Making Sense of Numbers in the NICU

Pediatrics Workshop
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CCOM
Objectives

- Introduce the basics of the newborn resuscitation period
- Practice calculations for TPN orders
- Learn how to manage basic ventilator settings
WHY do you care?

- Complex concepts you may be expected to know
- Not taught this in class
- Everyone required to do a pediatric rotation!
WHAT is the Newborn Resuscitation?

- Special skill set used in the period immediately after delivery to assist the newborn transition from intrauterine to extrauterine life
Baby’s 1st Breath
WHERE does the Newborn Resuscitation take place?

- Delivery Room
- Operating Room
WHO is present during the Newborn Resuscitation?

- OB crew
- OB/Neonatal nurse(s)
- Neonatologist/Pediatrician
- Resident(s)
- Medical Student(s) - YOU!
WHAT skills are involved in the Newborn Resuscitation?

- Thermoregulation (37°C)
- Airway Management
- Stimulation
- Cardiovascular Support
- Medications
HOW can YOU prepare?

- Wear gloves and mask
- Be aware of surroundings
- Make sure the appropriate help is in the room
- Make sure suction kit, intubation kits, and resuscitation medications are in the room and readily available
- Make sure oxygen is flowing, bag valve mask working properly and at appropriate pressure
- Make sure blankets are laid out and warmer is set to 37°C
- Make sure timer is reset on warmer
HOW can YOU participate?

- "Catch the Baby!"
- **Start the timer...**
- CONSTANTLY ASSESS THE BABY
- Bulb suction
- Dry with blankets
- Check for pulse
- Listen to lungs
- **Watch the timer...**
- Quick exam
- Put on the cap
- **Record APGAR scores**
- Secure side rails
- Congratulate the parents!
APGAR Scores

- Assessment of newborn viability
  - @ 1 min, 5 min, 10 min

- Pneumonic & Eponym
  - Each letter represents a sign evaluated in the score
  - Developed by Virginia Apgar, MD, leader in anesthesiology
# APGAR Scores

<table>
<thead>
<tr>
<th>SIGN</th>
<th>SCORE 0</th>
<th>SCORE 1</th>
<th>SCORE 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity</td>
<td>Flaccid</td>
<td>Some flexion</td>
<td>Well flexed</td>
</tr>
<tr>
<td>Pulse</td>
<td>Absent</td>
<td>&lt;100 per minute</td>
<td>&gt;100 per minute</td>
</tr>
<tr>
<td>Grimace</td>
<td>No response</td>
<td>Grimace</td>
<td>Cough or sneeze</td>
</tr>
<tr>
<td>Appearance</td>
<td>Pale/Blue</td>
<td>Blue extremities</td>
<td>Completely pink</td>
</tr>
<tr>
<td>Respiration</td>
<td>Absent</td>
<td>Weak</td>
<td>Good cry</td>
</tr>
</tbody>
</table>
Case 1

- Newborn male
- Full term
- NSVD
- Immediate loud cry
- Coughs after bulb suction
- Moves all four extremities
- Face and trunk pink, hands and feet dusky
- HR 120
Case 1

- 9/10
- 1 pt loss for color
- Most NORMAL newborns only ever achieve 9/10
Case 2

- 27 5/7 weeks premature female
- Born to G1P1 26 y/o female
- PPROM, NSVD
- Newborn required vigorous resuscitation
- APGARs: 6 @1min and 7 @ 5 min
- Birth weight: 1 kg
- Transported to NICU, currently stable, intubated, UVC placed
Case 2
Hungry babies are not happy babies!

- 2 arteries, 1 vein

- How are we going to feed her?
Parenteral Nutrition

- Intravenous nutritional support
- Can be started as soon as venous access obtained
Parenteral Nutrition

TERMINOLOGY

- TPN - Total Parenteral Nutrition
  - ALL IV, patient NPO
- PPN - Partial Parenteral Nutrition
  - SOME IV, patient supplementing with PO
WHAT is in TPN?

- **Macronutrients**
  - Carbohydrate (dextrose)
  - Protein (amino acids)
  - Fat (fat emulsion)

- **Micronutrients**
  - Vitamins & Minerals
  - Electrolytes
  - Trace elements

- **Miscellaneous constituents**
  - Heparin protects line integrity
  - Carnitine aids fat metabolism
  - Famotidine protects stomach mucosa
Filling out the TPN Form...

- Identifying information
  - Patient Sticker (be careful with multiples!)
  - Date
  - Day # TPN
  - Current GA (weeks days/7)
Daily Information

- Dosing weight (kg) (A)
- Line Access
  - Central- UVC, PICC, CVL
  - Peripheral- PIV
  - Heparin?
- Labs
  - BMP every 1-2 days
  - LFTs and TG at least every week
Total Daily Fluid

TPN
- Dextrose
- Amino Acids
- Electrolytes
- Vitamins
- Trace Elements

FAT Emulsion
- Fat

OTHER
- Medications
- Infusions
- Oral Feeds
Calculations

- Total Fluid (TF) (B)
  - 150ml/kg/day

  \[
  \text{Total Daily Fluid Intake (B) ml/kg/day} \times (A) \text{ kg} = (C) \text{ ml/day} \\
  150 \text{ ml/kg/day} \times 1 \text{ kg} = 150 \text{ ml/day}
  \]

- No Non-TPN Infusions or Enteral Rx (D)

  \[
  \text{Parenteral Feeding Allowance (C) ml} - (D) \text{ ml} = (E) \text{ ml} \\
  150 \text{ ml} - 0 \text{ ml} = 150 \text{ ml}
  \]
Calculation of Fat Emulsion

- Separate bag!
- Start with 1 gm/kg
- Increase by 0.5 gm/kg/day, max 3 gm/kg
- 1 gm fat dispensed in 5 ml

\[
\text{Fat Emulsion} \quad \# \text{gm/kg} \times (A) \text{ kg} = (F) \text{ gm} \times 5 \text{ ml/gm} = (G) \text{ ml}
\]

\[
1 \text{ gm/kg} \times 1 \text{ kg} = 1 \text{ gm} \times 5 \text{ ml/gm} = 5 \text{ ml}
\]
Total Daily Fluid

TPN
- Dextrose
- Amino Acids
- Electrolytes
- Vitamins
- Trace Elements

Separate bag!
- FAT Emulsion
- Fat
- OTHER
- Medications
- Insulin
- Oral Feeds
Calculations

- TPN Volume over 24 hours (H)
  - Parenteral feeding allowance – intralipid volume

  TPN Volume/24 hours (E) ml - (G) ml = (H) ml
  150 ml - 5 ml = 145 ml
Calculations

- **Fat Infusion Rate**
  - (G) / 24 hours
  - 5 ml / 24 hours = 0.2 ml/hr

- **TPN Infusion Rate**
  - (H) / 24 hours
  - 145 ml / 24 hours = 6 ml/hr
Total Daily Fluid

TPN
Dextrose
Amino Acids
Electrolytes
Vitamins
Trace Elements

Separate bag!
FAT Emulsion
Fat

OTHER
Medications
Muscles
Oral Feeds
Calculations

- Dextrose Concentration \((I)\)
- Glucose Infusion Rate \((R)\)
  - Initiate at 6-8 mg/kg/min
  - Increase by 1 mg/kg/day, max 13 mg/kg/min

\[
(R) = \frac{(I)}{100} \times \frac{(H)}{1.44} \times \frac{(A)}{}
\]

Solve for \((I)\)

7 mg/kg/day = \(\frac{(I)}{100} \times 145 \text{ ml} \times \frac{1.44}{1 \text{ kg}}\)

\((I) = 7\%\)
Your New Best Friends!
Amino Acids (J)

- Initiate at 3 gm/kg

\[
3 \text{ gm/kg} \times (A) \text{ kg} = (J) \text{ gm}
\]
\[
3 \text{ gm/kg} \times 1 \text{ kg} = 3 \text{ gm}
\]
Calculations

- **Electrolytes**
  - None included in TPN until DOL #3
  - Allow for stabilization
  - Adjust day to day

- **Multivitamin**
  - Check Daily

- **Trace Elements**
  - Check Daily
Calculations

- Enteral Calories (P)
- Parenteral (TPN) Calories (Q)
  - Fat: (F) x 10 = (K)
  - Dextrose: (I) / 100 x (H) x 3.4 = (L)
  - Protein: (J) x 4 = (M)

  - TPN Kcal/day: (K) + (L) + (M) = (N)
  - TPN Kcal/kg/day: (N) / (A) = (Q)

- Total Calories
  - Total Kcal/kg/day: (Q) + (P)
How will your TPN order change?

- Keep track of days and age
- Update weight daily
- Know line access
- Know oral volumes or infusions
- Increase fats and dextrose
- Adjust fats, dextrose, amino acids, electrolytes*, and additives as needed based on labs
Case 3

- 29 0/7 weeks premature male
- Meconium aspiration, absent cry, required intubation
- Blood Gas:
  - pH 7.21
  - PaCO2 50
  - PaO2 56
  - HCO3 20
  - Base Deficit -4

What Acid-Base imbalance does he have?
Case 3

- Respiratory acidosis

- How can we help reduce his acidosis?
Affected by Ventilation or Oxygenation?

- pH
- PaCO2
- PaO2
- HCO3
- Base Deficit
Affected by Ventilation or Oxygenation?

- pH: Ventilation
- PaCO2: Ventilation
- PaO2: Oxygenation
- HCO3: Neither
- Base Deficit: Neither
Ventilator Settings

- Same indications as adults
- Modes
  - **AC** - Assist Control
  - **SIMV** - Synchronous Intermittent Mandatory Ventilation
  - **PS** - Pressure Support
  - **CPAP** - Continuous Positive Airway Pressure
  - **BiPAP** - Bilevel Positive Airway Pressure
Ventilator Settings

- Rate
- Tidal Volume
- FiO2
- PEEP
Remember...

- pH: Ventilation
- PaCO2: Ventilation
- PaO2: Oxygenation
- HCO3: Neither
- Base Deficit: Neither
Affects Ventilation or Oxygenation?

- Rate
- Tidal Volume
- FiO2
- PEEP
Affects Ventilation or Oxygenation?

- Rate: Ventilation
- Tidal Volume: Ventilation
- FiO2: Oxygenation
- PEEP: Oxygenation
### Ventilation

<table>
<thead>
<tr>
<th>Rate</th>
<th>Tidal Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>To ↑ pH</td>
<td>↑</td>
</tr>
<tr>
<td>To ↓ pH</td>
<td>↓</td>
</tr>
<tr>
<td>To ↑ PaCO2</td>
<td>↓</td>
</tr>
<tr>
<td>To ↓ PaCO2</td>
<td>↑</td>
</tr>
</tbody>
</table>

### Oxygenation

<table>
<thead>
<tr>
<th>Rate</th>
<th>FiO2</th>
<th>PEEP</th>
</tr>
</thead>
<tbody>
<tr>
<td>To ↑ PaO2</td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td>To ↓ PaO2</td>
<td>↓</td>
<td>↓</td>
</tr>
</tbody>
</table>
What's abnormal?  | What's the problem? | What can you change?
---|---|---
pH or PaCO2 | Ventilation | Rate or Tidal Volume
PaO2 | Oxygenation | FiO2 or PEEP
Be an active participant in the newborn resuscitation!
TPN looks hard, but doesn’t have to be.
Know why your blood gasses are abnormal, and fix them!
Feel smarter than a 5th grader... and some interns.
Have Fun on Peds & Share the wealth!
References

- Emedicine: Neonatal Resuscitation
  - [Link](http://emedicine.medscape.com/article/977002-overview#a1)

- Neonatology: Newborn and Acid Base Balance.
  - [Link](http://www.kairos2.com/14_Acid%20base%20balance.pdf)
Contact Information

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