Modification of Critical Congenital Heart Disease Screening Practices at Moderate Altitude

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CCHD Newborn Screening at Altitude

• Challenges of Pulse Oximetry Screening at Altitude
• Delayed Transition in infants born at Altitude
• Expected 4-5% infants to fail CCHD newborn screening
• Implemented sea-level protocol at moderate altitude of 5557 feet (1694 m)

• Proportion of infants failing: 1.1%
  – First 500 infants: 8 of 500 (1.6%) failed
    • with 18 of 500 (3.6%) either failing or having incomplete screening.
  – Last 503 infants: 3 of 503 infants (0.6%) failed
    • 9 of 503 (1.8%) either failed or had incomplete screening.
Experience at Highest Altitudes in Colorado

- Vail Valley Medical Center at 8,100 feet elevation
- Participation in a multi-site national study
- Preliminary data showing an over 30% false positive screen rate on well newborns.
- All the positive screens had negative cardiac echocardiograms (no CCHDs detected)
Colorado CCHD Newborn Screening Status

- Recommendations are dependent upon altitude:
  - Proportion failing pulse oximetry screening is greater than sea-level
    - Tolerable (<1%) at hospitals <7000 feet
    - Not tolerable (>30%) >8,000 feet
    - Not enough data in hospitals between 7,000 and 8,000 feet
  - Colorado is moving forward with CCHD newborn screening with staggered recommendations based on altitude
What can we do to decrease the percent of false positives?

Historic Riede NJ BWH

0.15% 0.09% 0.07% 0.01%

OVERALL first 500 second 500

1.10% 1.60% 0.60%

Implementation of CCHD Screening

- University of Colorado Hospital
- Following the feasibility study, CCHD screening was implemented as standard of care (9/2012)
Modifications to the protocol based on Hospital Practices

- Newborns screened at 24 hours during standard ‘24-hour makeover’
- Standard protocol and cutoffs used (Kemper 2012)
- Newborns who failed the screen
  - Careful observation
  - Ordered echocardiogram
  - Repeated pulse oximetry every 4 hours
    - *They have a passing pulse ox valu*
    - *They have an ECHO performed*
Adjustments to AAP/Kemper protocol

- **Fail:** Pulse Ox ≤ 84 in either preductal or postductal limb
- **Pass:** Pulse Ox ≥ 95 in either limb and a difference between limbs ≤ 3
- **Re-Screen:**
  - 85 ≤ (Pulse Ox for both limbs) < 95
  - Difference between limbs ≥ 4
## Demographics

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<table>
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<tbody>
<tr>
<td>Total Infants</td>
<td>2383</td>
</tr>
<tr>
<td>Male gender</td>
<td>1107 (50.9%)</td>
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<tr>
<td>Gestational Age</td>
<td>39 weeks (IQR 38-40 weeks)</td>
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<td>Birth weight (mean)</td>
<td>3253 grams (std dev 470 grams)</td>
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Screening results

● Using the modified Colorado approach the overall failure rate is \( \frac{2}{2383} = 0.503\% \) Incomplete rate would be: \( \frac{(55+5)}{2383} = 2.52\% \)

● Non-passing values by the end of the 3rd screen
  ● Echos completed: 5 (0.21\% of the study population)
  ● Remaining infants had repeat pulse oximetry

● Implementing AAP/Kemper Protocol: \( \frac{29}{2383} = 1.22\% \)
False positives are improving

Other hospitals, other approaches

- Modifications vary throughout hospitals, implementing under standard of care
  - Later screening (30-36 hours)
  - Oxygen hood to simulate sea level oxygen
- Current mechanisms to compare outcomes are lacking
- Mandate for screening and data collection will lead to ability to compare data and refine algorithms.
CCHD Screening at Altitude

• Modified CCHD algorithm may decrease the false positive CCHD screening results

• Additional modifications to the high altitude algorithm are needed

• Screening at moderate altitude is possible, however additional modifications may be needed.
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