6-8 hours

Diana's Case

- Normal Tryptase <10.9 mcg/L
- After episode=18.9 mcg/L, 14:40=36.2 mcg/L, 18:00=18.9 mcg/L

Epinephrine Dose for Anaphylaxis

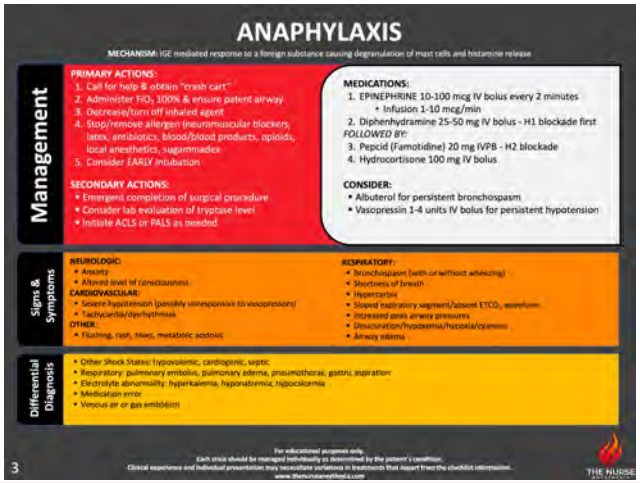
- Initial:10-100 mcg
- Preparation: gold box-100 mcg/mL

Diana's Case

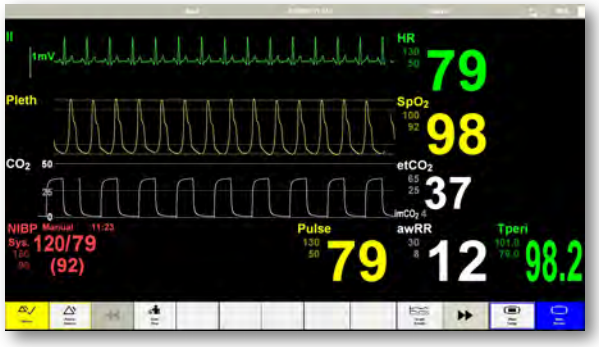
- SBP approximately 50 mm/Hg
- Initial-100 mcg epinephrine, 3 units vasopressin
- After approximately 5 min-SBP approximately 100 mm/Hg

Case #2-Circumcision (Anaphylaxis)

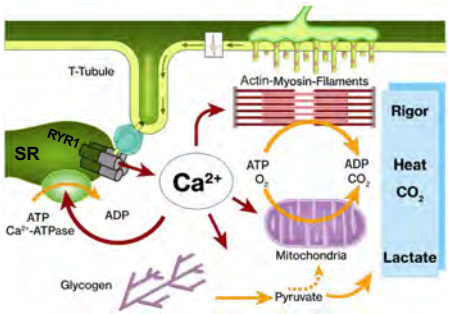
- **Verification (Artifact)**-No
- **Generic response**-Decreased anesthetic depth, fluid, phenylephrine
- **Identification of cause**-Antibiotic minutes prior to event
- **Broad differential dx**-Severe hypotension unresponsive to phenylephrine, deep anesthesia, volume ↓
- **Narrowed differential dx**-Anaphylaxis
- **Targeted treatment**-See TNA checklist-**Anaphylaxis**



Neck Mass Excision-6 year old



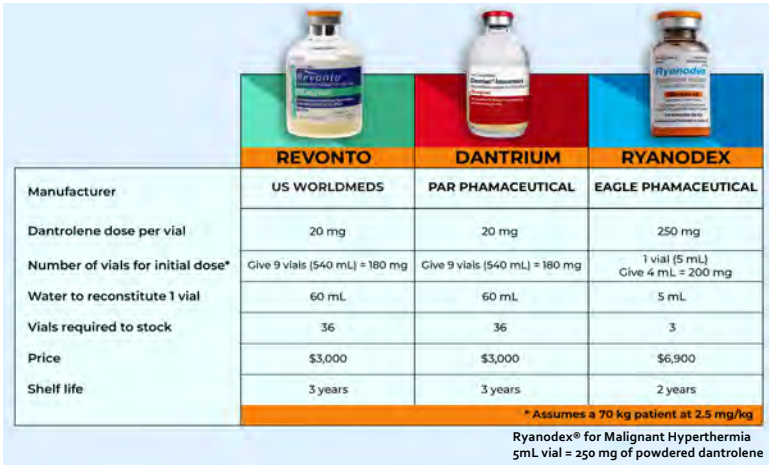
Pathophysiology of MH



- Ryanodine receptor
- Sarcoplasmic reticulum
- Massive calcium release
- Hypermetabolism (creation of heat and CO_2)
- Increased O_2 consumption & ATP depletion
- Lactic acidosis

Signs and Symptoms

- ***Increased HR – First sign***
- ***Rise in $EtCO_2$ – Most reliable sign***
- Increased temperature
- Muscle rigidity
- Arrhythmias
- Rhabdomyolysis/Myoglobinuria
- Mottled/cyanotic skin
- Decreased SaO_2



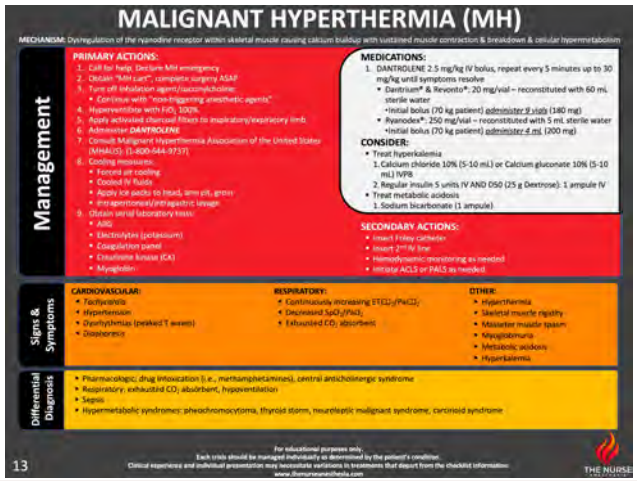
	REVONTO	DANTRIUM	RYANODEX
Manufacturer	US WORLDMEDS	PAR PHAMACEUTICAL	EAGLE PHAMACEUTICAL
Dantrolene dose per vial	20 mg	20 mg	250 mg
Number of vials for initial dose*	Give 9 vials (540 mL) = 180 mg	Give 9 vials (540 mL) = 180 mg	1 vial (5 mL) Give 4 mL = 200 mg
Water to reconstitute 1 vial	60 mL	60 mL	5 mL
Vials required to stock	36	36	3
Price	$3,000	$3,000	$6,900
Shelf life	3 years	3 years	2 years

* Assumes a 70 kg patient at 2.5 mg/kg

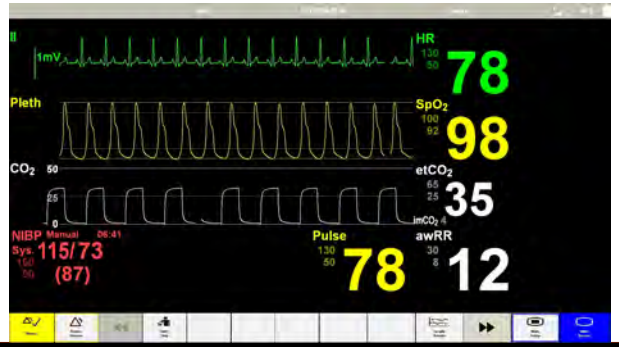
Ryanodex® for Malignant Hyperthermia
5mL vial = 250 mg of powdered dantrolene

Case #3-Neck mass excision (MH)

- **Verification (Artifact)**-No
- **Generic response**-Intubated, increased minute ventilation and depth of anesthesia
- **Identification of cause**-None
- **Broad differential dx**-Exhausted CO_2 granules, LMA placement, hypoventilation, laparoscopic surgery, MH☹
- **Narrowed differential dx**-MH
- **Targeted treatment**-See TNA checklist-**MH**

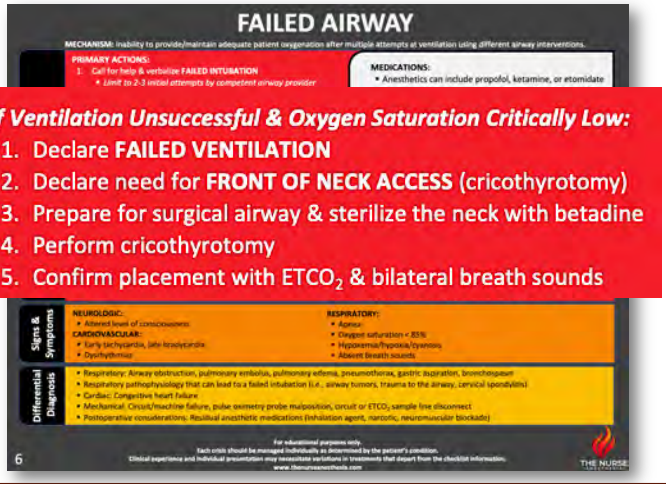


AV Fistula Creation



Case #2: A-V Fistula

1. **Verification (Artifact)** - Confirm pulse oximetry & $EtCO_2$ line connection
2. **Generic response** - 100% FiO_2, verify airway placement & patency, confirm adequate ventilation, call for assistance
3. **Preceding event** - Recent extubation with airway obstruction
4. **Broad differential dx** – Cannot intubate/cannot oxygenate or ventilate
5. **Narrowed differential dx** – Severe hypoxia
6. **Targeted treatment** - See TNA checklist – **Failed Airway**



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