

PAIN MANAGEMENT IN THE PEDIATRIC INTENSIVE CARE UNIT (PICU)

 Ann & Robert H. Lurie
Children's Hospital of Chicago

The
MAYDAY
Fund

*Pediatric Pain PRN
Curriculum*

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Focus

The focus of this content is pain experienced in critically ill pediatric patients. This material builds on the other foundational pediatric acute, chronic, procedural, general and disease specific pain assessment and management content in this curriculum. Please reference other content for developmentally appropriate pain assessments and treatments, including the NICU module for more information regarding care of critically ill neonates and infants.

Objectives

- Describe the prevalence of pain in PICU
- Identify pain assessment and management challenges in PICU
- Differentiate pain, agitation, delirium, and iatrogenic withdrawal
- Describe strategies to assess and manage pain and non-pain related distress in critically ill children

Scope of Pediatric Pain in Critically Ill Children

Prevalence of pain in PICUs



When compared to pain in children in general medical surgical floors, critically ill children have significantly more cases of moderate to severe pain and have higher pain scores.

- Significantly more moderate to severe pain (Groenewald, 2012).
- Pain scores 2.2 to 3.5 points higher (Stevens et al, 2012).

Most patients in the PICU experience pain

- Past prevalence studies suggest that nearly half of the children in PICUs experience pain on a given day.
- Most experience pain while admitted to the PICU.



Inadequate pain management in PICUs



Second most common adverse event across 15 PICUs, second only to intravenous complications (Agarwal et al., 2010).

Defined as score >5 of 10 for 2 consecutive hours

- 82.2% of events deemed preventable
- 1.6% prevalence of withdrawal
- 1.1% prevalence of over-sedation

Second most common sedation adverse event in children ventilated for acute respiratory failure, second only to inadequate sedation.

Defined as score >4 out of 10 or assumed pain present in patients receiving neuromuscular blockade for 2 consecutive hours not related to planned extubation (Grant et al., 2012; Curley et al., 2015).

- 20-30% experienced inadequate sedation
- 14 – 27% experienced inadequate pain management
- 8 – 12% experienced clinically significant iatrogenic withdrawal.



Take a minute to reflect...

- What is the criteria for a child to be hospitalized in the PICU?
- Based on your response, how may these criteria also be barriers to pain assessment?

Type your answer here.

Iatrogenic pain in PICUs

Pain that occurs due to treatment/hospitalization is very common in the PICU

Common procedures nurses conduct (sometimes hourly) have been reported to be painful by children and adults. We must presume they are also painful in patients unable to communicate their pain.

- In the PICU, children experience about six times more painful procedures per day than children in general medical-surgical units; median is 12 procedures per day (Stevens, et al, 2011).
- Mean of 9.7, and a range of 0 to 70 per day (LaFond, Hanrahan, Bohr, Perkounkova & McCarthy, under review, 2019).
- Children and adults report that daily nursing procedures such as turning, tracheal suctioning, and wound care are painful (Puntillo et al., 2001).



Pain Assessment Challenges

PICU pain assessment challenges



Diverse population

- The diversity of patients cared for in PICUs (age, diagnosis, emotional and cognitive development, communicative ability) requires knowledge of multiple methods of assessment

Fluctuating condition

- Due to ongoing changes in acuity of illness, need for respiratory support, and medications administered, a child's ability to self-report pain can fluctuate throughout the PICU admission, even during the same shift.

Overlap of pain and non-pain distress

- Need to be knowledgeable of other sources of distress and knowledgeable in assessment of pain and other sources of distress



What would a thorough pain assessment of Jazmine include?

What should the nurse do next?

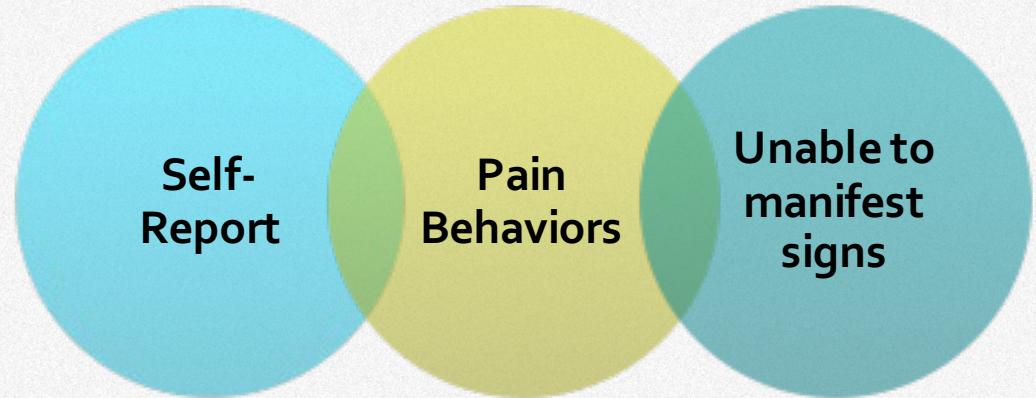
Jazmine

Jazmine is an 18-month-old ventilator-dependent toddler admitted to the PICU after surgery.

She is on nurse-controlled analgesia of fentanyl for pain. Her nurse hears the ventilator alarming and sees that Jazmine is grimacing. The nurse pushes the PCA button many times with no relief.

Ability to communicate pain

Due to ongoing changes in illness acuity, need for respiratory support, and medications administered, ability to self-report pain can fluctuate throughout a PICU admission.



- Self-report
- Gestures/few words
- Pain behaviors only (e.g. mechanically ventilated; infant)
- Unable to manifest nonverbal signs of pain (e.g. heavily sedated, neuromuscular block)

Some patients can be “in between” these categories.

For example, a child who can gesture to where pain is located but cannot use a self-report scale or a patient with a sedative infusion who at times may grimace but does not regularly move extremities.

Definitions

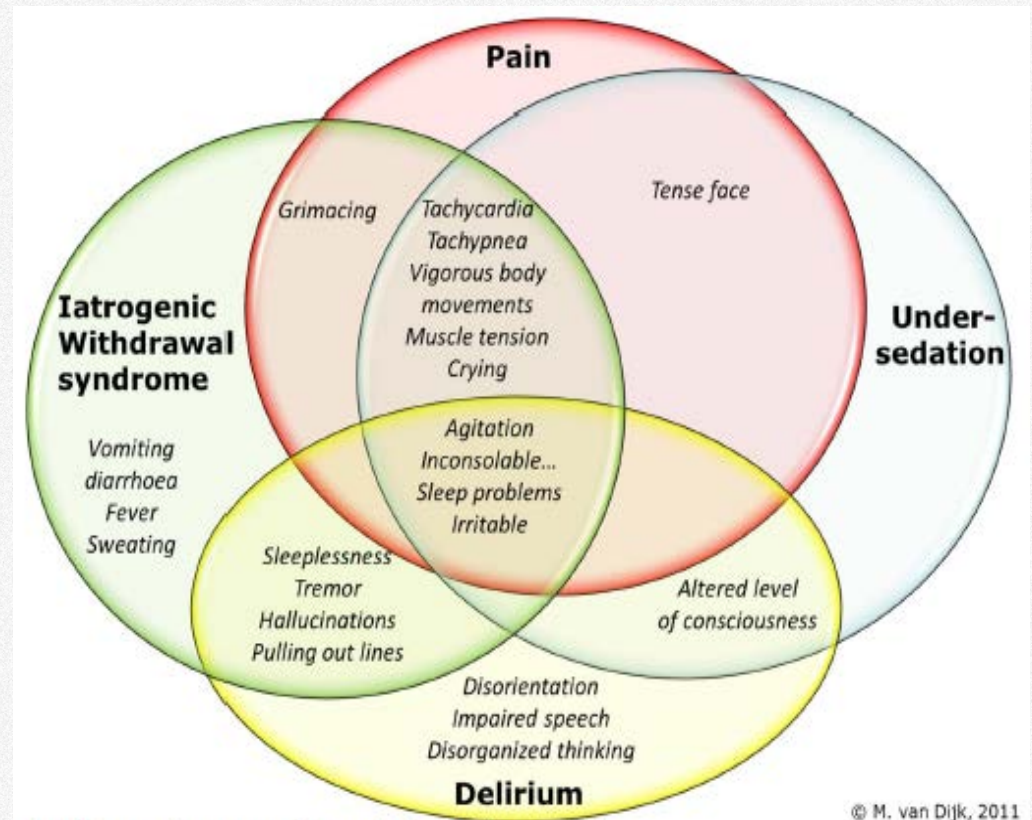


Concept	Definition	Reference
Distress	Child's response to aversive internal and external stimuli.	Ambuel et al., 1992, p. 97
Iatrogenic Withdrawal Syndrome	A clinical syndrome that manifests after stopping or reversing a drug following prolonged exposure to that drug.	Anand et al., 2010, p. e1209
Delirium	<p>Neurocognitive disorder characterized by change in baseline attention and awareness, with additional disturbance in cognition (e.g. memory deficit, disorientation, language) as the result of a medical condition or treatment.</p> <p>Delirium has a fluctuating course and is not explained by a preexisting, established, or evolving neurologic disorder.</p>	American Psychological Association, 2013

Overlap: Pain, agitation, withdrawal, delirium

When patients are unable to effectively communicate, it is difficult to differentiate pain from other non-pain-related sources of distress

This image depicts the overlap in behavioral and some physiologic cues for the presence of pain or other non-pain distress. All have similarities in the middle – agitation, inconsolable, sleep problems, irritable. Notice pain has considerable overlap with withdrawal and under-sedation also.



Overlap: Pain, agitation, withdrawal, delirium



Distress and agitation are on a continuum with patients who are overly sedated and unresponsive to those who are agitated and severely distressed.

Distress may include discomfort, anxiety, fear, and pain manifested by:

- **Behavior:** agitated movement, grimacing, crying, avoidance
- **Physiologic:** increased muscle tension, heart rate, blood pressure, hormonal response, etc.
- **Phenomenologic:** self-report of anxiety, fear, pain

Sedation is provided for multiple reasons in PICU including decreasing distress/anxiety, providing amnesia, facilitation of care, patient safety (e.g. avoid removal of lines), and decreasing oxygen consumption

The goal of sedation is usually to achieve a calm but responsive state in the patient.

Overlap: Pain, agitation, withdrawal, delirium



Iatrogenic Withdrawal Syndrome

- Increased risk after 5 days of continuous opioid or benzodiazepine infusion
- Onset 1 to 48 hours after tapering or discontinuation
- Manifested as:

Neurologic: irritability, anxiety, tremors, clonus, yawning, sneezing, delirium, seizures, hallucinations, and mydriasis

Gastroenteric: feeding intolerance with vomiting, diarrhea, uncoordinated sucking

Activation of sympathetic nervous system: tachycardia, hypertension, tachypnea, sweating, fever, and cough

Delirium

- Develops over hours to days
- Fluctuates in severity
- 25% of PICU patients screened positive (Traube et al., 2017). Higher rate in patients with longer PICU length of stay
- Risk factors:

<2 years old
Benzodiazepines
Physical restraints
Vasopressors

Mechanical ventilation
Opioids
Antiepileptics

Standardized assessment instruments



Use of standardized assessment instruments is recommended to differentiate sources of distress and target interventions (Harris et al., 2016).

This table provides examples of instruments recommended for use in the literature.

Concept	Instruments	When to use
Sedation/ Agitation	<ul style="list-style-type: none">• State Behavior Scale (SBS)• Comfort Scale• Comfort B Scale	Every 4 to 8 hours and as clinically indicated
Iatrogenic Withdrawal Syndrome	<ul style="list-style-type: none">• Withdrawal Assessment Tool version 1 (WAT-1)• Sophia Observation withdrawal Symptoms-scale (SOS)	When weaning opioids or benzodiazepines infused ≥ 5 days
Delirium	<ul style="list-style-type: none">• Cornell Assessment of Pediatric Delirium (CAPD)	Every shift

Pain Assessment Strategies

Hierarchy of assessments for children unable to self-report



Search for potential reasons for pain

- Review the patient's clinical condition. Are there any problems or diagnoses that commonly cause pain? If so, assume pain is present and treat it.
- Anticipate and treat pain caused by procedures.

Rule out other conditions such as constipation or infection. Be sure the patient is dry, warm or cool enough, positioned in a comfortable way, and that other basic needs are met.

Try to obtain self-report

- Attempts should first be made to obtain self-report from all patients, even if it's a simple "yes/no." It may be possible to obtain a self-report from patients with intellectual disabilities and those who are critically ill.

Observe behaviors (use validated tools)

- Be vigilant for subtle behavioral changes; remember that behavioral changes do not translate to a pain intensity rating, but should raise suspicion of the presence of pain.

Ask others who know the child well (parent or caregiver reports)

- Ask others (surrogate reporting), if the child is in pain. Those who know a patient best can help identify specific behaviors that indicate pain for this individual.

Trial a treatment (consider an analgesic)

If pain is likely, attempt an analgesic trial and look for changes in behavior or other signs of improvement.

Assessment tools for mechanically ventilated children

These instruments are commonly recommended, valid and reliable scales to assess pain in mechanically ventilated children who are unable to self-report. The Comfort scales also assess non-pain related distress/level of sedation. The use of physiologic measures for pain have come into question and led to the development of the Comfort B, which eliminates these items.

- Always choose a pain scale that is appropriate for the child's age/development and ability to self-report (some ventilated children can point to a printed scale and location of pain on their body).
- It has been suggested that separate tools (pain separated from sedation) allow more targeted therapeutic management (Curley et al., 2006).
- These scales are not intended to assess sub-acute or persistent pain or pain in children who are muscle relaxed/receiving neuromuscular blockade.

Scale	Use	Pros	Cons
Comfort	Pain and non-pain distress/sedation	<ul style="list-style-type: none"> • Easy to use • Child doesn't have to be disturbed from rest 	<ul style="list-style-type: none"> • Not useful for procedural pain • Time-consuming • Question whether physiologic variables (HR, MAP, muscle tone) should be used
Comfort B	Pain and non-pain distress/sedation	<ul style="list-style-type: none"> • Easy to Use • Child doesn't have to be disturbed from rest • Ventilated and non-ventilated 	<ul style="list-style-type: none"> • Not useful for procedural pain • Time-consuming • Some scores do not adequately predict under/over sedation
Modified FLACC	Pain Assessment	<ul style="list-style-type: none"> • Easy and faster to use • No physiologic variables • Ventilated and non-ventilated 	<ul style="list-style-type: none"> • Mixed recommendations about use for post-op pain in children less than 2 months (Dorfman et al., 2014)

What about vital signs?



Vital sign changes and physiologic indicators are NOT valid indicators of pain in critically ill children or adults.

However, these may be the only indicators of distress in the critically ill child.

Vital sign changes

- Usually reflect stress response; therefore they are not specific or sensitive to pain
- Inconsistent across patients
- Inconsistent during single patient observations
- Some PICU patients lack ability to exhibit some vital sign changes due to medical condition and/or treatments. Example: a child with congenital heart disease with conduction abnormality, pacemaker, and/or cardiovascular medications

Physiologic indicators

There is not sufficient evidence to support using vital signs or other physiologic indicators to assess pain. There is high inter-individual variability in vital sign data.

Proposed physiologic indicators include diaphoresis, pupil dilation, and processed electroencephalography (i.e. bispectral index).

Pupillary dilation may indicate inadequate analgesia (Gelinas et al., 2014; Luckett & Hays, 2013). Like vital signs, pupil dilation is NOT specific for pain and pupils can be constricted with severe pain.

Processed electroencephalography, such as **bispectral index** (BIS), may be used when patients are sedated and/or muscle-relaxed. BIS values are subject to artifact from clinical conditions and medical devices, and therefore, are NOT recommended for monitoring pain (Lamas & Lopez-Herce, 2010; Barr et al., 2013; Luckett & Hays, 2013).

How to assess pain in the critically ill child

Search for potential reasons for pain

Try to obtain self-report

Observe behaviors

Ask others who know the child well

Trial a treatment



Use the Pain Hierarchy, search for potential causes, and treat if present.

Interpret vital signs and other proposed physiologic indicators associated with pain with extreme caution!

Lack of vital sign changes does not mean lack of pain!!!

Examples of other causes of vital sign changes:

- Non-pain-related distress (e.g. fear, anxiety)
- Pathophysiologic changes (e.g. infection, anemia)
- Treatments provided (e.g. fluids, inotropic medications).

Assessment of patients who are heavily sedated or muscle-relaxed



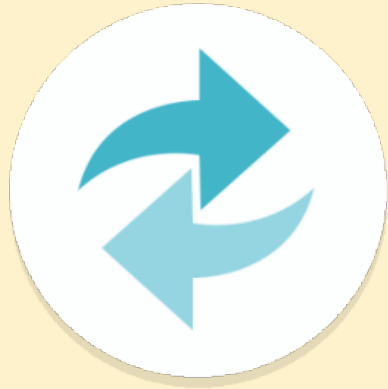
There are no validated pain scales for patients who are heavily sedated or receiving neuromuscular blockade.

Patients unable to express pain behaviors will be scored as deeply sedated or without pain if using behavioral scales.

How to Assess:

1. Search for potential sources of pain and assume pain present if there is cause for pain
2. Anticipate and treat pain for procedures
3. Trial treatment/analgesia
4. Use physiologic indicators cautiously to prompt further assessment/treatment, but do not rely on them exclusively

Warning:
Current sedation and behavioral pain scales were created for patients able to display behaviors.



Jazmine

Why did the nurse recommend Precedex?

How do you assess pain on a patient receiving sedatives?

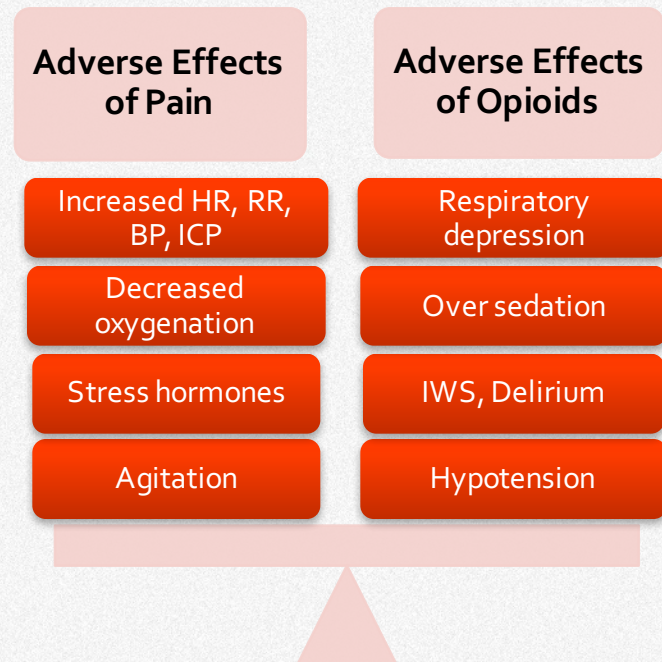
How do you assess pain on a patient receiving neuromuscular blockade?

A continuous drip of fentanyl is added to Jazmine's pain management plan. The nurse felt Jazmine received some relief after the continuous was added but then suggested dexmedetomidine.

Dexmedetomidine was started and the patient was comfortable shortly afterwards.

Managing Pain during Critical Illness

Balancing adverse effects of pain and pain treatment



Managing pain during critical illness is a true balancing act – providing treatment to avoid the adverse effects of pain while also minimizing the risk of pain treatment-related complications, such as respiratory depression from opioids.

Pain

- While not specific or sensitive indicators of pain, responses to pain and stress can include increases in intracranial pressure, heart rate, respiratory rate, blood pressure, blood glucose, and stress hormones and decreases in oxygen saturation.
- Pain can induce agitation.

Pain events in critically ill children can be life-threatening:

- Physiologic responses to pain add stressors that can lead to secondary injury.
- Pain-related agitation can be a safety risk, causing loss of artificial airway or intravenous access.

Treatment

- Respiratory depression occurs more often in PICUs (Chidambaran et al., 2014).
- Over-sedation with analgesics and sedatives can lead to negative outcomes
- Iatrogenic withdrawal syndrome (IWS) and delirium can result from prolonged analgesia and sedation
- Histamine release and subsequent vasodilation from some opioids (e.g. morphine), can lead to hypotension.

Long-term adverse effects of PICU hospitalization

School-aged children discharged from PICU have worse mental and physical well-being compared to healthy controls.

Approximately five months after PICU discharge:

- 34% at risk of post-traumatic stress disorder
- 20% at risk of a general psychiatric disorder
- 38% at risk of fatigue disorder
- 80% at risk of a sleep disorder

(Als et al., 2015)

Stressors of PICU admission that may contribute to Post-Traumatic Stress (PTS) include:

Environmental-related: noise from pumps, ventilators, monitors, devices, other patients, staff and lights, fewer family visits.

Disease-related: pain, perceived disease severity.

Treatment-related: invasive procedures, drugs, such as benzodiazepines may contribute to post-traumatic stress disorder.

(Dow et al., 2012)

Preventing adverse effects of PICU hospitalization



Strategies to reduce pain

- Identify painful events that can be eliminated or reduced
- Use developmentally-appropriate pharmacological and biobehavioral approaches for painful procedures
- Ensure adequate analgesia if pain identified or likely
- Incorporate multi-modal analgesia
- Balance needs for analgesia and sedation
- Address sources of non-pain related distress

Appropriate sedation and analgesia can lessen the stress response, hasten recovery, and prevent patient safety issues



Take a minute to reflect...

- What are the **patient-related barriers** to effective pain management in the PICU?
- What are the **unit-related barriers** to effective pain management in the PICU

Type your answer here.

List the frequency of all care routines in the PICU.



Type your answer here.

Managing distress in critically-ill children

Always try to communicate with the patient to learn the source of distress. Even when it isn't clear if the patient is experiencing pain or non-pain related distress, be vigilant for sources of distress.

1. Address environmental stressors, such as noise, light, temperature.
2. Identify potential sources of discomfort.
 - Positioning
 - Devices or lines that may be pulling/causing pressure
 - Incontinence or diaper care
3. Evaluate clinical context for presence of pain and treat accordingly (pharmacologic and non-pharmacologic).
4. Include caregivers in assessment.
5. Re-evaluate after intervention.

Pain treatments used in critically ill children

There is no consensus regarding best drug or route. The most common analgesics used in PICUs:

- Continuous infusion of morphine or fentanyl
- Acetaminophen most common non-opioid
- Opioids provided more often than non-opioids; multi-modal analgesia provided to about 1/3 of patients

Little research on effectiveness of biobehavioral interventions in PICU, most research focused on neonates or adults.





Jazmine

What else should be considered to manage Jazmine's pain and distress in the PICU after surgery?

Sleep in the PICU

PICU patients are at risk for sleep loss/disruption, which may contribute to delayed healing and poor pain tolerance.

Noise in PICU research is consistently over 45dB, reaching >75 dB at times, even during the night. Noise at 70-80 dB is equivalent to a vacuum cleaner running 10 feet away or a lawn mower at 100 feet away. (Harris et al., 2016; Kudchadkar, Aljohani, & Punjabi, 2014).

Promoting sleep can be considered a PICU pain management intervention.

Disruptions of sleep

- Noise
- Light
- Analgesics/sedatives
- Mechanical ventilation
- Nursing care/procedures
- Post-traumatic stress (pain from trauma/burn)

Recommendations

- Decrease noise < 45 dB
- Promote day/night rhythm
- Daylight
- Family presence
- Cluster care/ minimize night-time interruptions

* Remember that sedation and neuromuscular blockade are not the same as sleep.

Over-sedation

Over-sedation with analgesics and sedatives can lead to negative outcomes (Harris et al., 2016):

- prolonged ICU stays,
- longer ventilation times,
- drug tolerance and dependence

Recommendations

- Adopt goal-directed analgesia and sedation
- Identify the minimum effective dose
- Incorporate multi-modal pain interventions

Respiratory depression

May occur more often in the PICU due to:

- Concurrent use of opioids and sedatives
- Health conditions that may alter response and require dose reductions (liver and renal dysfunction, apnea, airway comorbidities, and neuromuscular disorder)
- Lasting effects of opioid/sedatives after extubation

Recommendations

- Multi-modal analgesia
- Identify the minimum effective dose
- Adjust dose based on patient condition and response
- Vigilantly monitor for unintended sedation and respiratory depression

* Remember that sedation always precedes respiratory depression from opioids.

Hypotension

Strategies

- *Do not withhold treatment of pain*
- *Optimize intravascular volume*
- *Administer opioid slowly*
- *Consider use of opioid, such as fentanyl, that does not release histamine*



Histamine release with vasodilation from some opioids (i.e. morphine), can lead to hypotension.

It is not common in doses for pain management.

The effect varies among individuals.

Patients with high sympathetic tone (e.g. pain, hypovolemia) are at greater risk.

Iatrogenic Withdrawal Syndrome (IWS)



Physiologic dependence is tied to tolerance, increasing doses, and extended treatment (Best, Boulatta, & Curley, 2015).

- Rare when opioid therapy <72 hours
- Increased risk with prolonged use of short-acting opioids

Once tolerance and dependence are present, ending therapy without measured weaning can lead to IWS.

- Strongest IWS risk factors are longer duration >5 days, higher cumulative dose.
- Abrupt discontinuation/rapid weaning precipitates symptoms.

Tolerance is defined as *"decreasing clinical effects of a drug after prolonged exposure to it"*.

Physical dependence is defined as the *"physiologic and biochemical adaptation of neurons such that removing a drug precipitates withdrawal or an abstinence syndrome"*

(Anand et al., 2010, p e1200)

Management of opioid withdrawal



It has been suggested that nurse-controlled sedation/analgesia protocols may reduce cases of IWS (Kanwaljeet, 2010), however in a recent randomized clinical trial of US PICUs (Curley, 2015) there was no difference. However patients were exposed to fewer days of opioids.

To prevent or delay tolerance:

- Titrate opioids to adequate pain management; adjust to minimum effective dose
- Regularly reassess if continued use needed
- Use longer acting opioids, like methadone, for persistent pain
- Consider daily interruption of sedatives

Gradually wean patients at risk (e.g. 10 -20% decline in dose every day or every-other day).

Consider a methadone weaning protocol or the addition of clonidine or alternatives.

Causes of delirium

*BRAIN MAPS is an acronym
for the differential causes of
Delirium in PICU*

(Smith et al., 2013)

B	Bring oxygen: treat hypoxemia, decreased cardiac output, anemia
R	Remove or Reduce drugs that can trigger delirium
A	Atmosphere
I	Infection, Immobilization, Inflammation
N	New organ dysfunction: CNS, Pulm, CV, Hepatic, Renal, Endocrine
M	Metabolic disturbances: hypo/hypernatremia, hypo/hyperkalemia, hypoglycemia, hypocalcemia, alkalosis, acidosis
A	Awake: no bedtime routine, sleep-wake cycle disturbance
P	Pain: too much/under-treated OR pain treated and over-sedated
S	Sedation: Assess need and set sedation target

Delirium management

Algorithms for assessing, preventing, and treating delirium have been published (Simone, 2017 & Smith, 2013). These are beyond the scope of this curriculum.

Preventive Interventions focus on keeping the healthy brain “awake” (Smith, 2013)

Preventive measures:

- Promote daily routine, caregiver interaction during day
- Promote uninterrupted sleep
- Offer a familiar environment (e.g. favorite toys)
- Cluster care to minimize interruptions
- Can drains, lines, tubes, or restraints be removed?
- Consult child life, hospital teachers
- Conduct regular delirium screening
- Assess and manage pain
- Consistent assessment/management of pain may decrease risk and severity of delirium





Take a minute to reflect...

- How do you balance clustering care to prevent patients' from associating any care with pain?
- In other words, is the only touch the patient experiences always associated with the pain of turning, or suctioning, or even the squeeze of the blood pressure cuff?

Type your answer here.

**In
Summary...**

Key Points



Pain and painful procedures are common in PICU.

Pain and hospitalization in the PICU have serious short and long-term adverse effects for children.

Patient distress may be related to their critical condition, pain, agitation, withdrawal, and/or delirium.

Nurses have an important role to vigilantly monitor and intervene for pain and other sources of distress.

Requires knowledge of:

- Assessments and interventions across varying ages, abilities, and diseases
- Conditions that increase risk for negative outcomes.

The Hierarchy of Pain assessments and standardized tools can help to differentiate pain from other types of distress.

Management strategies should be multi-modal.

Appendix

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