1.0 Introduction

This guideline provides NICU clinicians with suggested post-operative pain and sedation management. However, as each infant will respond to both pain and medications differently, clinical judgement, pain scores, gestational age, underlying diagnosis, previous exposure to opioids/sedatives and type of surgical procedure need to be considered in managing post-operative pain and sedation.

Pain is an expected consequence of surgery. Adequate pain control in the post-operative period is essential to minimize the endocrine and metabolic responses and has been shown to significantly improve outcomes such as recovery time, healing and can prevent the development of persistent pain. However, exposure to opioids in the absence of pain may adversely impact the developing brain and neurodevelopmental outcomes.[1, 2] Judicious use of opioids in neonates is of utmost importance and following a pain management algorithm has been shown to be effective in providing adequate pain control while minimizing opioid exposure. [3]

2.0 Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjuvant</td>
<td>A drug that is not primarily analgesic but has independent or additive analgesic properties.</td>
</tr>
<tr>
<td>Analgesic</td>
<td>A medication used for pain relief.</td>
</tr>
<tr>
<td>Anxiolytic</td>
<td>A drug that relieves anxiety.</td>
</tr>
<tr>
<td>Non-opioid</td>
<td>Referred to as non-narcotic. Includes acetaminophen and non-steroidal anti-inflammatory drugs (NSAIDs).</td>
</tr>
<tr>
<td>Opioid</td>
<td>Refers to natural, semi-synthetic and synthetic drugs that relieve pain by binding to opioid receptors in the nervous system e.g. codeine, morphine. Opioid is preferred to the word ‘narcotic’, which has legal connotations.</td>
</tr>
<tr>
<td>Pain</td>
<td>An unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage. It is a complex, multidimensional, and subjective experience.</td>
</tr>
<tr>
<td>Pharmacological strategies</td>
<td>The use of drugs for pain relief.</td>
</tr>
</tbody>
</table>
3.0 Clinical Practice Recommendations

3.1 Pain Assessment: The pain assessment tools currently used at SickKids for the assessment of pain in neonates and infants are the Premature Infant Pain Profile Revised (PIPP-R) and the Face, Legs, Activity, Cry, Consolability (FLACC-R) scales. The FLACC-R scale is to be used for NICU infants once they are 2 months corrected age (48 weeks post menstrual age [PMA]).

The PIPP-R has limited validation in the extremely low birthweight (ELBW) infant, thus factors such as developmental stage are to be considered when assessing post-operative pain in these infants.

PIPP-R scores of 0 to 6 indicate no pain to mild pain; scores of 7 to 11 indicate moderate pain; and scores greater than or equal to 12 indicate severe pain. FLACC-R scores of 0 to 3 indicates no pain; 4 to 6 indicates mild to moderate pain; and scores of 7 to 10 indicates severe pain.[4-6]

In addition to pain assessment scores, all patients receiving opioids or sedatives are to be assessed using the Neonatal Pain, Agitation and Sedation Scale (N-PASS). The N-Pass measures level of sedation either as a side effect of the opioid or to aid in titration of sedative medications if sedation is required. An N-PASS score of 0 indicates no sedation. A score of -1 to -2 indicates light sedation; -3 to -5 indicates moderate sedation; greater than or equal to -6 indicates deep sedation.[7, 8]

3.2 Surgical Procedures: Although infants vary in their individual responses to pain, surgical procedures can be classified as POTENTIALLY causing mild, moderate or severe pain depending on the level and location of tissue injury. Expected severity of pain will be discussed in the post-operative huddle.
### Neonatal Post Operative Pain Guidelines

<table>
<thead>
<tr>
<th>Procedures potentially causing mild pain</th>
<th>Procedures potentially causing moderate pain</th>
<th>Procedures potentially causing severe pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimally invasive procedures (e.g. bronchoscopy, laparoscopic surgeries)</td>
<td>Abdominal drain insertion</td>
<td>Congenital diaphragmatic hernia (CDH) repair</td>
</tr>
<tr>
<td>Ventricular shunt insertion</td>
<td>Chest tube insertion</td>
<td>Esophageal atresia and/or tracheoesophageal repair</td>
</tr>
<tr>
<td>Ommaya reservoir insertion</td>
<td>Tracheostomy/critical airway procedure</td>
<td>Patent ductus arteriosus ligation</td>
</tr>
<tr>
<td>Myelomeningocele repair</td>
<td>Incarcerated hernia repair</td>
<td>Thoracotomy</td>
</tr>
<tr>
<td>Patent ductus arteriosus device closure</td>
<td>Gastrostomy tube insertion</td>
<td>Laparotomy (excludes colostomy creation)</td>
</tr>
<tr>
<td>Colostomy creation</td>
<td>Omphalocele (small)</td>
<td>Nissen fundoplication +/- gastrostomy tube insertion</td>
</tr>
<tr>
<td>Uncomplicated inguinal hernia repair</td>
<td>Gastrochisis closure (uncomplicated)</td>
<td>Operative necrotizing enterocolitis</td>
</tr>
<tr>
<td>Gastrochisis patch repair with no previous silo (primary repair)</td>
<td>Gastrochisis silo insertion with spring and suture</td>
<td>Gastrochisis or omphalocele closure under tension</td>
</tr>
</tbody>
</table>

See [Algorithm A](#) for postoperative pain management involving use of a **continuous regional block or epidural**

Single shot regional blocks (e.g. tAP, ilioinguinal nerve block) should follow [Algorithm A](#)
Algorithm A: Management of expected mild post-operative pain

Post-operative pain expected to be mild or following a single shot regional block  
(Refer to surgical procedures chart 4.0)

1. Order scheduled acetaminophen for 48 hours (IV or Enteral; see e-formulary for dosing)
2. Order intermittent IV morphine (0.05 mg/kg/dose) every 4 hours PRN for breakthrough pain

Assess pain* (PIPP-R or FLACC-R) and sedation† (N-PASS) scores minimum q1h x 4 hours

Box 1
- N-PASS score 3 to 10
- OR
- PIPP-R scores ≤ 6
- OR
- FLACC-R score ≤ 3

No pain and over-sedation
- Wean morphine (if on infusion)
- or discontinue PRN morphine (if on opioid > 5 days refer to withdrawal guideline)
- Change scheduled acetaminophen to PRN

Box 2
- N-PASS score 0 to 2
- AND
- PIPP-R score ≤ 6
- OR
- FLACC-R score ≤ 3

Adequate pain control and sedation
- No dosing changes recommended

Box 3
- N-PASS score 0
- AND
- PIPP-R score > 6
- OR
- FLACC-R score > 3

Inadequate pain control and sedation
- Use non-pharmacological treatment options
- Use PRN morphine
- Reassess pain score within 1 hour of intervention for pain
- ≥ 3 PRN doses used within 12 hours or 2 consecutive pain scores indicate pain
- Administer morphine bolus
- Start continuous morphine infusion 5 mcg/kg/hour
- Continue PRN doses

Reassess pain and sedation scores minimum every 4 hours
- If pain score indicates moderate/severe pain* give PRN morphine and/or titrate morphine dosing up by 5 mcg/kg/hr despite PRN doses if 2 consecutive scores indicate pain* (Box 3)
- If 2 consecutive pain scores indicate no pain OR 1 score indicates over sedation† titrate morphine down based on duration of exposure – refer to Prevention and Treatment of Opioid and Benzodiazepine Withdrawal Clinical Practice Guideline

Pain scores:
- 0 – no/pain
- 1 – mild pain
- 2 – moderate pain
- 3 – severe pain
- 4 – very severe pain

FLACC scores:
- 0 – no/pain
- 4 – mild/moderate pain
- 8 – severe pain

N-PASS scores:
- 0 – no sedation
- 1 to -2 = light sedation
- -3 to -5 = moderate sedation
- -6 = heavy sedation
Neonatal Post Operative Pain Guidelines

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Algorithm B: Management of expected moderate to severe post-operative pain

Post-operative pain expected to be moderate to severe
Single shot regional blocks (e.g. TAP, spinal, nerve block) should follow Algorithm A (Refer to surgical procedures chart 4.0)

1. Order scheduled acetaminophen for 72 hours (IV or Enteral – see e-formulary for dosing)
2. Start continuous morphine infusion 5 mcg/kg/hour
   NB: if morphine contraindicated due to hemodynamic instability, consider Fentanyl use and follow Table A
3. Order intermittent morphine IV (0.1 mg/kg/dose) every 4 hours PRN for breakthrough pain (if patient is extubated)
4. If on opioids < 24 hours prior to operation:
   a. continue infusion and increase dose by 10% from pre-op dose
   b. if intra-operative analgesic requirements are high, an increase of > 10% from pre-op dose may be required

Assess pain* (PIPP-R or FLACC-R) and sedation* (N-PASS) scores minimum q1h x 4 hours

Box 1
- N-PASS score - 3 to -10
- OR
- PIPP-R scores ≤ 6
- OR
- FLACC-R score ≤ 3

No pain and oversedation
- Wean continuous morphine infusion
- If continuous morphine infusion higher than initial dose, reduce continuous morphine infusion dose and consider PRN morphine dosing only
- If no morphine in use, change acetaminophen to PRN

Box 2
- N-PASS score 0 to -2
- AND
- PIPP-R score ≤ 6
- OR
- FLACC-R score ≤ 3

Adequate pain control and sedation
- No dosing changes recommended

Box 3
- N-PASS score 0
- AND
- PIPP-R score > 6
- OR
- FLACC-R score > 3

Inadequate pain control and sedation
- Use non-pharmacological treatment options
- Use PRN morphine
- Reassess pain score within 1 hour of intervention for pain

≥ 3 PRN doses used within 12 hours or 2 consecutive pain scores indicate pain after boluses
- Administer morphine bolus
- Increase continuous morphine infusion by 10%
- Continue PRN doses

Reassess pain and sedation scores minimum every 4 hours
- If pain score indicates moderate/severe pain* give PRN morphine and/or titrate morphine dosing up by 3mcg/kg/hr despite PRN doses if 2 consecutive scores indicate pain* (Box 3)
- If 2 consecutive pain scores indicate no pain* OR 1 score indicates over sedation* titrate morphine down based on duration of exposure – refer to Prevention and Treatment of Opioid and Benzodiazepine Withdrawal Clinical Practice Guideline

* PIPP-R scores 0 - 6 = no/mild pain; 7 - 11 = moderate pain; ≥ 12 = severe pain
FLACC-R scores 0 - 3 = no pain; 4 - 6 = mild/moderate pain; 7 - 10 = severe pain
*N-PASS scores 0 = no sedation; 1-2 = light sedation; 3-5 = moderate sedation; ≥ 6 = heavy sedation

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Algorithm C: Management of post-operative pain in patients with regional block/epidural

Post-operative patients with continuous regional block/epidural
Single shot regional blocks (e.g. TAP, ilioinguinal nerve block) should follow Algorithm A
(Table D)

1. Order scheduled acetaminophen for 72 hours (IV or Enteral – see e-formulary for dosing)
2. Acute Pain Service (APS) will order continuous regional/epidural infusion and PRN morphine (0.02-0.05 mg/kg/dose) if needed

Assess pain* [PIPP-R or FLACC-R] and sedation* [N-PASS] scores minimum q1h x 4 hours

Box 1
N-PASS score - 3 to -10
OR
PIPP-R scores ≤ 6
OR
FLACC-R score ≤ 3

No pain and over-sedation
- Call Acute Pain Service
- Consider other causes of over sedation (decreased level of consciousness, sepsis, toxicity)

Box 2
N-PASS score 0 to -2
AND
PIPP-R score ≤ 6
OR
FLACC-R score ≤ 3

Adequate pain control and sedation
No dosing changes recommended

Box 3
N-PASS score ≤ 0
AND
PIPP-R score > 6
OR
FLACC-R score > 3

Inadequate pain control and sedation
- Call Acute Pain Service
- Use non-pharmacological treatment options
- Acute Pain Service to adjust regional/epidural if possible
- If unable to adjust, use PRN opioid in consultation with APS
- Reassess pain score within 1 hour for pain (pain score should not be completed for at least 15 minutes after intervention for pain (Table D)

Reassess pain and sedation scores minimum every 4 hours
- Contact APS for all concerns or trouble shooting
- Continue to follow Boxes 1 - 3 for assessment and management

If no response after 2 attempts at adjusting regional/epidural +/- bolus add opioid PRN +/- start opioid infusion in consultation with APS
- If inadequate response to infusion, use PRN doses
- If > 3 PRN doses required, call Acute Pain Service (APS)

* PIPP-R scores 0 - 6 = no/mild pain; 7 - 11 = moderate pain; ≥ 12 = severe pain
FLACC-R scores 0 - 3 = no pain; 4 - 6 = mild/moderate pain; 7 - 10 = severe pain
*N-PASS scores 0 = no sedation; -1 to -2 = light sedation; -3 to -5 = moderate sedation; ≥ 6 = heavy sedation
Table A: Use of Fentanyl in post-operative pain management

- Morphine is the pharmacological agent recommended for post-operative pain management.
- Fentanyl use is indicated for moderate to severe procedural pain.
- Fentanyl use in neonates provides limited sedation at low doses (< 5 mcg/kg/hr).
- Fentanyl use should be reserved for post-operative pain management when morphine dosing has increased to high doses and pain remains severe.
- In discussion with the medical team, fentanyl use as a first line post-operative pain management agent may be indicated for infants with hypotension or if there is a concern of hypotension developing (e.g. post PDA ligation).
- If fentanyl is used as a continuous infusion – consider starting at 0.5 mcg/kg/hour and increase by 0.1-0.2 mcg/kg/hr as needed and replace fentanyl for morphine in algorithm.
- Patients exposed to fentanyl for > 5 days will require weaning utilizing Prevention and Treatment of Opioid and Benzodiazepine Withdrawal Clinical Practice Guideline.

Table B: Dexmedetomidine as adjunct sedation in post-operative pain management

- Dexmedetomidine is a centrally acting alpha2-receptor agonist that has both sedative and analgesic properties.
- Unlike narcotics, it does not have an appreciable effect on respiratory drive or gastric motility.
- May be used in the post-operative period to provide sedation and MINIMIZE anaesthesia.
- It is not a substitute for the appropriate analgesic but concurrent use may result in lower analgesic use and faster recovery.
- Most common adverse effects include hypotension and bradycardia.

Table C: Benzodiazepines as adjunct sedation in post-op pain management

- Benzodiazepines have no intrinsic analgesic activity.
- Midazolam is the main benzodiazepine used in neonates as a sedation adjunct for pain management.
- Benzodiazepines are not a substitute for the appropriate analgesic but concurrent use may result in lower analgesic use and faster recovery.
- Benzodiazepines (e.g. midazolam or lorazepam) use should be considered in the care of infants greater than 34 weeks gestational age.
- Respiratory depression and apneas can occur, especially if co-administered with opioids.
- Hypotension can also occur if co-administered with fentanyl.
- Myoclonic, seizure-like activity can occur with rapid administration.

Table D: Regional/Epidural use in post op pain management

- The Acute Pain Service (APS) will manage patients with a regional block/epidural in consultation with NICU medical team.
- Adjustments to pain management are to be completed in consultation with APS.
- An epidural bolus may require up to 20 minutes for effect, therefore allow this time period to pass before reassessing pain.
- Continue to use non-pharmacological strategies to optimize pain management.
- Single shot regional blocks (e.g. TAR, iliopsoas) should follow Algorithm A.
6.0 References


7.0 Guideline Group and Reviewers

Guideline Group Membership:
1. Carol McNair, NP, Neonatology
2. Sharifa Habib, NP, Neonatology
3. Erase Post Op Pain Committee, NICU

Internal Reviewers:
1. Christine Elliot, Quality Leader, Neonatology
2. Judy Hawes, NP, Neonatology
3. Kyong-Soon Lee, MD, Neonatology
4. NICU Nursing Practice Committee

Attachments:

Algorithm A - Management of expected mild post-operative pain.pdf
Neonatal Post Operative Pain Guidelines

Algorithm B - Management of expected moderate to severe post-operative pain.pdf

Algorithm C - Management of post-operative pain in patients with regional block_epidural.pdf

NICU Post-operative pain tables.pdf