

Review of latest NRP Guidelines

Mary-Alice Johnson, MD
Alaska Neonatology Associates

Neonatal Resuscitation Program

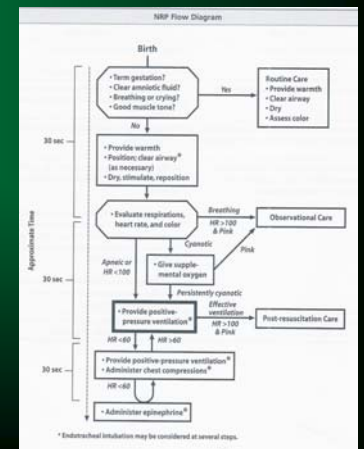
- Standardized instruction in neonatal resuscitation
 - Courses, textbooks, instructors, certification
 - 1.9 million participants over 15 years



Countries in Which NRP Has Been Taught:

Albania	Ecuador	Jamaica	Nicaragua	South Africa
Argentina	El Salvador	Japan	Oman	South Korea
Armenia	Egypt	Jordan	Pakistan	Sudan
Australia	Georgia	Kenya	Panama	Syria
Azerbaijan	Ghana	Korea	Papua New Guinea	Taiwan
Bahamas	Great Britain	Kosovo	Paraguay	Tanzania
Bahrain	Greece	Laos	Peru	Thailand
Bolivia	Guam	Latvia	Philippines	Turkey
Bosnia	Guatemala	Lebanon	Poland	Uganda
Brazil	Honduras	Lithuania	Portugal	United Arab Em.
Brit Virgin Isles	Hong Kong	Malaysia	Puerto Rico	Virgin Islands
Canada	Hungary	Malta	Qatar	Romania
Chile	India	Mexico	Russian Fed.	Saint Lucia
China	Indonesia	Micronesia	Saudi Arabia	Scotland
Columbia	Iran	Moldova	Samoa	
Costa Rica	Iraq	Mongolia	Nepal	
Cuba	Ireland	Israel	New Zealand	
Czechoslovakia	Italy			
Dominican Rep.				

NRP Flow Diagram



Evidence for Evaluation Process for 5th Edition


- Spring, 2003 – Definition of Issues
- Fall, 2003 – Development of worksheets
- Dec. 2003 – ILCOR debate (US)
- May, 2004 – NRPSC debate
- Sept. 2004 – ILCOR debate (Europe)
- Feb. 2005 – Evidence Evaluation Conference
- March-Dec. 2005 – Development of programs
- Spring, 2006 – Release of NRP



Topics addressed for 2006 Guidelines


- Use of O₂ during neonatal resuscitation
- Meconium
- Bag-and-mask ventilation
- Devices for assisting ventilation
- Effectiveness of assisted ventilation
- Laryngeal mask airway
- Use of CO₂ detector
- Epinephrine
- Naloxone
- Temperature control
- Therapeutic hypothermia
- Hyperthermia
- Withholding or withdrawing resuscitation
- Discontinuing resuscitation efforts





Francoise Chaussier

- ✓ Professor of Obstetrics
French Academy of Science
- Gave oxygen to neonate in 1780
- Described mouth-to-mouth resuscitation of infants
- Described an intra-laryngeal tube for use in infants
- Described a means of providing ventilatory support for infants



Supplemental Oxygen

NRP 1996 Guidelines:

- ✓ “During resuscitation and when a baby is cyanotic, it is important to deliver as close to 100% oxygen as possible, without allowing it to mix with room air.”

NRP 2000 Guidelines:

- ✓ “100% oxygen is recommended for assisted ventilation; however, if supplemental oxygen is unavailable, positive pressure ventilation should be initiated with room air.”

Supplemental Oxygen

- ✓ Question:
 - Is room air as effective as 100% oxygen for resuscitation of most infants at birth?
 - Should the guidelines be different for term and preterm infants?

Supplemental Oxygen

- ✓ Concerns:
 - Potential adverse effects of 100% on
 - Breathing physiology
 - Prolong time until initial ventilation
 - Cerebral circulation
 - Decrease cerebral blood flow
 - Tissue damage from oxygen free radicals
 - Antioxidant systems develop in 3rd trimester
 - Oxidize enzymes
 - Inhibit protein and DNA synthesis
 - Decrease surfactant production
 - Cause lipid peroxidation
 - Lung injury sequence secondary to hyperoxia
 - Retinopathy of prematurity

Supplemental Oxygen

- ✓ Concerns:
 - Potential adverse effects of not using 100% resulting in lower oxygen concentrations (especially in preemies)
 - Potentiate PPHN
 - Contribute to hypoxic brain injury
 - Potentially lead to higher mortality rate
 - Be more likely to keep ductus arteriosus open

Supplemental Oxygen

- ✓ Consensus on Science
 - Only published articles reporting of primary data
 - Conflicting results in animal studies
 - Blood pressure
 - Cerebral blood flow
 - Oxygen free radical damage (*same biochemical markers shown to persist in infants for 28 days after resuscitation w/ 100% oxygen*)

Solas, *Pediatr Crit Care Med.* 2001
Solas, *Pediatr Res.* 2004
Solas, *Biol Neonate.* 2004
Huang, *J Neurochem.* 1995
Kutzsche, *Pediatr Res.* 2001

Supplemental Oxygen

✓ Consensus on science

- Human studies (5 total)
 - Lundstrum, 1995, *Arch Dis Child Fetal Neonatal Ed.*
 - Premies <33weeks exposed to 80% oxygen had lower cerebral blood flow compared to those stabilized with 21%
 - Meta-analysis of 4 studies
 - Reduction in mortality and no evidence of harm in infants resuscitated with air compared with 100% oxygen

Tan, *Cochrane Database Syst Rev*, 2004
Davis, *Lancet*, 2004

Supplemental Oxygen

Consensus on Science
Human Studies, The Limitations

- ✓ Patients enrolled from 3 biggest studies recruited in developing countries
 - Different antenatal/perinatal care
 - Different resuscitation equipment
 - Different perinatal mortality rates
- ✓ Inadequate randomization and blinding
- ✓ Methodology concerns
- ✓ Scant long-term follow up data
 - Cerebral palsy or mental retardation
- ✓ No studies reporting incidences of BPD, ROP, IVH, NEC, PVL, PDA, PPHN
- ✓ No sufficient trials to examine <1000g, congenital pulmonary or cyanotic heart disease or those w/out discernible signs of life at birth
- ✓ No evidence that room air *reduces* neurologic injury in infants needing resuscitation
- ✓ Sickest babies (free radical generators), infants w/ meconium aspiration, perinatal infection and "apparent stillbirths" have been excluded from many of the human studies

Supplemental Oxygen

✓ Consensus on Science:

Insufficient evidence to specify the concentration of oxygen to be used at initiation of resuscitation

Supplemental Oxygen


✓ Treatment Recommendations:

- Term infants
 - 100% when cyanotic or when PPV required during resuscitation
 - Resuscitation w/ less than 100% may be just as successful
 - If start w/ less than 100%, increase to 100% if no appreciable improvement w/ in 90 seconds
 - If oxygen unavailable, use room air to deliver PPV

Supplemental Oxygen

✓ Treatment Recommendations:

- Preterm infants (<32weeks)
 - Use oxygen blender and pulse oximetry
 - Begin PPV w/ oxygen concentration somewhere between 21-100% (no studies to justify starting at any particular concentration)
 - Adjust oxygen to achieve oxyhemoglobin concentration that gradually increases towards 90%
 - Decrease oxygen concentration as saturation rises over 95%
 - If HR does not respond by increasing rapidly to >100bpm, correct any ventilation problem and use 100%
- There is no convincing evidence that a brief period of 100% oxygen during resuscitation will be detrimental to preterm infant



Supplemental Oxygen

✓ Consensus on science

Continuous oximetry studies show healthy term newborns may take >10 minutes to achieve pre-ductal oxygen saturation >95% and nearly 1 hour to achieve this post-ductally

Harris, *J Pediatrics*, 1986
Reddy, *Clin Pediatr (Phila)*, 1999
Toth, *Arch Gynecol Obstet*, 2002

Ventilatory Strategies



“Ventilation of the lungs is the single most important and most effective step in cardiopulmonary resuscitation of the compromised newly born baby.”

Neonatal Resuscitation Textbook, 4th Edition

Dr. Benjamin Pugh (1754)

Treatise on Midwifery

“If the child does not breathe immediately upon Delivery, which sometimes it will not, especially when it has taken Air in the womb; wipe its Mouth, and press your Mouth to the Child’s, at the same time pinching the Nose with your Thumb and Finger, to prevent the Air escaping; inflate the lungs; rubbing it before the Fire; by which Method I have saved many.”



Ventilation Strategies

Question

Inflating pressures and times for initial assisted breaths?

Mechanical inflation devices (T-piece)?

CPAP during DR resuscitation (term, preterm)?

Ventilatory Strategies

Initial Assisted Breaths

Consensus on Science

- Primary measure of adequate ventilation: prompt improvement of HR
- Purpose of initial inflation (spontaneous or assisted): to establish FRC
 - Optimum pressure, inflation time and flow have not been determined.
 - Case series reporting of pressures required to initiate ventilation in term neonates vary widely (18-60cm H2O)
 - Average initial peak pressures 30-40cm H2O
 - Case series in preterm infants show most can be ventilated with initial inflation pressures of 20-25cm H2O
- Ventilation rates 30-60 commonly used, efficacy of various rates has not been investigated.

Ventilatory Strategies

Initial Assisted Breaths

Treatment recommendations:

- Establishing effective ventilation is primary objective
 - Prompt improvement of heart rate is primary measure
 - Chest wall movement and breath sounds secondary measures
- Term infant
 - Initial inflation pressure of 20cm H2O may be effective, but \geq 30 to 40 cm H2O may be necessary for some infants
- Premature infant
 - Initial inflation pressure of 20-25 cm H2O (higher if needed)

Ventilatory Strategies

Mechanical Devices for Ventilation

Consensus on Science

- Effective ventilation can be achieved with:
 - Flow-inflating bag
 - Self-inflating bag
 - T-piece resuscitator

Allwood, *Arch Dis Child Fetal Neonatal Ed.* 2003
Hoskyns, *Arch Dis Child.* 1987
Cole, *Anesthesiology.* 1979

- Target inflation pressures and long I-times achieved more consistently w/ T-piece devices

Finer, *Resuscitation.* 2001

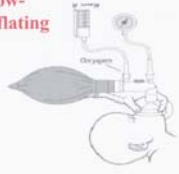
Ventilatory Strategies

Positive Pressure Ventilation Devices for Neonatal Resuscitation

Self-Inflating



Flow-Inflating



T-Piece Resuscitator



Ventilatory Strategies

✓CPAP in the DR

Insufficient data to support or refute routine use during or immediately after resuscitation in DR



Ventilatory Strategies

✓CO₂ detectors

- An indicator of tracheal tube placement based on exhaled carbon dioxide



Ventilatory Strategies

✓Question

Can CO₂ detector be recommended as a device to help confirm ETT placement during resuscitation?

Ventilatory Strategies

CO₂ detector

✓Consensus on Science:

- Exhaled CO₂ detection reliable indicator of ETT placement in infants
- Identifies esophageal intubation faster than clinical assessment

Aziz, *J Perinatol*, 1999
Bhende, *Pediatrics*, 1995
Repetto, *J Perinatol*, 2001
Roberts, *Pediatr Pulmonol*, 1995

Ventilatory Strategies

CO₂ detectors

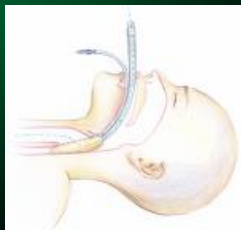
✓Treatment recommendations:

- Exhaled CO₂ detection is useful to confirm tracheal tube placement.

Ventilatory Strategies

✓ Laryngeal Mask Airway (LMA)

- Mask that fits over the laryngeal inlet to assist in ventilating



Ventilatory Strategies

Laryngeal Mask Airway

✓ Consensus on Science:

- Effective for ventilating newborn term infants in a time frame consistent with current resuscitation guidelines
- Limited data on preterm newborns
- No evidence comparing LMA with BVM during resuscitation

Esmail, *Egypt J Anaesth*, 2002
Gandini, *Anesth Analg*, 1999
Paterson, *Anesthesiology*, 1994

Ventilatory Strategies

Laryngeal Mask Airway

✓ Treatment recommendations

- LMA may enable effective ventilation during neonatal resuscitation if BVM is unsuccessful and ETT intubation unsuccessful or not feasible
- Insufficient evidence to recommend in:
 - Meconium-stained fluid
 - When chest compressions required
 - Delivery of drugs into trachea

Meconium



- ✓ Aspiration of meconium before delivery, during birth, or during resuscitation can cause severe aspiration pneumonia.
- ✓ Intrapartum suctioning
 - Obstetrical technique to try to decrease aspiration
 - Suction meconium from trachea after delivery of head, before delivery of body

Meconium

✓ Question

Should intrapartum suctioning be recommended?

Should tracheal suctioning immediately after birth be recommended?

Meconium

Intrapartum suctioning

✓ Consensus on Science:


- Large recent multi-center randomized trial found intrapartum suctioning does not reduce incidence of MAS.

Vain, *Lancet*, 2004

✓ Treatment recommendation:

- Routine intrapartum oropharyngeal and nasopharyngeal suctioning for meconium-stained amniotic fluid no longer recommended.

Meconium




Tracheal suctioning

- ✓ Consensus on Science:
 - Randomized, controlled trial: tracheal intubation and suctioning of meconium-stained but *vigorous* infants offers no benefit.

Wiswell, *Pediatrics*, 2000


- ✓ Treatment recommendation:
 - Meconium-stained, depressed infants should receive tracheal suctioning after birth and before stimulation
 - Tracheal suctioning is not necessary for vigorous infants.

Medications - recommendations



- ✓ Epinephrine
 - IV route is preferred
 - Dose 0.01-0.03mg/kg (0.1-0.3ml/kg of 1:10,000)
 - ETT route if necessary
 - Dose 0.03-0.1mg/kg (0.3-1.0ml/kg of 1:10,000)
 - Smaller doses will likely be ineffective
 - Safety and efficacy have not been evaluated

Medications - recommendations



- ✓ Naloxone
 - Studies shows may interfere with critical functions of endogenous opioids and exacerbate long-term neurohistologic injury of cerebral white matter in asphyxiated animals

Laudenbach, *J Clin Invest* 2001
de-Castro, *Braz J Med Biol Res.* 1993

- NOT recommended as part of initial resuscitation in DR
- Indications for use (all must be present):
 - Continued respiratory depression after PPV has restored HR, tone, color
 - History of maternal narcotic w/in past 4 hours
- IV route preferred

Withholding or Withdrawing Resuscitation


- ✓ Regional differences in morbidity/mortality
- ✓ Opinions among neonatal providers vary
- ✓ Consistent and coordinated approach to individual cases by:
 - Obstetrics
 - Neonatal team
 - Parents
- ✓ Not starting resuscitation and discontinuation of life-sustaining measures are ethically equivalent

Withholding or Withdrawing Resuscitation


- ✓ Guidelines (regional outcomes and societal principles):
 - Resuscitation not indicated (early death and unacceptably high morbidity)
 - Extreme prematurity (<23wks or BW <400g)
 - Anencephaly
 - Confirmed trisomy 13 or 18
 - Resuscitation nearly always indicated with high rate of survival and acceptable morbidity
 - ≥25wks, unless otherwise compromised
 - Most congenital malformations
 - Uncertain prognosis (borderline survival and high rate of morbidity), parents views should be supported




Discontinuing Resuscitative Efforts


- ✓ If no signs of life (no heart beat and no respiratory effort) after 10 minutes continuous and adequate resuscitative efforts, acceptable to discontinue.



Temperature Control



- ✓ Polyethylene bags to maintain temp in VLBW 
- ✓ Selective/Systemic hypothermia for asphyxia – Insufficient data 
- ✓ Goal is normothermia



NRP guidelines, 2006

www.aap.org/nrp

Thank you

