You want me to get an IV on that little thing??

Pediatric Critical Procedures in the ED

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Case

- 18 month old child run over by a car
- Unconscious and posturing
- VS HR 160, BP 60/p, RR shallow and slow
  Pulse ox 83%
- Massive facial trauma with obviously open-fractured mandible
- Very difficult to bag-valve-mask
- Attempts at oral intubation are unsuccessful
- Pulse ox and HR are decreasing

Cases

- 1 month old full arrest
- 2 year old with complete airway obstruction due to foreign body
- 3 year old multi-trauma patient, pale, tachycardic, hypotensive and no IV access
**Emergency Pediatric Procedures**

- Bag-valve mask
- Intubation
- Foreign Body Removal
- Airway toys such as LMAs
- Needle cricothyrotomy
- Vascular access such as IOs

**Anatomic Differences**

- Prominent occiput
  - Shoulder lift
- Caution with hyperflexion OR hyperextension
- Dependence on nasopharynx patency
- Lots of secretions
- Loose teeth

**Anatomic Differences**

- Larger tongues
- Larger adenoids
- Floppy epiglottis
- Anterior larynx
Anatomic Differences

- Smaller cricoid - narrowest portion
  - Anatomical "cuff"
- Smaller tracheal width
- Shorter tracheal length
  - 4-5cm in newborns, 7-8cm at 18mths

- Narrower large airways
- Higher resistance to airflow
- Ribs more horizontal
- Fatigable diaphragm, drop NG tube!!
  - Size is 2X ETT

Edema Effects

Diagram of the Effect of Edema on the Cross-Sectional Airway Diameter

**Adult Airway**

- Area = \( \pi r^2 \) = 314 mm² (Normal)
- If have 1 mm Edema: Area = \( \pi (r + 1)^2 \) = 616 mm²
- or 2X of normal

**Full Term Newborn**

- Area = \( \pi r^2 \) = 9 mm² (Normal)
- If have 1 mm Edema: Area = \( \pi (r + 1)^2 \) = 44 mm²
- or 4X of normal
Physiological Differences

- Basal metabolic rate is twice that of adults
- Infants metabolize O2 at 6ml/kg/min
- Smaller functional residual capacity (FCR) compared to adults
- Shorter periods of allowable apnea
  - Get hypoxic faster
- May need BVM with cricoid pressure intermittently

Indications

- Respiratory failure or impending
  - RR<12 or >60
- Cardiac failure
- Shock
- Emergency drug administration
- Neurological resuscitation
- Protects airway

Airway Management

- Bag-valve-mask
- Bridge of nose, cleft of chin
- "C-E" grip
- Avoid soft tissue
- Chest rise only
- Infants 30/minute
**Airway Management**

- **Nasal Airways**
  - >1yr old

- **Oral Airways**
  - Any age
  - Unconscious, no gag

**Airway Management**

- **Laryngoscope Blade**
  - 00 - premie
  - 0 - newborn
  - 1 - small child
  - 2 - bigger child
  - 3, 4 - teenagers, adults

**Airway Management**

- **Endotracheal tubes**
  - Cuffed tubes OK!
  - Uncuffed: 4 + age/4
  - Cuffed: 3 + age/4
  - Broselow
  - Little finger nail width
  - Lip cm mark = 3 x ETT
And if you forget everything...

- 1 year old: 10 kg, 4 ETT
- 5 year old: 20 kg, 5 ETT
- 10 year old: 30 kg, 6 ETT

Intubation - Sedation

- Versed
- Ketamine
  - Good for asthma
  - Bad for head trauma
- Etomidate
  - Good for multi-trauma
- Barbiturates

Intubation - Paralysis

- Succinylcholine (Anectine)
  - Higher doses needed
    - 2mg/kg in kids
    - 3mg/kg in newborns
    - Larger volumes of extracellular water
  - Defasciculating drug
    - 0.01mg/kg Pancuronium (Pavulon)
    - Not in kids < 5yo
### Intubation - Paralysis

- Vecuronium (Norcuron)
  - Dose 0.1mg/kg
  - Onset 1min
  - Duration 25-60mins
- Rocuronium (Zemuron)
  - Dose 1 mg/kg
  - Onset 1min
  - Duration 25-60mins
- Neonate may only need atropine, if anything

### Intubation - Atropine?

- If succinylcholine is used
  - Especially 2nd dose
- For kids < 10 yo, especially < 5 yo
  - high vagal tone
  - brady from SCH and airway manipulation
  - Dose 0.01 mg/kg
  - Minimum 0.1 mg

### Case

- 18 mo old eating “Cracker Jack” (peanuts and popcorn)
  - Begins to cough and choke
  - Arrives to ED awake and alert, but anxious with audible stridor
    - or
  - Arrives to ED cyanotic and unresponsive
Mild Airway Obstruction

- Mild = partial obstruction
- Awake, alert but anxious, stridorous
- Keep child calm!
- Death begins in radiology
- Heliox?
- To the OR for inhaled anesthetics and bronchoscopy

Severe Airway Obstruction

- Severe = complete or almost complete obstruction
- AMS, signs of severe resp distress or failure
- Attempt BVM
- Removal with Magill forceps
  - Avoid pushing FB down farther

Airway Foreign Body

- Remember, BLS maneuvers!
- Esophageal FB?
- Attempt intubation
  - ETT down right mainstem
  - Then pull back
- FB at end of ETT?
- Bilateral pneumothoraces?
- Cricothyrotomy?
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Difficult Airways

- Can't intubate, can't ventilate!
- Rescue Airways -
  - LMA's for small children
  - Pediatric Intubating Stylets do exist
  - Combitubes not small enough
    - minimum 4 feet tall
  - Surgical cricothyrotomy
    - Not in young children and time-consuming
  - Percutaneous or Needle cricothyrotomy

Laryngeal Mask Airway

- Cuff device
- Allows for positive-pressure ventilation
- Not a definitive airway
- Sizes
  - 1 for infants
  - 5 for adult
**Pediatric Intubating Stylets**

- Used in difficult airway cases
- More experience in adult patients
- Intubating stylet advanced in upper trachea
- ETT slid over stylet into trachea

**Rusch QuickTrach**

- Sharp conical needle
  - No blade needed
- Syringe attached
- Depth gauge
- 15mm connector for bagging
- 4mm adult
- 2mm pediatric

**Needle Cric**

- Needle cricothyroidotomy may be only option
- Have equipment ready!
Needle Cricothyroidotomy

- Complication rates 10-40%
  - Subcutaneous air, barotrauma, obstruction or kinking of catheter, esophageal puncture
  - Remember your alternative!
- Goal is oxygenation!!

Needle Cric Equipment

- Catheter
  - 14 gauge
- Ability to connect to oxygen:
  1. ETT adapter and self-inflating bag
  2. Attach to a jet ventilator
  3. Tubing to wall oxygen
     e.g. ENK Oxygen Flow Modulator

Needle Cricothyroidotomy

- Find cricothyroid membrane
  - Or go between tracheal rings
- 14g Angiocath with 3cc saline syringe
- Aim toward the feet, 45 degrees
- Aspirate
**Needle Cricothyroidotomy**

- Remove the syringe
- Remove the needle
  - Sliding catheter snug to skin
- Catheter now in trachea
- Now attach to oxygen.....

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**Needle Cricothyroidotomy**

- Attach bag-valve-mask system
  - 3-0 ETT top
  - 7-0 ETT top + barrel 3cc syringe
- Very difficult to deliver adequate tidal volume
  - OK kids < 5yo?

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**Needle Cricothyroidotomy**

- Attach to a jet ventilator
  - Rare to have
- Attach to wall oxygen
  - Cook Needle Cricothyrotomy
  - Must plan ahead
**Needle Cricothyroidotomy**

- Need 20-30 psi for kids
- Humidify
- I:E ratio 1:4 seconds
- Obstruct upper airway during inhalation,
  - Let go during exhalation
- Look for chest rise

**Blood draws + Vascular lines**

- Dark room and vascular light
- Between 4th, 5th metacarpal
- Don’t forget scalp veins

**Peripheral IV Sites**

- Antecubital
- Basilic/cephalic veins
- Saphenous vein
- External jugular veins
External Jugular

Use needle (used for guidewire) attached to TB syringe
or
Use needle alone

Femoral Vein

Diku Mandavia (expert) recommends “linear ray” transducer (rectangular image)
- 7.5-10 MHz transducer

Ultrasound ??

- Limited literature on use in kids
- Few studies on use for Internal Jugular
- Diku Mandavia (expert) recommends “linear ray” transducer (rectangular image)
  - 7.5-10 MHz transducer
**Pediatric Resusc Fluids**

- Neonates: 10cc/kg NS or LR
- Children: 20cc/kg NS or LR
  - repeat x2
- PRBC's: 10cc/kg
- FFP: 10cc/kg

**Intraosseous Needle**

- Life-threatening event and unable to establish peripheral IV
- PALS: 3 attempts or 90 seconds
  - Full arrest - just do it!
- Age: new PALS has no age cutoffs

**Intraosseous Needle Contraindications**

- Local infection
- Fracture
- Prior IO attempt in the same bone
- Osteogenesis imperfecta (relative)
Intraosseous Needle

- Proximal tibia
- Distal femur
- Medial malleolus
- Humerus

- 16 or 18 gauge IO or bone marrow needle
- 16 or 18 g Angiocath

2 fingers below tibial tuberosity

Direct needle caudally to avoid epiphyseal plate

Intraosseous Needle Confirmation

- IO needle stands by itself
- Aspiration of bone marrow contents
- Easy flushing of needle without infiltration

- IV pressure bag or syringe
- T connector
**Intraosseous Needle Complications**

- Infiltration
- Compartment syndrome
- Infection/Osteomyelitis
- Subcutaneous abscess
- Fracture
- Emboli
- Skin necrosis

**Umbilical Vein Line**

- Emergency access in newborn
- Can be used up to 3 weeks?
- 1 large vein, 2 thick-walled arteries
- Mr. Bill of SNL
- Umbilical vein → ductus venosus → vena cava

**Umbilical Vein Line**

- Loosely tie stump
- Trim stump with scalpel
  - expose vessels
- 3.5 or 5F catheter until free return of blood (4-6cm)
- UVC (cm) = 1.5 x birth wt (kg) + 5.5
  - e.g. 3kg = 10cm
**Umbilical Vein Line**

- Resistance?
  - Caught at ductus?
  - Pull back to 4-5 cm and reinsert while gently twisting clockwise
- X-ray - good placement of the catheter at or slightly above the diaphragm
- Can pull back to 4-5 cm and leave it in umbilical vein

**Complications**

- Hemorrhage
- Vessel perforation
- Air embolism
- Ischemia of extremities or intra-abdominal organs
- Infection
- Thrombosis

**Tubes**

- NG tube = 2 x ETT
- Foley catheter = 2 x ETT
- Chest Tubes = 4-5 x ETT