
Gilbert I. Martin, M.D.
Director Emeritus NICU
Citrus Valley Medical Center
West Covina, California
Clinical Professor of Pediatrics
Loma Linda Medical Center
Disclosure – Dr. Martin

- Neither I nor any member of my immediate family has a financial relationship or interest with any proprietary entity producing health care goods or services related to the content of this CME activity.

- I do not intend to discuss an unapproved or investigative use of commercial products or devices.
Delivery Room Resuscitation

The somewhat primitive bridge between Perinatal Obstetrics & Neonatal Intensive Care
The Depressed Newborn

**Primary Apnea Characteristics**

- HR > 100
- Apgars 4-7
- pH > 7.0
- Reflexes intact (Head paradoxical inflation reflex)
- Responds to stimulation, blow-by oxygen, bag-mask ventilation
The Depressed Newborn

◆ Secondary Apnea Characteristics

- HR < 100
- Apgar 0-3
- pH < 7.0 (frequently)
- Reflexes absent (no Head reflex, poor response to BM ventilation)
- Must give adequate tidal volume to achieve response (often requires early intubation)

Milner, 1984
“Pearls” of Neonatal Resuscitation

- Only 1-2 babies in 1,000 need chest compression and/or drugs.
- Babies who need chest compression and/or drugs are either very acidotic or are not being ventilated appropriately.
- Chest compressions open up the coronary arteries which allow oxygenated blood to the myocardium.
- IV epinephrine is more effective than ET epinephrine (prepare the UVC tray before delivery).
- The administration of Narcan as the first act of a resuscitation is an indication that the team is not trained.
The 6th Edition

1. New algorithm with less emphasis on oxygen.
2. Revised textbook – new cases, new approach to mega code.
3. New instructional materials (CD-ROM, DVD)
4. New paradigm – simulation education
The 7th Edition

1. New algorithm
2. Extensive evaluation by International Liaison Committee on Resuscitation (ILCOR)
3. Population, Intervention, Control, Outcome (PICO)
4. Scientific Evidence and Evaluation Review System (SEERS)
5. New instructional materials (CD-ROM, DVD)
What is ILCOR?

- International Liaison Committee on Resuscitation
- 7 Task Forces: ACS, ALS, BLS, First Aid, NRP, PEDS, EIT
- Sponsored by American Heart Association
- 26 countries represented
- 8 US neonatal members (Chair: Dr. Jeffrey Perlman, Weill-Cornell)
New ILCOR Statement

The recommendations of the CoSTR document were published on October 15, 2015.

The recommendations of the ILCOR Task Force are based on the best available science as well as expert opinion and may not be accepted or used by any national Resuscitation Council (i.e. NRP).
Achieving Consensus on Resuscitation Science

- Since 2000, the AAP with the American Heart Association, participates with the International Liaison Committee on Resuscitation (ILCOR) for a complete review of resuscitation science every 5 years
- 32 new questions being reviewed for 2015
Guidelines for Neonatal Resuscitation

- Guidelines published online October 15, 2015
- Printed Guidelines supplement published in Circulation, Resuscitation and Pediatrics
- Download at: www.heart.org/cpr or pediatrics.aappublications.org/content/early/recent
NRP 2016 Revision: ILCOR Process

● **PICO question:**

In a certain population (P), does an intervention (I) versus a control (C), change the outcome (O)?

● 32 PICO questions reviewed in NRP
NRP 2016 Revision: ILCOR Process

- Evidence evaluation done by international teams assigned topics; determine Consensus on Science
- Create worksheets on each PICO question (on line) - all literature: human, animal, mechanical model
- Question type: Diagnosis, intervention, prognosis
NRP 2016 Revision: Process

- ILCOR creates Consensus on Science and Treatment Recommendations (CoSTR): publication October 2015
- NRPSC reviews CoSTR and decides how evidence should be implemented in new textbook for US only
- Revision of NRP textbook began 2014; publication May 2016
Evidence-Based Process

- Problem or intervention is defined
- A PICO question is created
- Evidence is sought using numerous search engines i.e. Pubmed, Embase, ECC library etc
- Evidence includes both human, animal and mechanical model data (distinguishes this process from Cochrane)
Evidence-Based Process

- 5 levels of evidence; 3 categories (intervention, diagnosis, prognosis)
- Evidence is evaluated for quality and then placed in grids either supporting or opposing the question
- The data are summarized and a scientific statement with a class of recommendation is made
Executive Summary of ILCOR (International Liaison Committee on Resuscitation)

Changes 2015-2016

- Umbilical cord management
- How best to assess heart rate in the DR
- What temperature range should the term non-asphyxiated newborn be maintained?
- Does intubation and suction benefit the non-vigorous meconium stained neonate?
Executive Summary of ILCOR (International Liaison Committee on Resuscitation)
Changes 2015 - 2016

- How should oxygen be used for premature neonates in the delivery room?
- What level of oxygen should be given to neonates receiving cardiac compression?
- How often do we need to train providers to do neonatal CPR?
Umbilical Cord Management
Delayed Cord Clamping

- Question type: Intervention
- In preterm infants, including those who receive resuscitation (P), does delayed cord clamping (>30 seconds) (I), compared with immediate cord clamping (C), change survival, long term outcome, IVH, NEC, temperature on admission, hyperbilirubinemia (O)
## Delayed Cord Clamping: ILCOR 2015 - 2016

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Quality</th>
<th>Studies</th>
<th>Patients</th>
<th>Benefit/Harm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>Mod</td>
<td>11 RCTs</td>
<td>591</td>
<td>No</td>
</tr>
<tr>
<td>Severe IVH</td>
<td>Mod</td>
<td>5 RCTs</td>
<td>265</td>
<td>No</td>
</tr>
<tr>
<td>PVH/IVH</td>
<td>Mod</td>
<td>9 RCTs</td>
<td>499</td>
<td>No</td>
</tr>
<tr>
<td>CV stability: mean BP (birth)</td>
<td>Mod</td>
<td>2 RCTs</td>
<td>97</td>
<td>Yes</td>
</tr>
<tr>
<td>- Mean BP – 4 hr</td>
<td>Mod</td>
<td>3 RCTs</td>
<td>143</td>
<td>Yes</td>
</tr>
<tr>
<td>- Blood volume</td>
<td>Low</td>
<td>2 RCTs</td>
<td>81</td>
<td>Yes</td>
</tr>
<tr>
<td>- Transfusion</td>
<td>Mod</td>
<td>5 RCTs</td>
<td>398</td>
<td>Yes</td>
</tr>
<tr>
<td>NEC</td>
<td>Mod</td>
<td>5 RCTs</td>
<td>241</td>
<td>Yes</td>
</tr>
<tr>
<td>Admit Temp</td>
<td>Mod</td>
<td>4 RCTs</td>
<td>208</td>
<td>No</td>
</tr>
<tr>
<td>↑ Bili</td>
<td>Mod</td>
<td>6 RCTs</td>
<td>280</td>
<td>Harm (↑ bili, no ↑photo)</td>
</tr>
</tbody>
</table>
Umbilical Cord Management
Delayed Cord Clamping

- Delayed cord clamping for longer than 30 seconds is reasonable for both term and preterm infants **NOT** receiving resuscitation after birth.

- There is insufficient evidence to recommend delayed cord clamping on infants who **DO** receive resuscitation after birth.

- When delayed cord clamping cannot be accomplished **MILKING** of the cord is a procedure that is still controversial. In infants <29 weeks it is not recommended at present.
Umbilical Cord Management

Umbilical Cord Milking

Question type: Intervention

In very preterm infants (P), does milking the umbilical cord (I), compared with immediately clamping the umbilical cord (C), change airway pressure (O)?
## Umbilical Cord Management
### Umbilical Cord Milking

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Quality</th>
<th>Studies</th>
<th>Patients</th>
<th>Benefit/Harm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>Mod</td>
<td>4 RCTs</td>
<td>N/A</td>
<td>No</td>
</tr>
<tr>
<td>CNS outcome</td>
<td>No data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CV stability</td>
<td>Mod</td>
<td>3 RCTs</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>- Volume exp</td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>- Initial BP</td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>IVH</td>
<td>High</td>
<td>3 RCTs</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>Severe IVH</td>
<td>High</td>
<td>1 RCT</td>
<td>N/A</td>
<td>No</td>
</tr>
<tr>
<td>Initial Hgb</td>
<td>High</td>
<td>3 RCTs</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>Transfusion</td>
<td>High</td>
<td>3 RCTs</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>Initial temp</td>
<td>High</td>
<td>1 RCT</td>
<td>N/A</td>
<td>No</td>
</tr>
<tr>
<td>Bilirubin/photo</td>
<td>High</td>
<td>3 RCTs</td>
<td>N/A</td>
<td>No</td>
</tr>
</tbody>
</table>
Umbilical Cord Management
Umbilical Cord Milking

- Limited information re: safety of rapid changes in blood volume with milking for preemies <29 weeks, “we suggest against the routine use of cord milking”…Further research warranted since milking may improve initial BP, heme indicies, decrease IVH.
Assessment of Heart Rate

- Clinical assessment of heart rate in the delivery room is unreliable and inaccurate.
- ECG (3-lead) displayed reliable heart rate faster than pulse oximetry.
- Pulse oximetry underestimates heart rate and leads to potentially unnecessary interventions.
Temperature Management in the DR

- In non-asphyxiated babies at birth, does maintenance of normothermia (Core temp $\geq 36.5^\circ\text{C}$ and $\leq 37.5^\circ\text{C}$) from delivery to admission, compared with hypothermia ($< 36^\circ\text{C}$) or hyperthermia ($> 37.5^\circ\text{C}$), change outcome?

- Among preterm neonates who are under radiant warmers in the hospital, does increased room temperature, thermal mattress, or another intervention, compared with plastic wraps alone, change outcome?
Temperature Management in the DR

Question type: Intervention

In non-asphyxiated babies at birth (P), does maintenance of normothermia (Core temp $\geq 36.5^\circ C$ and $\leq 37.5^\circ C$) from delivery to admission (I), compared with hypothermic ($< 36^\circ C$) or hyperthermic ($> 37.5^\circ C$) (C), change survival to hospital discharge, respiratory distress, survival to admission, hypoglycemia, ICH, infection rate (O)?
Temperature Management in the DR: Treatment Recommendations

- The temperature of newly born infants should be maintained between 36.5°C and 37.5° after birth through admission and temperature check. Hyperthermia should be avoided.

(Worksheet comment)

The temperature on admission should be recorded as a predictor of mortality and potential morbidity as well as a quality indicator.
Warming Adjuncts for Premature Newborns in DR: **Recommendations**

Among newly born preterm infants <32 weeks gestation under RW in the DR, we recommend using a combination of interventions (environmental temperature 23-25°C, warm blankets, plastic body and head wrapping without drying, cap, thermal mattress) to reduce hypothermia (<36.0°C) on admission at NICU (strong recommendation, moderate quality of evidence).
Suctioning of the Non-Vigorous Meconium Stained Infant

- Question type: Intervention
- In non-vigorous infants born through MSAF(P), does tracheal intubation for suctioning (I), compared with no intubation (C), reduce MAS or death (O)?
Suctioning of the Non-Vigorous Meconium Stained Infant

- Mortality: no RCT data
- MAS: No RCT data
- 3 low quality studies (n=12389 infants) showing ↑MAS in depressed infants (26%) vs vigorous infants (0.3%)
- 7 observational studies (LQ) showed ↑survival, ↓MAS in intubated infants (depressed and vigorous)
- 10 observational studies (LQ) showed no benefit (survival/MAS) in infants intubated for MAS (depressed and vigorous)
The Non-Vigorous Meconium Stained Infant: 

**Recommendations**

- There is insufficient evidence to support the routine tracheal intubation for suctioning of meconium in non-vigorous infants born through meconium stained amniotic fluid.

- Greater value is placed on harm avoidance (delays in providing PPV) over the unknown benefit of routine intubation and suctioning.

- Tracheal intubation for suctioning should be considered when there is no increase in heart rate and no chest movement with bag and mask ventilation.
Oxygen Concentration for Resuscitating Premature Newborns

- Question type: Intervention

- Among preterm newborns who receive positive pressure ventilation in the delivery room (P), does low initial oxygen (21-30%) (I), compared with high initial high oxygen (50-100%) (C), change improve survival (O)?
## Oxygen Concentration for Resuscitating Premature Newborns

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Quality</th>
<th>Studies</th>
<th>Patients</th>
<th>Benefit/Harm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>Mod</td>
<td>7 RCTs</td>
<td>607</td>
<td>No benefit to high O2</td>
</tr>
<tr>
<td>Mortality with O2 targeting</td>
<td>Mod</td>
<td>5 trials</td>
<td>468</td>
<td>No benefit to high O2</td>
</tr>
<tr>
<td>Mortality</td>
<td>Low</td>
<td>1 cohort</td>
<td>125</td>
<td>No benefit to high O2</td>
</tr>
<tr>
<td>BPD</td>
<td>Low</td>
<td>5 RCTs</td>
<td>502</td>
<td>No benefit to high O2</td>
</tr>
<tr>
<td>ROP</td>
<td>Mod</td>
<td>3 RCTs</td>
<td>359</td>
<td>No benefit to high O2</td>
</tr>
<tr>
<td>IVH</td>
<td>Mod</td>
<td>4 RCTs</td>
<td>400</td>
<td>No benefits to high O2</td>
</tr>
</tbody>
</table>
Oxygen Concentration for Resuscitating Premature Newborns: Treatment Recommendations

- Resuscitation of newborns <35 weeks should be initiated with low oxygen concentration (21-30%) and oxygen concentration should be titrated to achieve preductal saturations similar to healthy term infants after vaginal birth at sea level improved.

- 2010 AHA Guidelines from Class IIb to Class I (Meta-analysis of randomized trials showed no improvement with higher FiO2.)
Values and preferences statement of authors:

In making this recommendation we place value on not exposing preterm newborns to additional oxygen without proven benefit for critical or important outcomes. Our preference for each outcome, therefore, was to describe the risk of high oxygen relative to low oxygen.
Oxygen Concentration for Resuscitating Premature Infants

- The most appropriate choice of a resuscitation device is guided by available resources, local expertise and preferences.
- Self inflating bags cannot deliver CPAP and may not be able to achieve PEEP reliably during PEEP.
Resuscitation Training Frequency

- Question type: Intervention
- For course participants, including trainees and practitioners (P), does frequent training (I) compared with less frequent training (annual or biennial) (C), improve all levels of education or practice and clinical outcomes (O)?
Resuscitation Training Frequency

- 16 studies (10 randomized, 6 non-randomized)
- Very low quality evidence with exception of psychomotor performance (mod)
- 8 studies evaluated impact of frequent training (1 week to 6 months) on psychomotor performance (simulation)
  - 6 studies showed improved psychomotor performance
  - 2 studies neutral
  - No negative effects
  - Low to mod LOE
It is therefore suggested that neonatal resuscitation task training occur more frequently than the current 2-year interval.

Studies show no differences in patient outcomes, but demonstrated advantages in psychomotor performance, knowledge and confidence when done every 6 months.
“…Readers are nevertheless advised that the statements and opinions expressed are provided as guidelines and should not be construed as official policy of the American Academy of Pediatrics or the American Heart Association. The recommendations in this publication and the accompanying materials do not indicate an exclusive course of treatment or serve as standard of care. Variations, taking into account individual circumstances, nature of medical oversight, and local protocols, may be appropriate….”

How will 2016 NRP affect Litigation?

- Training of providers attending deliveries
  - Who attends
  - Can they intubate?
- Cyanosis in the first 5-10 minutes of life
- What was the **REAL HR**? Were EKG leads placed?
- Handling the baby born through MSAF
Current Concepts:
Ethics in the Delivery Room

• What should I do?
• What should I not do?
• Might it be best to do nothing?
• What is the prognosis if we do everything optimally?
DNR in the Delivery Room: Do Laws Apply?

- No law mandating delivery room resuscitation in all circumstances.
- There are state and local laws that may apply to the care in your area.
- Preliminary decisions regarding providing care after delivery may need to be altered.

Do Laws Apply to Neonatal Resuscitation?

In most circumstances it is ethically and legally acceptable to withhold or withdraw resuscitation efforts if the parents and healthcare providers agree that further medical intervention would be futile, would merely prolong dying, or would not offer sufficient benefit to justify the burdens imposed on the baby.

If mother is a minor, she may be considered “emancipated” and can make decisions about her fetus and newborn.

DNR in the Delivery Room: When is it Ethical *Not* to Initiate Resuscitation?

- Confirmed gestational age <23 weeks or a birth weight <400 grams.
- Anencephaly
- Confirmed lethal genetic disorder or malformation
- Available data support and unacceptably high likelihood of death or severe disability.

DNR in the Delivery Room: Decision Making

- The factors under consideration include:
  1. The chance that the therapy will succeed.
  2. The risks involved with treatment and non-treatment.
  3. The degree to which the therapy, if successful, will extend life.
  4. The pain and discomfort associated with the therapy.
  5. The anticipated quality of life for the newborn with and without treatment.

DNR in the Delivery Room: The Grey Area

- Conditions with uncertain prognosis
- Borderline survival
- High rate of morbidity
- High burden to child

Communication essential between family and medical team.

*Do not make finite, unalterable resuscitation decisions before baby is born. Initial resuscitation and stabilization allows additional time for more complete clinical information and better communication.*

DNR in the Delivery Room: Resuscitation against Parental Wishes

If the responsible physician concludes that the parents’ decision is not in the best interest of the child, it is usually appropriate to resuscitate over the parents objections.

Documentation, Documentation, Documentation

DNR in the Delivery Room: History
Born-Alive Infants Protection Act of 2001
Public Law No. 107-207

◆ Does *not* proscribe care for newly born infants at the margins of viability
◆ Infants who are born alive (at any gestation) are entitled to protections of law
◆ Would not affect the applicable standard of care
◆ NRP Committee (2010): “Should not in any way affect the approach that physicians currently follow with respect to the extremely premature infant.”
Discontinuing Resuscitation Efforts

- After 10 minutes of continuous and adequate resuscitative efforts, discontinuation of resuscitation may be justified if there are no signs of life (no heartbeat, no respiratory efforts).
I used to be like this...
Then I met a girl...
She was like this...
Together, we were like this...
I gave her gifts like this...
When she accepted my proposal, I was like this...
I used to talk to her all night like this...
And at the office I used to do this...
When my friends saw my girlfriend, they stared like this...
And I used to react like this...
But on Valentine's Day, she received a red rose from someone else like this...
And she was like this...
And I was like this...
Which later led to this...
and this...
I felt like doing this...
So I started doing this...
NOW look at me...
DAMN GIRLS!
A special thank you to Dr. Jay Goldsmith who provided much of the material.