Improved routine pain assessment and management using a validated assessment tool in the neonatal ICU at Chris Hani Baragwanath Academic Hospital

Dr. Nisha Naka
Prof Haroon Saloojee
Dr Firdose Nakwa
Background

• Neonatal pain is poorly recognized and managed
• Presence of pain in neonates has been well established → behavioral, physiological, metabolic and hormonal responses to nociceptive stimuli
• Subsequent short and long term adverse events
• American Academy of Pediatrics - Implementation of the fifth vital sign

Batton et al. Paediatrics. 2006
Anand et al. Pain 2013
Hall et al. Clinics in perinatology
Special challenges in neonates

- Neonates are unable to express their discomfort → need behavioral and physiological assessment.
- Limiting factors: Inter-reliability and subjectivity of human assessments.
- Drug safety concerns → lack of pharmacokinetic and pharmacodynamics data.
- Data is subjective and not quantitative → analgesic therapy is variable and inconsistent.
Too little or too much?

**Failure to treat pain can cause**
- altered pain processing
- attention deficit disorder
- impaired visual-perceptual ability or visual-motor integration and poor executive functions

**Overuse of analgesia and sedatives**
- prolongs need for mechanical ventilation
- delays feeding
- impaired brain growth, poor socialization skills
- impaired performance in short-term memory tasks
Why the Neonatal ICU?

• Vulnerable population
• Neonates experience 10-15 painful procedures per day
• Enhanced survival of ELBW neonates - greater exposure to pain and stress
Pre-intervention
### Pre-interventional analysis

**Patient profile in CHBAH NICU (n=14), mean (range)**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average age (days)</td>
<td>64 (3-297)</td>
</tr>
<tr>
<td>Average duration of stay in NICU (days)</td>
<td>16 (0-85)</td>
</tr>
<tr>
<td>Gestational Age (n)</td>
<td></td>
</tr>
<tr>
<td>27-31 weeks</td>
<td>5</td>
</tr>
<tr>
<td>31-37 weeks</td>
<td>8</td>
</tr>
<tr>
<td>&gt; 37 weeks</td>
<td>1</td>
</tr>
</tbody>
</table>
Drugs used for pain and sedation

- Dormicum 41%
- Morphine 18%
- Fentanyl 21%
- Ketamine 7%
- Rocuronium 7%
- Nil 3%
- Panado 3%
Frequency of prescription

![Chart showing frequency of prescription for different agents: Dormicum, Morphine, and Fentanyl.](chart.png)
Duration of drug usage

Duration of drug usage - Dormicum

Duration of drug usage - Fentanyl

Duration of drug usage - Morphine
Summary of findings (pre-intervention)

• No standardized pain and sedation assessment tool
• No specified protocol followed for management of neonatal pain and sedation
• Idiosyncratic use of analgesics and sedatives
• Stat doses given and no documentation of indication
• Midazolam most widely used drug despite increasing evidence of its risks in preterm infants
• Acute and procedural pain inadequately managed
• Overuse of sedative
The Intervention
The need for a protocol

• Pain management is an integral part of standard effective management in the NICU and practically every NICU should have a protocol.

• Responsibility of every health care worker caring for the newborn.
Selection of a validated pain and assessment tool

- Development of criteria for selection of appropriate tool to our setting
- Reviewing various assessment tools
- Algorithm to facilitate utilization

Neonatal Pain, Agitation and Sedation Scale (N-PASS)
<table>
<thead>
<tr>
<th>Assessment Criteria</th>
<th>Sedation</th>
<th>Normal</th>
<th>Pain / Agitation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-2</td>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>Crying Irritability</td>
<td>No cry with painful stimuli</td>
<td>Moans or cries minimally with painful stimuli</td>
<td>Appropriate crying</td>
</tr>
<tr>
<td>Behavior State</td>
<td>No arousal to any stimuli</td>
<td>Arouses minimally to stimuli</td>
<td>Appropriate for gestational age</td>
</tr>
<tr>
<td></td>
<td>No spontaneous movement</td>
<td>Little spontaneous movement</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facial Expression</td>
<td>Mouth is lax</td>
<td>Minimal expression with stimuli</td>
<td>Relaxed</td>
</tr>
<tr>
<td></td>
<td>No expression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extremities Tone</td>
<td>No grasp reflex</td>
<td>Weak grasp reflex</td>
<td>Relaxed hands and feet</td>
</tr>
<tr>
<td></td>
<td>Flaccid tone</td>
<td>↓ muscle tone</td>
<td>Normal tone</td>
</tr>
<tr>
<td>Vital Signs HR, RR, BP, SaO₂</td>
<td>No variability with stimuli</td>
<td>&lt; 10% variability from baseline with stimuli</td>
<td>Within baseline or normal for gestational age</td>
</tr>
<tr>
<td></td>
<td>Hypoventilation or apnea</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
N-PASS - Assessment of sedation

- Sedation is scored in addition to pain for each behavioral and physiological criteria to assess the infant’s response to stimuli.
- Sedation does not need to be assessed/scored with every pain assessment/score.
- Sedation is scored from 0 → -2 for each behavioral and physiological criteria, then summed and noted as a negative score (0 → -10).
  - A score of 0 is given if the infant’s response to stimuli is normal for their gestational age.
- Desired levels of sedation vary according to the situation.
  - “Deep sedation” → score of -10 to -5 as goal.
  - “Light sedation” → score of -5 to -2 as goal.
- Deep sedation is not recommended unless an infant is receiving ventilatory support, related to the high potential for apnea and hypventilation.
- A negative score without the administration of opioids/sedatives may indicate:
  - The premature infant’s response to prolonged or persistent pain/stress.
  - Neurologic depression, sepsis, or other pathology.

Algorithm for pain and sedation assessment using N-PASS Tool

Pain Assessment
- On admission
- 3 hourly thereafter until discharge

N-PASS Score
- >3
- ≤3

Action:
- Document pain score
- Identify possible source of pain
- Morphine 0.1mg/kg IVI STAT

Reassess after 30 minutes
N-PASS Score
- >3
- ≤3

Action:
- Document pain score
- Identify possible source of pain
- Increase morphine – 0.1mg/kg IVI STAT

Action:
- Document pain score
- Continue care
- Repeat pain score in 3 hours

Reassess after 30 minutes
N-PASS Score
- >3
- ≤3

Action:
- Discuss with consultant
- Consider fentanyl – 1μg/kg IVI STAT
- Document plan of care

Action:
- Document pain score
- Continue care
- Repeat pain score in 3 hours
Pain monitoring
Implementation

- Placement of laminated copies at each bedside
- Group presentations and individual teaching sessions
- Continued reinforcement & recommendations
Revision of the current pain and sedation protocol

- Based on AAP guidelines
- Best evidence practices
- Safety profiles of drugs
- Institution-specific drugs and management practices

Pain and sedation protocol ➔ Neonatal protocol book
## Drug safety profile

<table>
<thead>
<tr>
<th>Drug Name</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| **Morphine** | • Potent pain relief  
• Better ventilator synchrony  
• Sedation  
• Hypnosis  
• Muscle relaxation  
• Inexpensive | • Respiratory depression  
• Arterial hypotension  
• Constipation, nausea  
• Urinary retention  
• Central nervous system depression  
• Tolerance and dependence  
• Long-term outcomes not studied  
• Prolonged ventilator use | |
| **Midazolam** | • Most studied benzodiazepine  
• Quickly metabolized | • Short acting  
• No safety established in premature neonates.  
• Concerns about neurotoxicity  
• New-born animal models – induces brain cell apoptosis | |
| **Fentanyl** | • Fast acting  
• Less hypotension | • Respiratory depression  
• Short half-life  
• Quick tolerance and dependence  
• Chest wall rigidity  
• Inadequately studied | |
| **Paracetamol** | • For mild and moderate procedural pain  
• Opioid sparing effect  
• Renal and hepatic toxicity rare in neonates | • Not for acute pain | |


Step-wise pain management

- **Baseline** - Avoid painful procedures, physical handling
- **Step 1** - Non-pharmacological interventions
  - Breastmilk
  - 25-50% glucose
  - Swaddling (in a sheet)
  - Facilitated tucking (limbs flexed)
- **Step 2** - Local Anaesthetic
  - Lignocaine
- **Step 3** - Analgesia & Sedatives
  - Morphine
  - Fentanyl
  - Paracetamol
  - Ketamine
  - Midazolam

Agents/Measures used (examples)
Post-intervention
What was different?

• Routine 3 hourly pain assessments
• Documentation of pain scores in chart
• No routine analgesia or sedation prescribed
• No PRN or infusions routinely (Infusions can be considered postoperatively)
• No role for dormicum (Midazolam) as a sedative in preterm and rarely in term neonates
### Post Interventional Analysis

**Patient profile in CHBAH NICU (n=15)**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average age (days)</td>
<td>42 (3-298)</td>
</tr>
<tr>
<td>Average duration of stay in NICU (days)</td>
<td>10 (0-32)</td>
</tr>
<tr>
<td>Gestational Age (n)</td>
<td></td>
</tr>
<tr>
<td>27-31 weeks</td>
<td>6</td>
</tr>
<tr>
<td>31-37 weeks</td>
<td>6</td>
</tr>
<tr>
<td>&gt; 37 weeks</td>
<td>3</td>
</tr>
</tbody>
</table>
Utilization of pain assessment and sedation assessment tool over 72 hours

(n=15)

Percentage (%) utilization

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Pain</th>
<th>Sedation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-25%</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>26-50%</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>&gt;50%</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>
Successes

• Implementation of a pain assessment and response strategy in the NICU
• Ease of use and availability of assessment tool at each bedside facilitated compliance
• Individual mentoring sessions → greater impact
• When utilized correctly → guided increased appropriate analgesic use and decrease in inappropriate use
• Increased knowledge of safety profiles → reduced use of midazolam
• Patient care → less routine prescription
• Personal and professional growth
“I was quite happy to see that there’s an awakening to the presence of pain in children. The sedation has been an eye opener for me. I am thrilled to be using the charts to make informed decisions when managing our patients. I hope this lasts far beyond the reaches of this QIP.”

**Paediatric registrar**

- Many were unaware of midazolam safety profile in pre-term neonates
- Easy to use
- Nurses: Unwilling to do assessments 3 hourly – “short staffed”
Limitations and Failures

- Short time period for implementation
- Post interventional analysis done over period of new shift of nursing staff
- High staff turnover
- Poor documentation in bed-letters, no re-assessment
- Management practices unlinked to pain scores → knowledge gaps and algorithm not used
Future Considerations

• Extending the use of the assessment tool to other areas in the neonatal unit.

• An ongoing “pain programme” (at least bimonthly) to allow for sustained practices of effective pain and sedation management and to orient new staff members – led by neonatal consultants.

• Impact of non-pharmacological methods to reduce pain in the NICU. Includes minimizing painful procedures.

• Ongoing revision of management strategies as new evidence becomes available or additional agents become available at the pharmacy.

• Prospective study to determine short and long term outcomes associated with improved pain management.
Let's make a change

We are what we repeatedly do. Excellence, then, is not an act, but a habit.

– Aristotle