Continuing Education
July 2015

Pediatrics part I Cardiac Arrest

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Educational Plan

- CE is 1st portion of 2 part module
- Intent - cover didactic content this month, will focus on psychomotor objectives (pediatric pit-crew team resuscitation) next month

Important: Expectation content reviewed this month will be remembered & utilized next month

Instructional Methodology

Question & Answer based **group discussion**

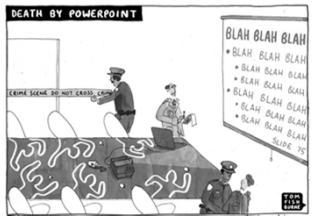
SOP review, plan to use SOP's

Handout (to be distributed @ end of class has all PPT slides with the questions & answers)

Instructional Methodology

Discussion….. not reading slides

Note: Educator will click past slides that have many words and no pictures or questions (slides w/ red arrow) as this content should have already been discussed.



They are included as they are in the handout.

Objectives

Upon successful completion of the CE module the participant will have reviewed, discussed, and planned management of a **pediatric pt in cardiac arrest** including:

unique situations (traumatic arrest, FBAO),
initial assessment, airway management,
circulatory support, vascular access,
medication administration,
defibrillation, ROSC, TOR,
death notification, and
NWC EMSS specific QI findings

Terminology

Minutes - hours after birth = **Newly-born/Newborn**
Birth - 1 month = **Neonate**
1 - 12 months = **Infant**
1 - 3 yrs = **Toddler**
6 - 12 yrs = **School-age**
Puberty - 18 yrs = **Adolescent**

AHA CPR Guidelines
Newly-born: in delivery room & first hours
Newborn: during initial hospitalization
Infant: up to 1 yr of age
Child: age 1 yr to puberty
Adult: puberty & beyond

Introduction

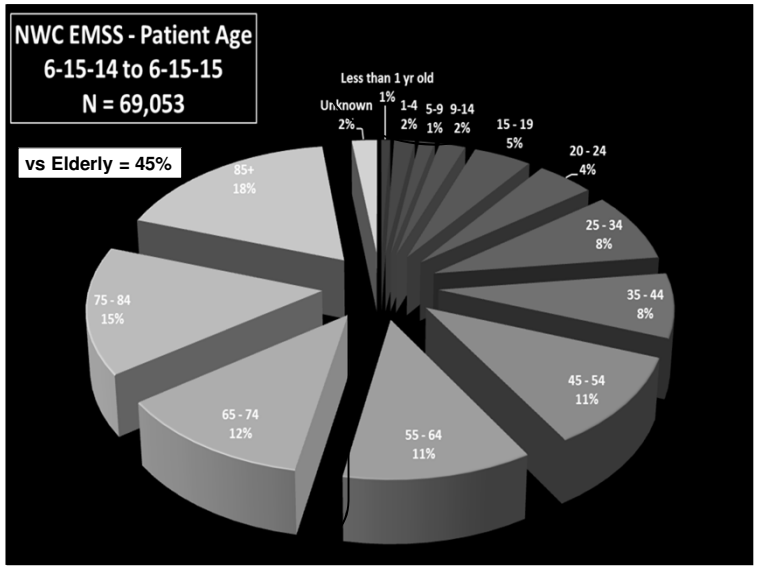
Dispatch:

"*Amb, Eng, respond to a 5 year-old, not breathing, we are instructing mother on CPR*"

- What is your first thought?
- How are you feeling?
- What will you do?

What % of calls are pediatric?

6%



Pediatric Cardiac Arrest

- How many are in cardiac arrest?

12/69,053 = **less than 0.02%**

1 per every 5,754 calls

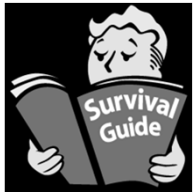
Thus, limited experience peds cardiac arrest

What to do?

- Education, Equipment, Practice

Survival

- Survival increased over past 20 years
  - Adult in-hospital arrest
  - Adult out-of-hospital arrest
  - Pediatric in-hospital arrest



- **No** change in survival past 20 years
  - Pediatric out-of-hospital arrest

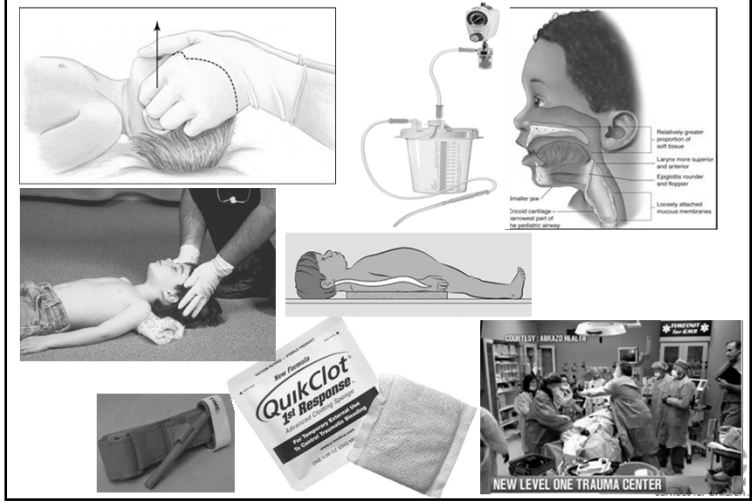
Traumatic Arrest

In children > 1 year, traumatic injury is the leading cause of death

Should peds traumatic arrest be managed differently than cardiac arrest?

- Traumatic arrest is an indication for rapid transport vs scene resuscitation
- Scene Time Goal: less than 10 minutes

Traumatic Arrest



Traumatic Arrest

- Principles of resuscitation are same, but some aspects deserve emphasis
- Anticipate airway obstruction by dental fragments, blood, or other debris. Use a suction device if necessary
- Open & maintain airway w/ jaw thrust, try not to tilt head
- If jaw thrust does not open airway, use head tilt–chin lift, because patent airway necessary. If 2 rescuers, manually restrict c-spine while other opens airway
- Stop external bleeding w/ pressure, hemostatic, tourniquet
- When appropriate, minimize motion of c-spine and movement of head & neck. To limit motion, secure at least thighs, pelvis, and shoulders
- Because of disproportionately large size of head in infants and young children, positioning may require elevating torso
- Transport to appropriate destination

Foreign-Body Airway Obstruction (FBAO)

What are s/s FBAO?

How differentiate mild & severe FBAO?

How treat mild FBAO?

How treat severe FBAO? Infant? Child?

Foreign-Body Airway Obstruction (FBAO)

- >90% of childhood deaths from FB aspiration in children <5 yrs; 65% infants. Liquids most common cause choking in infants; balloons, sm. objects, foods (eg, hot dogs, round candies, nuts, grapes) most common causes of FBAO in children
- Signs include sudden onset of respiratory distress w/ coughing, gagging, stridor, or wheezing
- Sudden onset of respiratory distress in absence of fever or other resp symptoms (eg, antecedent cough, congestion) suggests FBAO rather than infectious cause
- May cause mild or severe airway obstruction. When airway obstruction is mild, child can cough and make some sounds.
- When airway obstruction is severe, victim cannot cough or make any sound

Foreign-Body Airway Obstruction (FBAO)

- If FBAO mild, do not interfere. Allow victim to clear airway by coughing
- If FBAO severe (ie, victim unable to make a sound)
  - Child: perform subdiaphragmatic abdominal thrusts (Heimlich maneuver) until object expelled or becomes unresponsive
  - Infant: deliver repeated cycles of 5 back blows/slaps followed by 5 chest compressions until object is expelled or victim becomes unresponsive. Abdominal thrusts are not recommended for infants because they may damage relatively large, unprotected liver
- If unresponsive, start CPR w/ chest compressions (no pulse check). After 30 compressions, open airway. If FB seen, remove it but do not perform blind finger sweeps because may push obstructing objects farther into pharynx and damage oropharynx. Attempt to give 2 breaths and continue w/ cycles of compressions and ventilations until object expelled
- Perform direct laryngoscopy as soon as possible – to look for and remove FB using forceps/suction
- If obstructed & unable to ventilate, intubate & attempt to push FB into R mainstem bronchus, pull ETT back and ventilate L lung

EMSC Emergency Medical Services for Children

Are there warning signs for pediatric cardiac arrest?

EMSC Emergency Medical Services for Children

Etiology Peds Arrest

Often result of progressive resp failure (called asphyxial arrest) or shock

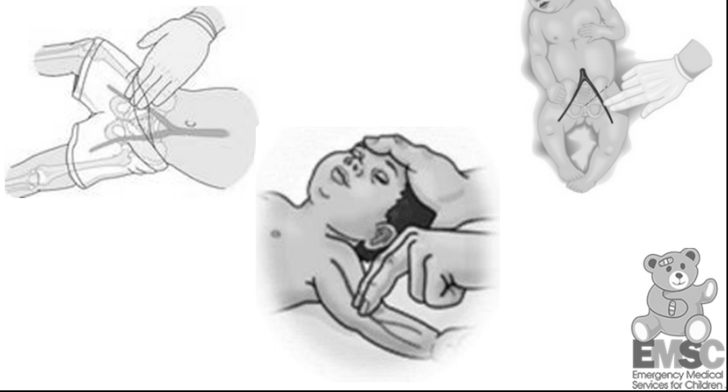
Asphyxia begins w/ variable period of systemic

- **hypoxia**
- **hypercapnea** (↑EtCO2) and acidosis
- progresses to **bradycardia**
- and **hypotension**
- and culminates w/ **cardiac arrest**

EMSC Emergency Medical Services for Children

Pulse Check

- Where check in infant? Child?
- How long can you take to check?



What if?

5 year-old, pulse 55, pale, resps assisted

BVM ventilation w/ O2 has not improved HR

- What should be done?
- Why?

Bradycardia w/ Poor Perfusion

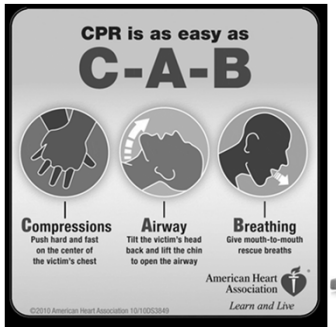
If pulse <60 per w/ poor perfusion (ie, pallor, mottling, cyanosis) despite oxygenation & ventilation - begin chest compressions

Because cardiac output in infancy/childhood largely depends on HR, profound bradycardia w/ poor perfusion is indication for chest compressions because cardiac arrest is imminent - and **beginning CPR prior to full cardiac arrest results in improved survival**

Pulse Check

- If unresponsive and not breathing (gasps do not count as breathing), HCP may take up to 10 sec to feel for a pulse
- Infant = brachial, Child = carotid/femoral
- If, within 10 sec, don't feel pulse or are not sure, begin chest compressions
- Can be difficult to feel a pulse, esp in the heat of an emergency, and studies show HCP are unable to reliably detect a pulse

ABC or CAB?



or

ABC

Chest Compressions

Immediately begin chest compressions while second rescuer prepares to start ventilation w/ BVM

"It is, however, unknown whether it makes a difference if the sequence begins with ventilations (ABC) or with chest compressions (CAB). Starting CPR with 30 compressions followed by 2 ventilations should theoretically delay ventilations by only about 18 seconds for the lone rescuer and by an even a shorter interval for 2 rescuers. The CAB sequence for infants and children is recommended in order to simplify training with the hope that more victims of sudden cardiac arrest will receive bystander CPR. It offers the advantage of consistency in teaching rescuers, whether their patients are infants, children, or adults."

Part 13: Pediatric BLS: 2010 AHA Guidelines for CPR and ECC. Circulation. 2010;122:S862-S875

ABC vs CAB

- Cardiac arrest due to respiratory arrest is more common (than VF arrest) in infants & children
- HCP can tailor sequence of actions to most likely cause of arrest
- For example, arrest witnessed & sudden (eg, collapse of child identified at high risk for arrhythmia or during athletic event), HCP may assume victim suffered VF arrest and as soon as rescuer verifies child is unresponsive and not breathing (or gasping) rescuer should immediately begin CPR and use AED

What are the 5 components of quality CPR?

Quality CPR

1. Rate correct
2. Depth correct
3. Release completely
4. Avoid interruptions
5. No hyperventilation

Quality CPR

- What rate?
- How deep? Infants? Children?
- What is meant by release completely?
- What are reasons to interrupt compressions?

Chest Compressions

- Push fast: rate of at least 100 compressions/min
- Push hard: sufficient to depress at least 1/3 anterior-posterior (AP) diameter of chest or ~1½ inches in infants and 2 inches in children
  - Inadequate depth common even by HCP
- Allow complete chest recoil after each compression to allow heart to refill with blood
- Minimize interruptions of chest compressions
- Avoid excessive ventilation
- Deliver chest compressions on a firm surface

Chest Compression Interruption

Compressions should only be interrupted for

- Ventilation
- Rhythm check
- Shock delivery

When should 2-finger technique be used for compressions in infant?

1-person Infant CPR

Two-finger chest compression technique in infant (1 rescuer).

Marc D. Berg et al. Circulation. 2010;122:S862-S875

How should compressions be performed on an infant when doing 2-person CPR?

2-person Infant CPR

Two thumb-encircling hands chest compression in infant (2 rescuers).

Marc D. Berg et al. Circulation. 2010;122:S862-S875

Chest Compressions - Infants

- Encircle chest w/ both hands; spread fingers around thorax, place thumbs together over lower third sternum
- Forcefully compress sternum w/ thumbs
- 2-thumb–encircling hands technique recommended when CPR provided by 2 rescuers
  - Preferred because produces higher coronary artery perfusion pressure, results more consistently in appropriate depth/force of compression and generates higher systolic & diastolic pressures
- If cannot physically encircle chest, compress chest w/ 2 fingers
- Lone HCP should use 2-finger compression technique.

How should chest compressions be performed on a child?

Child Chest Compressions

One or Two Handed

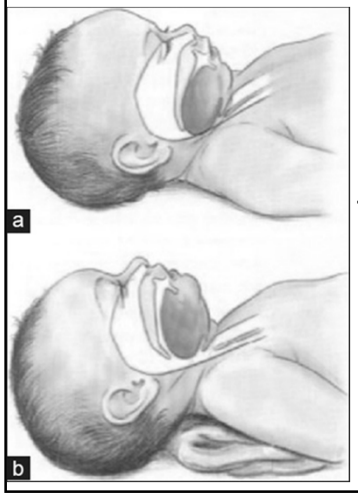
Avoid Common Errors

- Rescuer fatigue
- Interruptions to move pt
- Long/frequent interruptions check ECG
- Long/frequent interruptions to secure airway
- Inattention to detail when doing compressions

What are challenges with pediatric airway management?

What is important to remember?

Airway Challenges



Positioning
relative large head size

Tongue
relatively large

Positioning

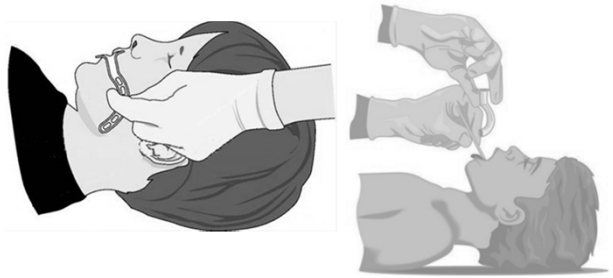
Airway

- Oral (OPA) & nasal (NPA) airways help open the airway by displacing tongue
  - Correct size important
- OPA: unresponsive & no gag reflex.
  - Too small may push tongue farther into airway
- NPA: (+) gag reflex
  - Too short may not open airway
  - NPA may require frequent suctioning

OPA Sizing

How should an OPA be sized? Inserted?

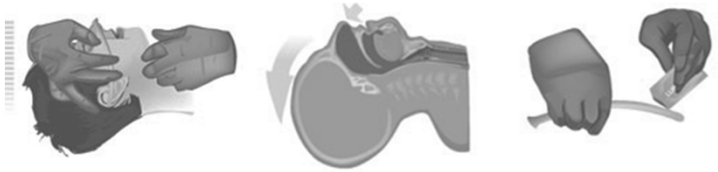
Inserting an oropharyngeal airway in a child with the use of a tongue blade.



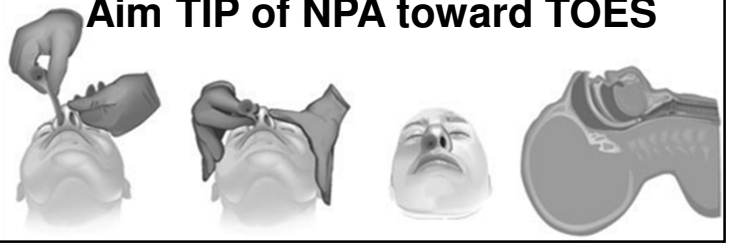
Front of teeth/gums to angle of jaw

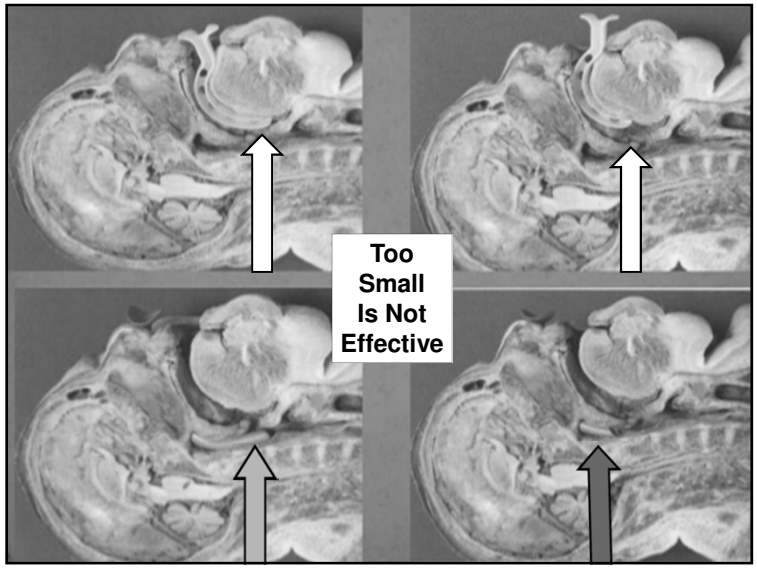
NPA Sizing

How should a NPA be sized? Inserted?



Aim TIP of NPA toward TOES





Bag-Mask Ventilation

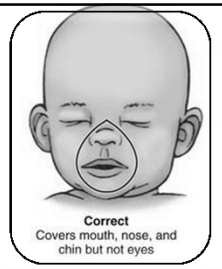
Requires education in opening airway, selecting correct mask size, making tight face-mask seal, delivering effective ventilation, and assessing effectiveness of ventilation

Because effective bag-mask ventilation requires complex steps, it is NOT recommended for a lone rescuer CPR

EMSC Emergency Medical Services for Children

How should the mask on BVM device be sized for an infant/child?

(Sizing



How should the mask be held on pts face?

Face-Mask Seal

Open airway by lifting jaw toward mask, making a tight seal and squeeze bag until chest rises

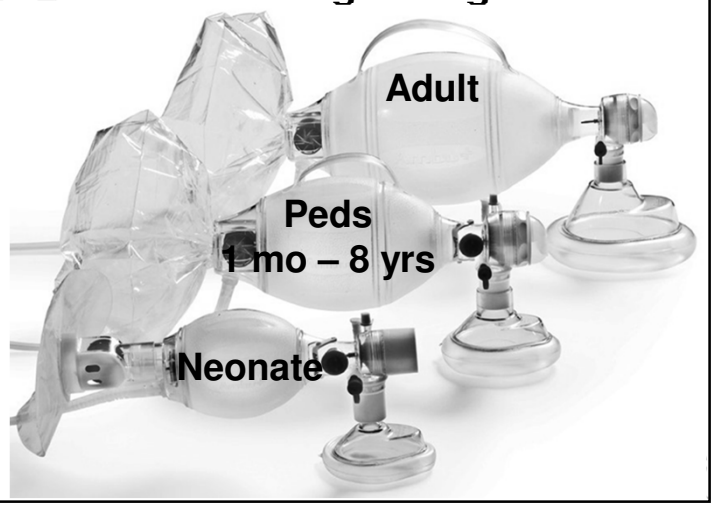
Effective ventilation requires tight seal between mask and face

Fingers on jaw, not soft tissue below chin

How many sizes of BVM's do you have?

Who gets which size?

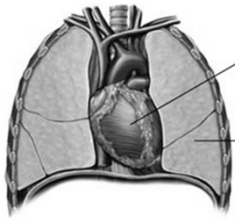
Bag Sizing



Why is hyperventilation so harmful?

Ventilation Precautions

- HCP often deliver excessive ventilation during CPR
- Hyperventilation is harmful because it



- Increases intrathoracic pressure, impedes venous return, decreases cardiac output, decreases cerebral blood flow, decreases coronary perfusion, making ROSC less likely
- Causes air trapping and barotrauma esp. in pts with small-airway obstruction
- Increases risk of gastric distention, regurgitation and aspiration in pts without advanced airway

How can hyperventilation be avoided?

Ventilation Precautions

- Avoid excessive ventilation; use only force & volume necessary **to just make chest rise**
- Give breath over ~1 sec, watch for chest rise
- If chest does not rise, reopen airway, add airway device, verify tight seal between mask & face and reattempt ventilation

How can gastric inflation be minimized?

Gastric Inflation

Interferes w/ effective ventilation, cause regurgitation, aspiration of stomach contents, and further ventilatory compromise

Risk can be decreased by:

- Avoid excessive peak inspiratory pressures by ventilating slowly (over ~1 sec) & giving only enough volume to just achieve visible chest rise
- Apply cricoid pressure to reduce air entry into stomach. Avoid excessive pressure to not obstruct trachea

2-Person Bag-Mask Ventilation

- May provide more effective ventilation than single-person technique
- May be required to provide effective ventilation when significant airway obstruction, poor lung compliance, or difficulty creating tight face-mask seal

- One rescuer uses both hands to open airway and maintain tight face-mask seal while other compresses ventilation bag
- Both rescuers observe chest rise
- Be careful to avoid delivering too high volume that may contribute to excessive ventilation

What are the pediatric compression:ventilation ratios?

Compression-Ventilation Ratio

Pediatric

1 person CPR = 30:2

2 person CPR = 15:2

Compressions & Ventilations

No advanced airway

- Deliver ventilations w/ minimal interruption in chest compressions

Advanced airway present

- Cycles of compressions & ventilations not delivered
- Perform 100 compressions/min continuously without pauses for ventilation
- Ventilation rescuer delivers 8-10 breaths min (every 6-8 sec) being careful to avoid hyperventilation in stressful environment of pediatric arrest

Newborn Resuscitation

Quick Review

not focus of this class

1. Warm & dry
2. Stimulate
3. Position
4. Suction mouth then nose
5. Ventilate w/ RA @ 40-60/min
6. Add oxygen
7. HR <60, begin compressions
8. Compression rate 120/min
9. Compression:Ventilation ratio 3:1
10. Administer epinephrine
11. Check glucose

Should pediatric pts in cardiac arrest be intubated?

Why?

Intubation

www.nwcemss.org/assets/1/standard_operating_procedures/2014_SOPs.pdf

PEDS AIRWAY ADJUNCTS

Children < 8 years of age shall have airways secured using BLS adjuncts & interventions
Possible indications for intubation: CHILDREN 8-12 years per OLMC only; ADOLESCENTS > 12 yrs/SOP

- Less than 8: BLS adjuncts
- 8-12: ETI only per OLMC
- Over 12: per adult SOP's

No evidence ETI improves outcomes in peds pts; may worsen outcome

Airway & O2 esp. critical for pediatric pts

What are pts not getting during ETI attempts?

Initial practice doing peds ETI rare; With infrequent use, skill deterioration occurs

Peds pts are usually easier to BVM ventilate

Effect of Out-of-Hospital Pediatric Endotracheal Intubation on Survival and Neurological Outcome

A Controlled Clinical Trial

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Samuel J. Stratton, MD, MPH
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Carol S. Gunter, BSN, MPA
Suzanne M. Goodrich, RN, MSN
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Deborah P. Henderson, PhD, RN
Franklin D. Pratt, MD
James S. Seidel, MD, PhD

Context Endotracheal intubation (ETI) is widely used for airway management of children in the out-of-hospital setting, despite a lack of controlled trials demonstrating a positive effect on survival or neurological outcome.

Objective To compare the survival and neurological outcomes of pediatric patients treated with bag-valve-mask ventilation (BVM) with those of patients treated with BVM followed by ETI.

Design Controlled clinical trial, in which patients were assigned to interventions by calendar day from March 15, 1994, through January 1, 1997.

Setting Two large, urban, rapid-transport emergency medical services (EMS) systems.

Participants A total of 830 consecutive patients aged 12 years or younger or estimated to weigh less than 40 kg who required airway management; 820 were available for follow-up.

Interventions Patients were assigned to receive either BVM (odd days; n = 410) or BVM followed by ETI (even days; n = 420).

Main Outcome Measures Survival to hospital discharge and neurological status at discharge from an acute care hospital compared by treatment group.

Results There was no significant difference in survival between the BVM group (123/404 [30%]) and the ETI group (110/416 [26%]) (odds ratio [OR], 0.82; 95% confidence interval [CI], 0.61-1.11) or in the rate of achieving a good neurological outcome (BVM, 92/404 [23%] vs ETI, 85/416 [20%]) (OR, 0.82; 95% CI, 0.5-1.32).

Conclusion These results indicate that the addition of out-of-hospital ETI to a paramedic scope of practice that already includes BVM did not improve survival or neurological outcome of pediatric patients treated in an urban EMS system.

JAMA. 2000;283:783-790 www.jama.com

ALTHOUGH BAG-VALVE-MASK ventilation (BVM) and endotracheal intubation (ETI) are both widely used in the out-of-hospital setting in caring for critically ill or injured children, there has been no controlled study comparing the outcomes of pediatric or adult patients treated with these 2 procedures. In 1 out-of-hospital study, BVM did compare favorably to non-ETI advanced airway management techniques (pharyngeal tracheal lumen, laryngeal mask, and esophageal tracheal combination esophageal-tracheal tube) among adults and children, as measured by Po_2 and Pco_2 values on arrival in the emergency department (ED), frequency of vomiting, and patient outcome.[1]

There have been a number of descriptive studies of ETI in the out-of-hospital setting. Reported success rates of pediatric ETI vary from 50% to 100%, depending on the patient's presenting illness or injury, the age of the patient, education level of the health care provider, and use of neuromuscular blocking agents to facilitate intubation.[2-9] Major complications of ETI, such as esophageal intubation, have been reported in as little as 1.8% and as many as 17% of pediatric patients in the out-of-hospital setting.[2,6] One study reported an overall complication rate of 22.6%, using succinylcholine to facilitate intubation.[10] Despite the fact that retrospective studies comparing the survival of patients treated with BVM and ETI have generally found no difference, some investigators have suggested that ETI may

For editorial comment see p 797.

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Advanced Airway

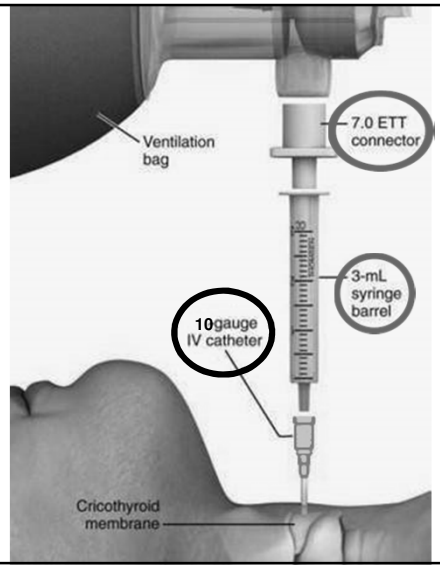
While the KLT airway can be used in pts 4-5' tall

- **Considered an "advanced airway"**
- **Do NOT use under age 8**
- **Age 8-12 only per OLMC**

Size	3	4	5
Connector Color	Yellow	Red	Purple
Cuff Pressure	60 cm H_2O	60 cm H_2O	60 cm H_2O
Patient Criteria	4-5 feet (122-155 cm)	5-6 feet (155-180 cm)	greater than 6 feet (>180 cm)
KLTD O.D./I.D.	14 mm/10 mm	14 mm/10 mm	14 mm/10 mm
KLTSD O.D./I.D.*	18 mm/10 mm	18 mm/10 mm	18 mm/10 mm
KLTSD Cuff Volume	40-55 ml	50-70 ml	60-80 ml

What equipment is needed for needle cric?

Needle Cric Set-Up



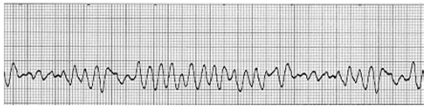
How is EtCO2 helpful in cardiac arrest?

EtCO2

- Helps evaluate quality of chest compressions
  - Minor adjustment of hand position or depth of compression may improve stroke volume
  - If low, focus on improving chest compressions & assure no hyperventilation
- May decrease 1-2 min after epi because of decreased pulmonary blood flow
- Abrupt/sustained rise observed just prior to ROSC

Pediatric VF / pVT

- Ventricular fibrillation (VF) / pulseless ventricular tach (pVT) initial rhythm ~5-15%
- Occurs ~27% at some point during resusc
- Incidence VF/ pVT rises w/ age
- Sudden unexpected peds death can be associated w/ genetic abnormalities in myocyte ion channels



Can AED's be used on peds pts?

Defibrillation

- Some AED's equipped to decrease (attenuate) energy to make them suitable for infants/children <8 yrs
- AED w/ ped attenuator preferred for child <8 yrs
- Infants - manual defib preferred
- If manual defib not available, AED w/ ped attenuator preferred
- If neither (manual defib or AED w/ attenuator) available, AED without a dose attenuator may be used
- AEDs that deliver relatively high energy have been successfully used in infants w/ minimal myocardial damage & good neuro outcomes

When should peds (vs adult) defibrillation paddles/pads be used?

Does your agency have peds pads or paddles?

Defib Paddles

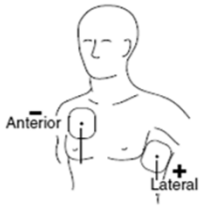
- Manual defibrillators have 2 sizes: adult & infant
- Use largest paddles/pads that fit on chest without touching
- When possible, leave ~3 cm between paddles/electrodes
- Appropriate size
  - "Adult" (8-10 cm) for children over 10 kg (~1 year)
  - "Infant" for less than 10 kg
- Paddles & combo-pads appear to be equally effective

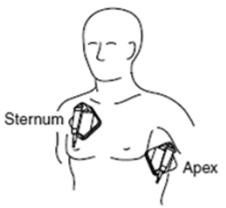
- Combo-Pads
  - Press pads firmly on chest so gel completely touches chest
- Paddles
  - Infant paddles may slide over or be under adult paddles
  - Apply electrode gel liberally on paddles
  - Do not use NS-soaked pad, ultrasound gel, or bare paddles

Stand & place your hands on your chest in the position defib electrodes should be placed

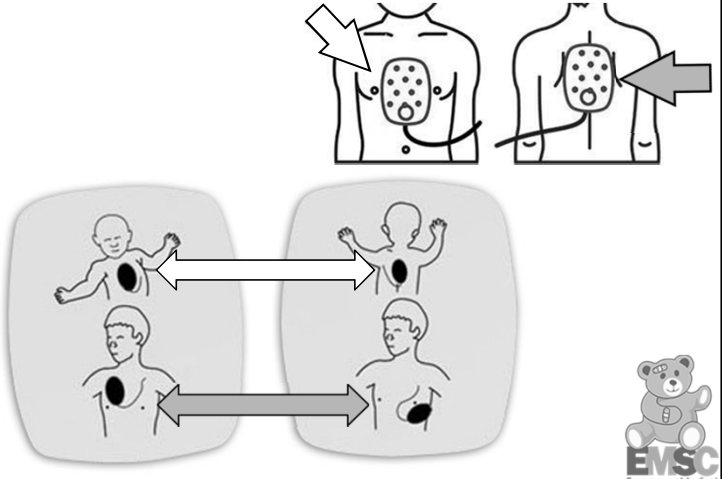
Defib Paddle/Pad Placement

- Place paddles/pads
  - over R side of upper chest
  - apex of heart, to L of nipple over lower ribs
- Apply firm pressure when using paddles
- No advantage of anterior-posterior position



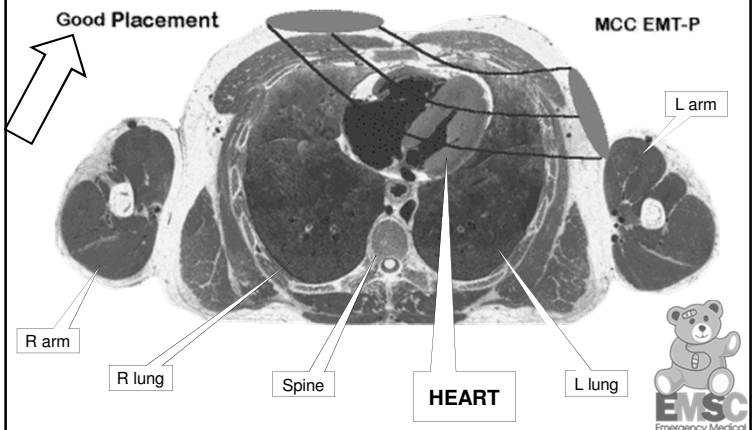


Infant Pad Placement



Defibrillation Pad Placement

slide will demonstrate good vs bad placement



What can increase the success of defibrillation?

Defibrillation

- More likely to be successful after period of effective chest compressions
- Most effective when minimum time between the last compression & shock delivery
  - CPR
  - Check rhythm = VF
  - Resume CPR & charge defib
  - Hold CPR
  - Shock
  - Resume CPR x 2 minutes (no rhythm or pulse check until after 2 minutes of chest compressions)

Note: The AHA does **NOT** recommend pre-charging defibrillator to check ECG & defib during the same pause in chest compressions.

What is the energy for peds defib?

Initial?
Subsequent?

Defib Energy

- Initial 2 J/kg *(round up if needed)*
- Repeat 4 J/kg *(round up if needed)*
- Children w/ VF, an initial biphasic 2 J/kg effective in terminating VF 48% of the time
- Doses 4 J/kg (up to 9 J/kg) have effectively defib children w/ negligible adverse effects
- Higher levels may be considered (by OLMC), not to exceed 10 J/kg or adult max dose

Where is the preferred insertion site for peds IO?

What is the purpose of the black marks on The EZ-IO needle?

EZ-IO – Peds Considerations

Proximal Tibia Site

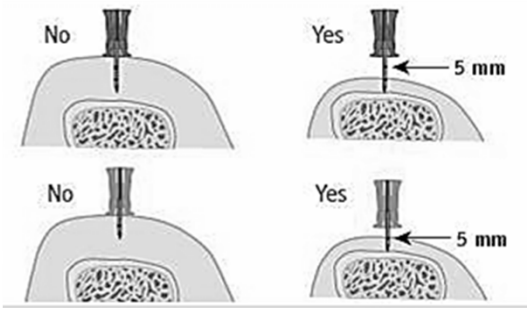
- Extend leg
- Insertion site ~1cm medial to tibial tuberosity (just below patella [~1cm/1 finger-width]) and slightly medial (~1cm/1 finger-width) along flat aspect of tibia
- Pinch tibia between fingers to identify medial & lateral borders

Remember

- Stabilize extremity
- Aim needle at 90-degree angle to center of bone
- Push needle through skin until tip rests on bone
- 5 mm mark must be visible above skin - for confirmation of adequate needle length
- Gently drill, immediately release trigger when feel “pop” or “give” as needle enters medullary space
- Avoid recoil – do NOT pull back on driver

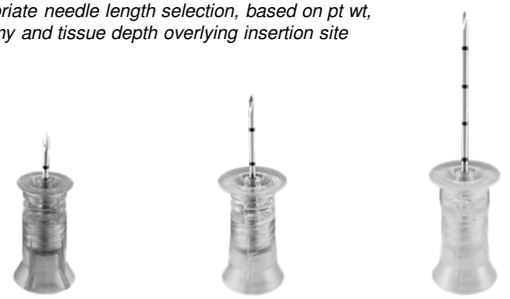
IO

- Before activating drill, puncture tissue and rest needle on bone, verify 5 mm mark visible
- If not seen, use longer needle or different site



EZ-IO General Sizing Guidelines

Clinical judgment should be used to determine appropriate needle length selection, based on pt wt, anatomy and tissue depth overlying insertion site



15 mm
3-39 kg

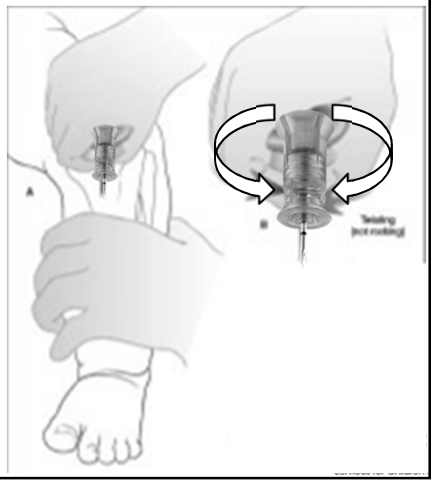
25 mm

45 mm
Excessive tissue depth
Humeral site

EZ-IO

If driver failure, on peds or adult pt, insert manually
(not difficult)

Use back & forth twisting motion
(not like a screw)



Is knowing the child's weight important? Why?

How can you determine a child's weight?

Age ≠ Weight

Equipment & med doses often based on weight

Solutions

- Length-based weight tape
- Parental information
- Scale (not often used in EMS)
- 2 x age + 8 = kg weight

Med Dose Calculation

- Use weight if known
- If unknown, use body length tape
- Obese children: Unknown if dose adjustment needed. Use of actual/obese weight may result in toxic doses
- Length-based tapes estimate 50th percentile weight for length (ie, ideal body weight) may result in inadequate doses of meds in obese pts. There is no data regarding safety or efficacy of adjusting doses of meds in obese pts. Therefore use actual body weight for calculating initial drug dose or use a body length tape
- For subsequent doses, expert providers (OLMC) may consider adjusting dose to achieve desired effect
- Dose given should not exceed adult dose

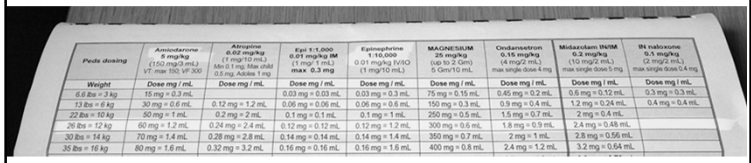
Weight Examples

"*At the doctors office yesterday when they weighed him, he was 47 pounds*"

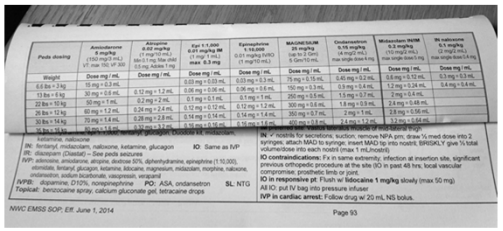
– Use that known weight

"*I don't know how much he weighs*"

- Use weight from length based tape



Can highlight or fold back drug dose page in SOP



What is 1st drug given to all pulseless arrests after oxygen?

Epinephrine

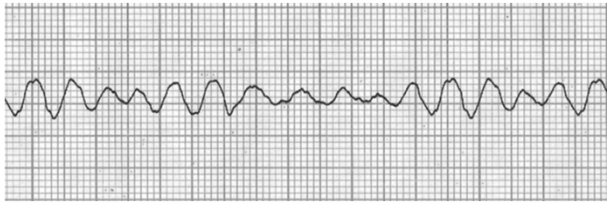
- 1st drug given during CPR
- Dose
  - 0.01 mg/kg
  - 0.1 mL/kg (1:10 000 solution)
  - max 1 mg (10 mL) per dose
- Repeat same dose every 3-5 minutes
- Prepare dose before needed, so it can be administered on-time

What drug should be given if VF/pVT?

Amiodarone

- Given if rhythm is VF or pVT
- Dose 5 mg/kg IV/IO
- Max single dose 300 mg

Contact OLMC for additional doses
AHA: 5 mg/kg IV/IO; may repeat twice up to 15 mg/kg



What should be done to promote IO drug delivery into central circulation?

Intraosseous (IO) Access

- Rapid, safe, effective route; useful as initial vascular access in cases of cardiac arrest
- All IV meds can be given IO
- Onset of action and drug levels are comparable to IV admin
- Follow each med w/ NS flush to promote entry into central circulation

Search for Treatable Causes

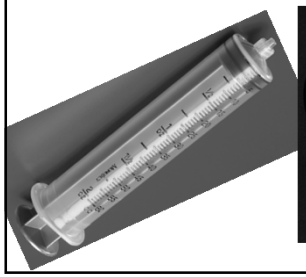
- **Hypoxia**
- **Hypovolemia**
- **Hypoglycemia**
- Hypothermia
- Hydrogen ion (acidosis)
- Hypo/hyperkalemia
- **Trauma**
- **Toxins**
- **Tension pneumo**
- Tamponade – cardiac
- Thrombosis

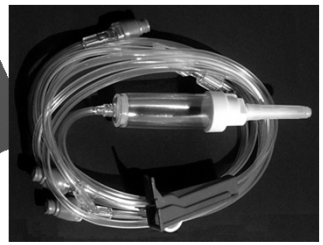
What is the IVF bolus amount for peds pts?

How should that be delivered?

IVF Bolus

- Hypovolemia, Dehydrated, Tamponade
- NS 20 mL/kg, may repeat x 2
- Use 60 mL syringe





Glucose

Because infants have high glucose requirement & low glycogen stores, may develop hypoglycemia when energy requirements rise

Check bG during resuscitation & treat hypoglycemia promptly

Practice: 9 yr-old (62 lbs/28kg)

- What is dose of epi 1:10,000 (mg & mL)?
  - 0.28 mg = 2.8 mL
- What is the 1st & subsequent defib energy?
  - 56J, 112J
- What is dose of amiodarone (mg & mL)?
  - 140 mg = 2.8 mL
- What is the 10% dextrose dose (dose & mL)?
  - 14 g = 140 mL
- What is the initial IVF bolus amount?
  - 560 mL

Practice: 6-mo old (13 lbs/6kg)

- What is dose of epi 1:10,000 (mg & mL)?
  - 0.06 mg = 0.6 mL
- What is the 1st & subsequent defib energy?
  - 12J, 24J
- What is dose of amiodarone (mg & mL)?
  - 30 mg = 0.6 mL
- What is the 10% dextrose dose (dose & mL)?
  - 3 g = 30 mL
- What is the initial IVF bolus amount?
  - 120 mL

Practice: 2 yr-old (26 lbs/12kg)

- What is dose of epi 1:10,000 (mg & mL)?
  - 0.12 mg = 1.2 mL
- What is the 1st & subsequent defib energy?
  - 24J, 48J
- What is dose of amiodarone (mg & mL)?
  - 60 mg = 1.2 mL
- What is the 10% dextrose dose (dose & mL)?
  - 6 g = 60 mL
- What is the initial IVF bolus amount?
  - 240 mL

CORRECTED SLIDE

Practice: Newborn (6.5lbs/3 kg)

- What is dose of epi 1:10,000 (mg & mL)?
  - 0.03 mg = 0.3 mL
- What is the 1st & subsequent defib energy?
  - 6J, 12J
- What is dose of amiodarone (mg & mL)?
  - 15 mg = 0.3 mL
- What is the 10% dextrose dose (dose & mL)?
  - 1.5 g = 15 mL
- What is the initial IVF bolus amount?
  - 60 mL

ROSC Treatment

ROSC

is a shorter form of

Return Of Spontaneous Circulation

ROSC Treatment

- Assess oxygenation, check pulse ox
- Assess ventilation, check EtCO2
  - Do NOT hyperventilate to decrease EtCO2
- Monitor HR & ECG closely
- Check BP frequently
  - Treat hypotension
    - IVF – run IV while preparing dopamine
    - Dopamine
- OLMC – ? therapeutic hypothermia

ROSC Assisted Ventilation

- 1 breath every 3-5 seconds (12-20 min)
- The higher rate for younger child

Pulse Oximetry

Should pulse ox be used to monitor O2 saturation during cardiac arrest w/ CPR?

Why?

When should it be initiated?

How else may it be useful?

Pulse Oximetry

- During cardiac arrest, pulse oximetry does NOT provide a reliable signal because pulsatile blood flow is inadequate in peripheral tissue beds
- Presence of plethysmograph waveform is potentially valuable in detecting ROSC (or loss of pulse)
- Pulse oximetry is useful to ensure appropriate oxygenation after ROSC

What is considered hypotension for a child?

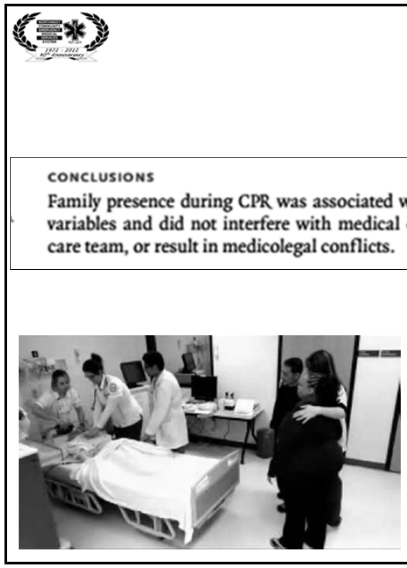
Hypotension

SBP less than

- Neonate: 60 mm Hg
- Infant: 70
- Child 1-10 years: 70 + (age x 2)
- Child 10 or older: 90

Should parents be allowed to watch child's resuscitation?

Why?



The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Family Presence during Cardiopulmonary Resuscitation

Patricia Jabre, M.D., Ph.D., Vanessa Belpomme, M.D., Elie Azoulay, M.D., Ph.D., Line Jacob, M.D., Lionel Bertrand, M.D., Frederic Lapostolle, M.D., Ph.D., Karim Tazarourte, M.D., Ph.D., Guillem Bouilleau, M.D., Virginie Pinaud, M.D., Claire Broche, M.D., Domitille Normand, M.S., Thierry Baubet, M.D., Ph.D.

CONCLUSIONS

Family presence during CPR was associated with positive results on psychological variables and did not interfere with medical efforts, increase stress in the health care team, or result in medicolegal conflicts.

METHODS

We enrolled 570 relatives of patients who were in cardiac arrest and were given CPR by 15 prehospital emergency medical service units. The units were randomly assigned either to systematically offer the family member the opportunity to observe CPR (intervention group) or to follow standard practice regarding family presence (control group). The primary end point was the proportion of relatives with post-traumatic stress disorder (PTSD)–related symptoms on day 90. Secondary end points included the presence of anxiety and depression symptoms and the effect of family presence on medical efforts at resuscitation, the well-being of the health care team, and the occurrence of medicolegal claims.

RESULTS

In the intervention group, 211 of 266 relatives (79%) witnessed CPR, as compared with 131 of 304 relatives (43%) in the control group. In the intention-to-treat analysis, the frequency of PTSD-related symptoms was significantly higher in the control group than in the intervention group (adjusted odds ratio, 1.7; 95% confidence interval [CI], 1.2 to 2.5; P=0.004) and among family members who did not witness CPR than among those who did (adjusted odds ratio, 1.6; 95% CI, 1.1 to 2.5; P=0.02). Relatives who did not witness CPR had symptoms of anxiety and depression more frequently than those who did witness CPR. Family-witnessed CPR did not affect resuscitation characteristics, patient survival, or the level of emotional stress in the medical team and did not result in medicolegal claims.

CONCLUSIONS

Family presence during CPR was associated with positive results on psychological variables and did not interfere with medical efforts, increase stress in the health care team, or result in medicolegal conflicts. (Funded by Programme Hospitalier de Recherche Clinique 2008 of the French Ministry of Health; ClinicalTrials.gov number, NCT01009606.)

N ENGL J MED 368;11 NEJM.ORG MARCH 14, 2013

Family Presence During Resuscitation

- Family presence during CPR is increasingly common, and most would like to be given opportunity to be present during resuscitation of child
- Studies show family members present at a resuscitation would recommend it to others
- Parents of chronically ill child comfortable w/ equipment & emergency procedures
- Even family members with no medical background who were at the side of a loved one to say goodbye during the final moments of life believe their presence was beneficial to patient, comforting for them, and helpful in adjustment and grieving process
- Standardized psych examinations suggest, compared w/ those not present, family members present during attempted resuscitations have less anxiety & depression and more constructive grieving behavior
- Family members often fail to ask, but HCP should offer opportunity in most situations
- Whenever possible, provide family members w/ option of being present during resuscitation of child
- Studies show family presence during resuscitation, is not disruptive, and does not create stress among staff or negatively affect their performance
- If presence of family members creates undue staff stress or is considered detrimental to resuscitation, then family members should be respectfully asked to leave
- Members of resuscitation team must be sensitive to presence of family members, and one person should be assigned to remain with family to comfort, answer questions, and support family

TOR?

SOP “adult”

Termination of Resuscitative Efforts

- **No reliable predictors of outcome guide when to terminate resuscitation in children**
- Clinical variables assoc. w/ survival incl. length of CPR, # doses of epi, age, witnessed vs. unwitnessed arrest, first & subsequent rhythm
- **None predict outcome**
- Witnessed collapse, bystander CPR, short interval from collapse to arrival of professionals improve chances of successful resuscitation
- **Intact survival has been documented after unusually prolonged resuscitation**

Death Notification

Death Notification

Table. The GRIEV_ING Mnemonic.

G	Gather; gather the family; ensure that all members are present.
R	Resources; call for support resources available to assist the family with their grief, i.e., chaplain services, ministers, family and friends.
I	Identify; identify yourself, identify the deceased or injured patient by name, and identify the state of knowledge of the family relative to the events of the day.
E	Educate; briefly educate the family as to the events that have occurred in the emergency department, educate them about the current state of their loved one
V	Verify; verify that their family member has died. Be clear! Use the words “dead” or “died.”
_	Space; give the family personal space and time for an emotional moment; allow the family time to absorb the information.
I	Inquire; ask if there are any questions, and answer them all.
N	Nuts and bolts; inquire about organ donation, funeral services, and personal belongings. Offer the family opportunity to view the body.
G	Give; give them your card and access information. Offer to answer any questions that may arise later. Always return their call.

Death Notification - Basic Principles

- One of most difficult tasks faced by professionals, because learning of a loved one's death is often the most traumatic event in a person's life. Something most people remember vividly for the rest of their life.

"In Person"

- Make notification in person - not by phone
- Provides survivor with human presence during difficult time
- Can help if survivor has severe reaction

"In Time"

- Provide notice ASAP, but be absolutely sure of positive ID; mistaken death notifications have caused enormous trauma
- Before notice quickly gather info, next of kin, circumstances of death, health considerations of survivors

"In Pairs"

- Try to have 2 people; support one another before and after notification
- May experience severe emotional or physical reactions
- Plan notification; decide who speaks and what is said

EMSC Emergency Medical Services for Children

Death Notification

"With Compassion"

- Presence & compassion important resources you bring
- Accept survivor's & your own emotions
- Better to tear up, than appear cold & unfeeling
- Do not try to "talk survivors out of grief" or offer false hope
- Do not impose your own religious beliefs
- Survivors report ***not*** helpful statements: "It was God's will," "He led a full life," "I understand what you're going through"
- Take time to provide information, support, direction
- Help begin mourning & grieving process by providing immediate direction in dealing with the death
- Offer to call friend/family member to come & support
- Offer chance to view deceased's body; explain condition

EMSC Emergency Medical Services for Children

Death Notification

"In Plain Language"

- Identify yourself
- Try to get survivor seated in privacy of home
- Be sure speaking to right person
- Relate message directly and in plain language
- Begin by saying, "I have some very bad news" or a similar statement, gives survivor moment to prepare for the shock
- Avoid vague language like "John was lost" or "passed away"
- Presence of crew has alerted them of a problem
- Inform of death, speaking slowly and carefully giving appropriate details
- Call victim by name, not "the body"
- Calmly answer any questions
- If you don't know answer to a question, don't be afraid to say so
- Offer to help survivor get more information
- There are few consoling words survivors find helpful, but it is appropriate to say, "I am sorry for your loss"

EMSC Emergency Medical Services for Children

not always bad news

NWC EMSS QI

ePCR's reviewed for 12 pediatric arrests

- Document ECG & EtCO2 every 2 min
- HR 60-54, RR 6 agonal, O2 sat 54%, no BP; CPR not started until asystole
  - Begin CPR w/ bradycardia & hypoperfusion despite O2, don't wait for asystole
- P 28, R 2 agonal, no IO, no epi
  - CPR, IO & epinephrine more important than 2 unsuccessful ETI attempts
- IVF bolus (20 mL/kg) can repeat x 2

NWC EMSS QI

- IO not attempted on 4 kg pt b/c PM thought pt too small for IO
  - EZ-IO pink 15 mm needle FDA approved for weight 3-39 kg
- IO & epi more important than failed ETI (another call)
- Hit by car, alert initially, no VS taken, 17 min after EMS pt contact - arrested
  - Get VS on seriously ill/injured child, may help predict impending arrest, VS are higher priority than traction splint which was applied
- Good work checked bG, found hypoglycemia

NWC EMSS QI

CONGRATULATIONS to the following crews who worked peds pts on-scene and obtained ROSC!

AHFD (KLTSD, IO, epi x 3 [AS-SR])
PM's Kazimierz Krzeczkowski, Steven Landt, Albert Zloza; EMT Daniel Bennett

SFD (NPA, BVM, DFx2, RQP, IO, epi x2, amiodarone [VF-ST])
PM's Nicholas Alvardo, Andrew Neuberger, Travis McKelvie; EMT's Frank Chambers, William Gaydo; FR's Fabio Puccini, John Steele