

Developmental care in the NICU

Workshop in Neonatology
Management of extremely premature infants - the
Viennese Concept

Angelika Berger



Change in Goals in Neonatal Intensive Care

„Co
inter
the t
com
as p

Focus on prevention of adverse
effects of intensive care and on
minimizing invasive treatments

al
by
a
far

Prävention 2007 , R. Koch Institut

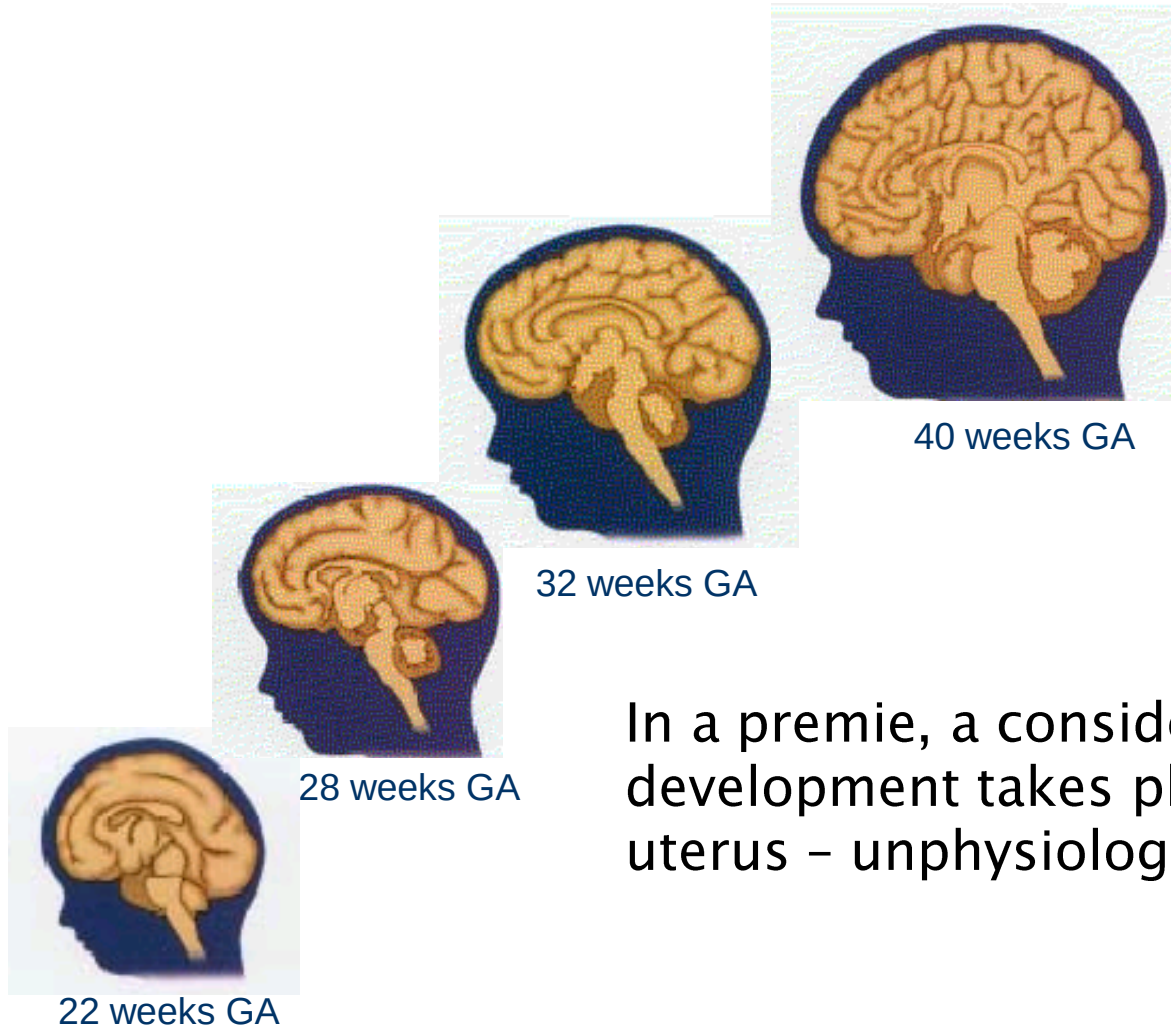
FOCUS ON THE BRAIN

„The neurobehavioral sequelae of preterm birth is one of the major pediatric public health questions of our time“

Lagercrantz

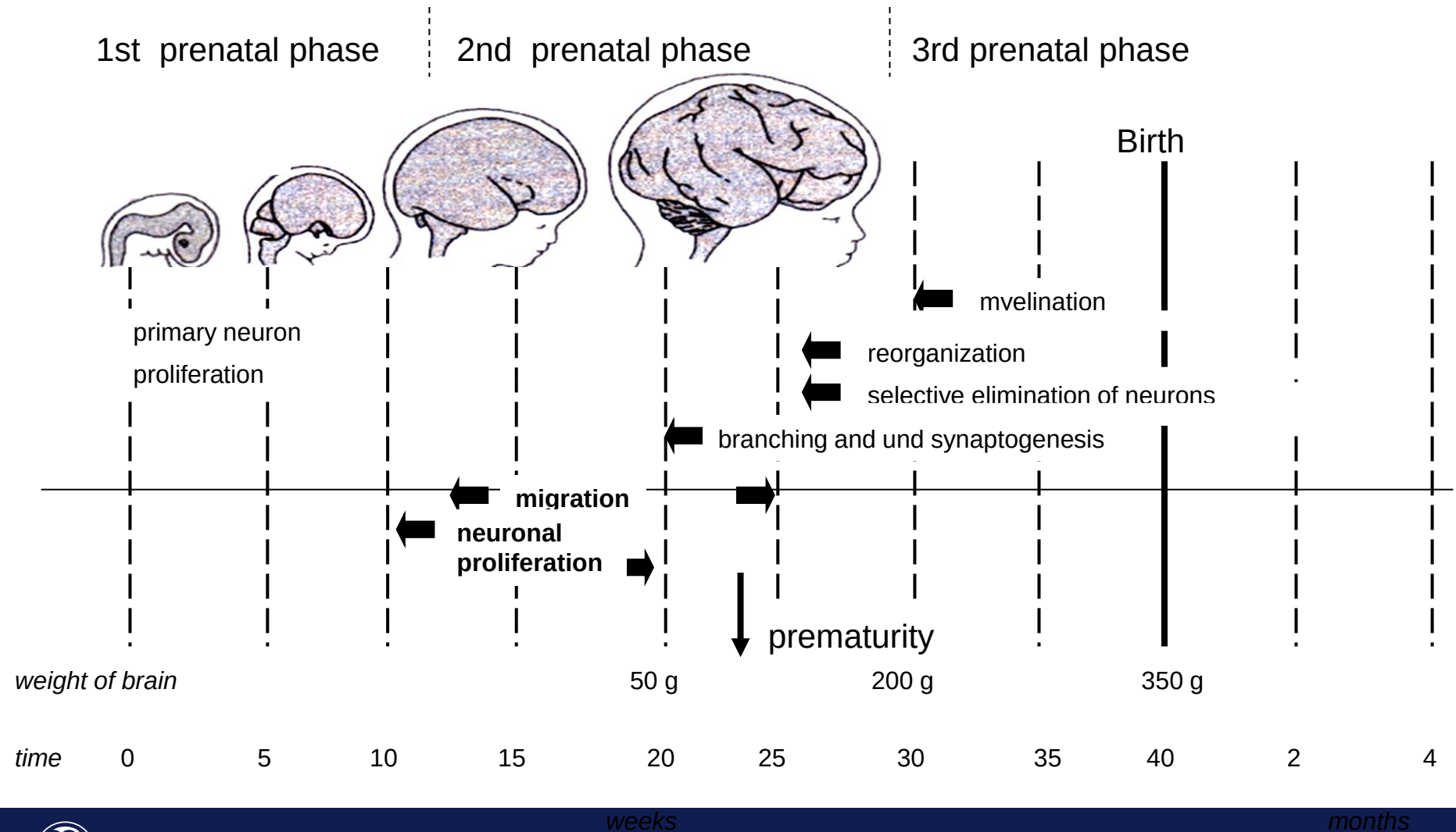


Fetal brain development



In a premie, a considerable part of brain development takes place outside the uterus – unphysiologic surrounding

The Developing Brain



Brain plasticity – brain structure as consequence of interactions with outside world

Principle of activity dependant development: „Firing is wiring“

- Neuron connections rarely used – death of neurons and synapses (e.g. skin – missing touch – problems in sensory integration)
- Neuron connections frequently activated – enhanced representation in corresponding area (e.g. enhanced stimulation of dopaminergic neurons – ADHS)
- Environmental input leads to altered pathway development which may lead to deviant developmental functioning

Brain plasticity – brain structure as consequence of interactions with outside world

Principle of activity dependant development: „Firing is wiring“

Preterm infants have lack of natural, positive stimuli and overload of unfamiliar, negative stimuli

⇒ later problems in motor development, behavioural and cognitive problems

Term infant

Sensory stimuli in utero

- Continuous touch with uterine wall, hand-mouth
- Flexor position dominant
- Dark light
- Noise of low frequency
- Rhythm activity/silence
- Mother as the only attachment person
- Odors of amniotic fluid
- COMFORT, EASE

PREDICTABLE AND ANTICIPATED
ENVIRONMENT

Preterm Infant

Sensory stimuli in NICU

- Touch by plaster, diapers, tubes
- Supine position
- Intense light of intensive care unit
- Noise (alarms, ventilators)
- Abrupt changes of activity
- Frequent handling by changing caregivers, up to 200 procedures/24hrs
- NICU smells : typical clinical odors
- PAIN, STRESS, DISCOMFORT

NOT PREDICTABLE AND ANTICIPATED
ENVIRONMENT

What is Developmental Care?

Developmentally supportive care is the implementation of a structured care environment which supports, encourages, and guides the developmental organization of the premature infant.

Minimize iatrogenic effects on disease states by modification of unfavourable environment.

All interventions designed to minimize stress of premature infant and family.

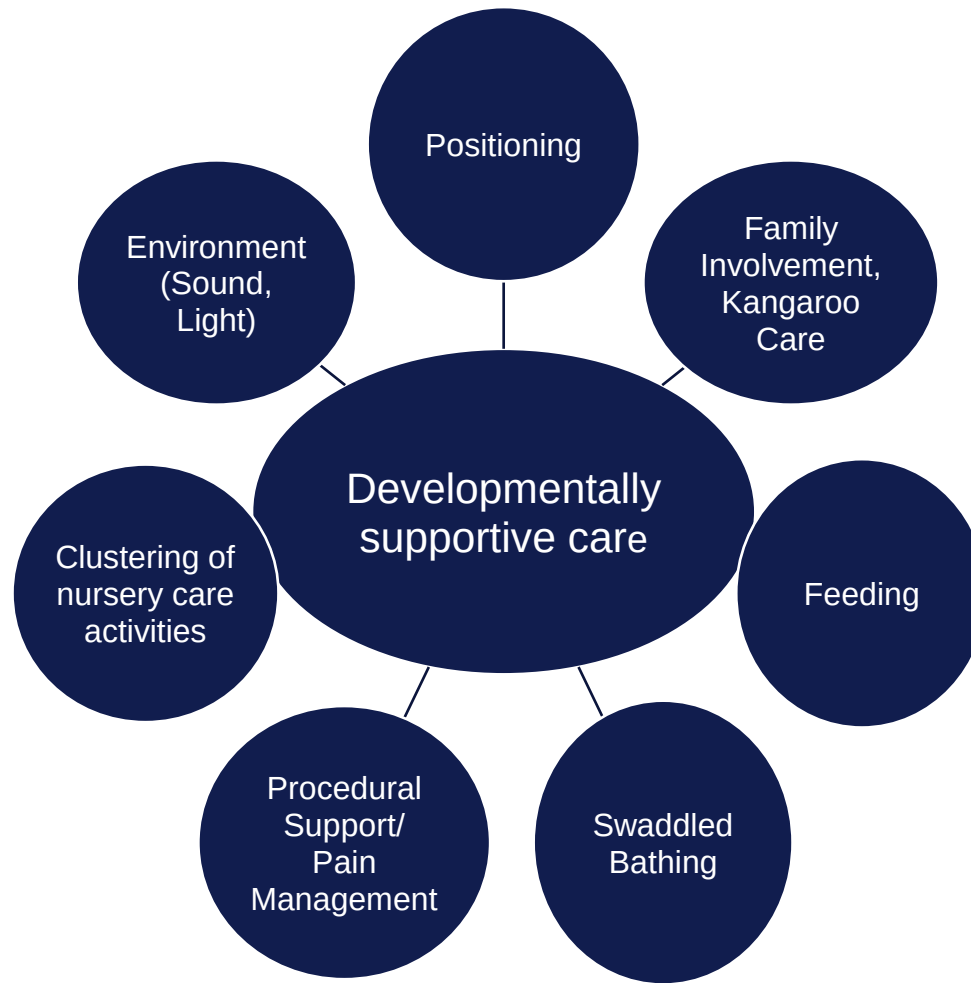
Developmental care

...to continue optimal brain development despite intensive care management

Als: „..to decrease the discrepancy between the immature human brain`s expectation and the actual experience in a typical NICU environment“



Developmental Care

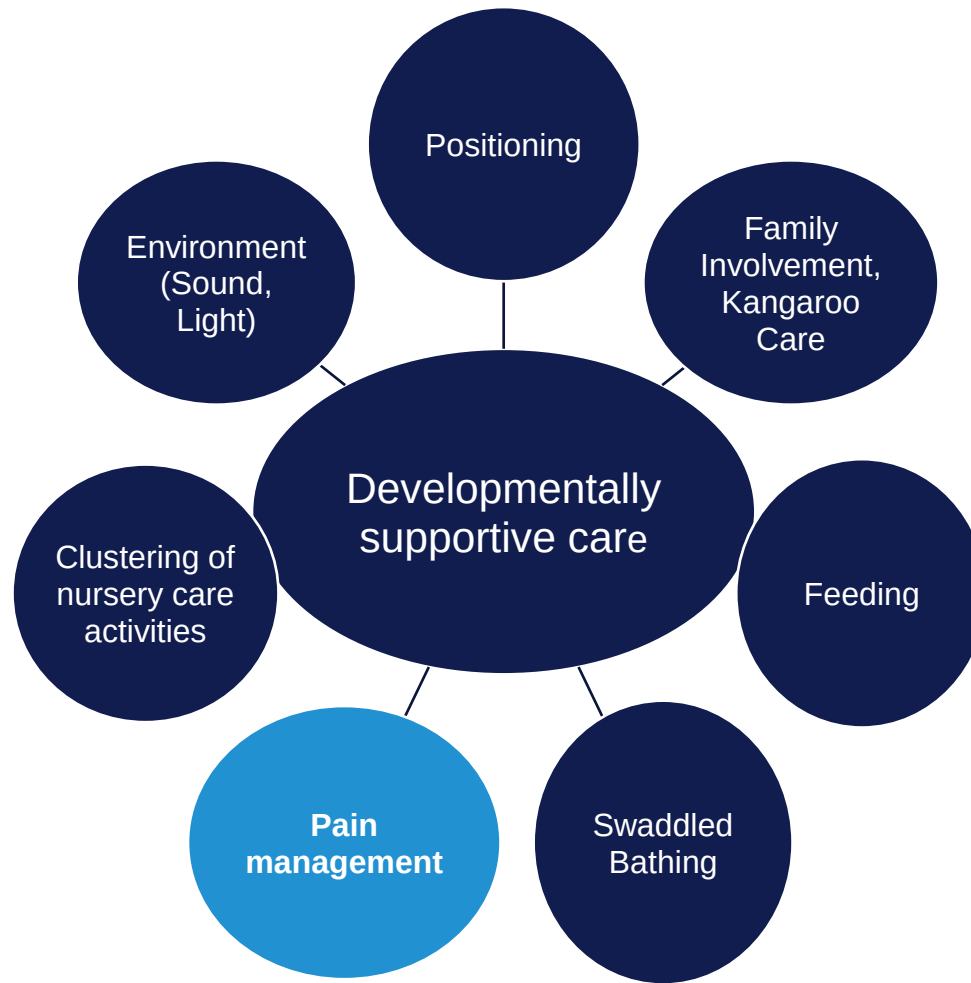


Family involvement



- **24h/day visiting hours for parents**
- Starting on the first day to enable parents to take active part in care of their baby in the NICU

Developmental Care



Non pharmacological Pain Management in the NICU

Developmentally Supportive Care



Background

- Newborns cannot experience pain – misconception until early 1990s
- Perception of and reaction to pain: 22–23 weeks gestational age (Anand NEJM 1987, Lancet 1987)
- Endocrine and metabolic response to stress evident from mid trimester of fetal life (Anand 1987)
- Even lowered pain threshold, increased hormonal, cardiovascular and metabolic reaction to pain (immaturity of pain–modulating/inhibitory signals in spinal tract) (Anand 1989 and 1999, Bhutta 2000)

Long term consequences of pain

- Increased affective response to pain (Grunau 1994, 1998)
- Impairment of cognitive and behavioural development (Bhutta 2002)
- Posttraumatic stress disorder (Rennick 2002)
- Reduced threshold of pain
- Increased vulnerability for stress disorders (Anand 1999)

Painful procedures in the NICU

- Endotracheal suctioning (Benis 2000, Simons 2003)
- Nasopharyngeal suctioning (Benis 2000)
- Insertion of intravenous catheters (Stevens 2003)
- Removal of tapes (Stevens 2003)
- Intubation
- Insertion of drainages
- Insertion of urinary catheter
- Insertion of gastric tubes
- Simple nursing round
- Heel prick
- Lumbar puncture
- Eye examination
- Surgery



Number of painful procedures in the NICU

- Average of **9** painful procedures per day during hospitalization (Stevens 1999)
- Average of **14** painful procedures pro day (Simons 2003)
- Depending on GA:
 - GA 24–28: **28** painful procedures/day
 - GA 28–32: **15** painful procedures/day
 - GA 32–37: **11** painful procedures/day(Cignacco 2006)
- **766** painful procedures in a 28 week preterm infant during hospitalization (Porter 1998)

Common conception that pain management is essential in NICUs

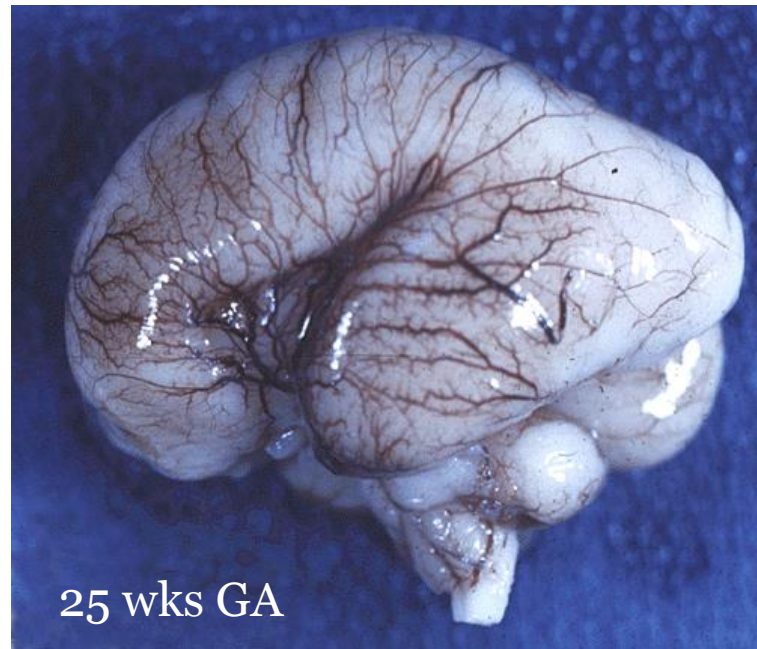


However.....

Increased vulnerability of immature brain towards drugs

Receptor system not mature

Incomplete myelinisation



Immature blood-brain-barrier

Lack of endogenous protectors

Dilemma

- Evidence of negative effects of analgetics/sedatives on developing brain
- Definitive evidence showing adverse neurologic outcome after stress and pain exposure

Recommendations Pain Management in the NICU

- Prevention and Reduction of stress and pain
- Routine use of pain scales for standardized evaluation of pain
- Non-pharmacological pain management
- Adequate pharmacological pain management if necessary

Infant pain assessment tools

Precondition for adequate pain management is adequate assessment of pain

- Subjective
- Behaviour (crying, motor reaction of extremities, grimassing, muscle tone)
- Physiologic effects (heart rate↑, blood pressure↑, oxygenation↓)
- Hormones (Catecholamines↑, Laktate↑, Cortisol↑)

Infant pain assessment tools

Pain scores for neonates

- BERNER Pain Score: acute pain in term and preterm infants (Ciagnacco 2004)
- N-PASS: neonatal pain, agitation and sedation scale, acute pain in term and preterm infants incl. mechanical ventilation
- PIPP: Premature Infant Pain Profil: acute pain (Ballantyne 1999)
- NIPS: Neonatal Infant Pain Score: acute pain
- CRIES: postoperative pain score
- COMFORT Scale: assessment of sedation depth and pain (van Dijk, 2000)

N-PASS:

Neonatal Pain, Agitation, & Sedation Scale

Pat Hummel, MA, RNC, NNP, PNP & Mary Puchalski, MS, RNC

Assessment Criteria	Sedation		Normal	Pain / Agitation	
	-2	-1	0	1	2
Crying Irritability	No cry with painful stimuli	Moans or cries minimally with painful stimuli	Appropriate crying Not irritable	Irritable or crying at intervals Consolable	High-pitched or silent-continuous cry Inconsolable
Behavior State	No arousal to any stimuli No spontaneous movement	Arouses minimally to stimuli Little spontaneous movement	Appropriate for gestational age	Restless, squirming Awakens frequently	Arching, kicking Constantly awake or Arouses minimally / no movement (not sedated)
Facial Expression	Mouth is lax No expression	Minimal expression with stimuli	Relaxed Appropriate	Any pain expression intermittent	Any pain expression continual
Extremities Tone	No grasp reflex Flaccid tone	Weak grasp reflex ↓ muscle tone	Relaxed hands and feet Normal tone	Intermittent clenched toes, fists or finger splay Body is not tense	Continual clenched toes, fists, or finger splay Body is tense
Vital Signs HR, RR, BP, SaO₂	No variability with stimuli Hypoventilation or apnea	< 10% variability from baseline with stimuli	Within baseline or normal for gestational age	↑ 10-20% from baseline SaO ₂ 76-85% with stimulation - quick ↑	↑ > 20% from baseline SaO ₂ ≤ 75% with stimulation - slow ↑ Out of sync with vent

© Hummel & Puchalski

(Rev. 8/14/01)

Loyola University Health System, Loyola University Chicago, 2000

All rights reserved. No part of this document may be reproduced in any form or by any means, electronic or mechanical without written permission of the authors. This tool is currently undergoing testing for validity and reliability, and the authors cannot accept responsibility for errors or omission or for any consequences resulting from the application or interpretation of this material.

Premature Pain Assessment

- + 3 if < 28 weeks gestation / corrected age
- + 2 if 28-31 weeks gestation / corrected age
- + 1 if 32-35 weeks gestation / corrected age

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

Assessment of Pain/Agitation

- Pain assessment is the fifth vital sign - assessment for pain should be included in every vital sign assessment
- Pain is scored from 0 → +2 for each behavioral and physiological criteria, then summed
 - Points are added to the premature infant's pain score based on their gestational age to compensate for their limited ability to behaviorally or physiologically communicate pain
 - Total pain score is documented as a positive number (0 → +10)
- Treatment/interventions are indicated for scores > 3

Non pharmacological analgesia

- Recommended to prevent pain and stress in neonates
- Stimulates release of endogenous opioids (endorphins)
- Can be done by nurses without any prescription of doctors

Non pharmacological analgesia

- Oral sweet solutions
- Non nutritive sucking
- Swaddling or positioning
- Facilitated tucking
- (Kangaroo care)

Sucrose for analgesia in newborn infants undergoing painful procedures.

Cochrane Database Syst Rev 2016

- Review of randomized controlled trials for use of sucrose for relieving procedural pain in neonates, 74 studies, 7049 infants
 - Sucrose significantly reduced duration of total crying time (s) during heel lance and venipuncture and intramuscular injection
 - Lower PIPP scores with sucrose after heel lance and venipuncture
 - Less but still beneficial effect in arterial puncture, s.c. injection, insertion of nasogastric tubes, bladder catheterization, eye examinations, echo examinations,....
- ⇒ Sucrose is safe and effective for reducing procedural pain from single events
- ⇒ No definitive recommendation on concentration and dosage (inconsistent data)

Randomised controlled trial showed that neonates received better pain relief from a higher dose of sucrose during venepuncture. Kristoffersen et al. 2018

- 53 preterm infants >1000g
 - 0.2ml vs 0.5ml sucrose before venepuncture (50% 2min before, rest immediately before procedure)
- ⇒ Significantly lower PIPP scores with 0.5ml sucrose than with 0.2ml during skin puncture
- ⇒ No difference in PIPP scores after needle was removed

A systematic review and meta-analyses of nonsucrose sweet solutions for pain relief in neonates. Bueno 2013

- 38 studies, 3785 neonates
- Significant reduction in PIPP scores during heel lances with 20–30% glucose versus no intervention
- Significant reduction in PIPP score during venipuncture with 25–30% glucose vs no intervention or water

⇒ 20–30% glucose solutions have analgesic effects and can be recommended as alternative to sucrose for procedural pain reduction in preterm neonates

Sucrose/glucose for analgesia

- Different dosing regimens published
- 0,25ml/kg of 25% sucrose/glucose 1 min PRIOR to each potentially painful/unpleasant procedure
- Together with non-nutritive sucking (pacifier or cotton swab)



Facilitated tucking

Positioning of the baby
in a frog like position,
legs bent

Facilitated tucking during heel
prick significantly reduced
increase in heart rate and crying
time (Corff 1995)

Significant pain-alleviating effect
in neonates (Cignacco 2007)

Swaddling

- Tight nesting of the baby (cocooning)
- During and after painful procedures (arms next to thorax)
- Significant positive effects on heart rate, oxygen saturation, crying time (Cignacco 2007)

Two persons nursing one child

- In all particularly painful nursing procedures such as
 - Endotracheal suctioning
 - Insertion/change of CPAP prongs
 - Removal of tapes
 - Venous puncture
 - Heel prick
- Second person supporting the baby (facilitated tucking, non nutritive sucking, comforting)

Non-pharmacological analgesia

Always use for:

- Capillary and venous blood sampling
- Peripheral venous catheters
- Removal of tapes
- Subcutaneous injections
- Endotracheal Suctioning
- Placement of oral/nasogastric tube
- Placement of urine catheters
- Eye examination/ROP screening

Kangaroo care

Heel prick
kangaroo care
versus incubator:
significant
reduction in crying
time, grimassing,
reduced increase in
heart rate (Gray et al.
2000, Johnston et al.,
2003, Ludington-Hoe et
al., 2005)

What else can we do?

- Reduce stress
- Reduce noise
- Reduce light
- Nesting of the baby
- Give the baby resting times without manipulation
- Try to make the baby feel comfortable like in utero

Positioning in the NICU

ENCOURAGE. flexed position with support from blankets/ boundaries, rotate baby in different positions to promote head shaping, gross motor strengthening, self-calming, and ability to participate in fine motor and developmental activities



Supervised Tummy Time



Side Lying



Back

AVOID: positioning without support/boundaries which can result in asymmetrical postures, skull deformations, delayed fine and gross motor development



“W” Position
of Arms



“M” Position
of Legs



No Boundaries



Preferential
Head Turning



Boundaries Too
Small

NOISE in the NICU

- Noise at NICU should be kept < 45 dB
(Intrauterine: About 28 db)
 - Abrupt closing of incubator doors: 110 dB
 - Loud conversations: Up to 100 dB
 - Telephone ringing: Up to 80 dB
 - Opening packages, water bubbling in respirator tubes: 65 dB
 - Normal Talking: 50–60 dB
- Reducing noise levels improves the physiologic stability of sick neonates and improves the potential for infant brain development
 - Reduce volume of telephones
 - Use vibracall in portable phones
 - Turn off alarms quickly
 - Limit conversation near child
 - Instruct people coming to the ward to support this concept



LIGHT in the NICU

- Interrupts sleep/rest
- May damage the retina

Reducing light improves the physiologic stability of sick neonates and improves the potential for infant brain development

- Covering incubators with blankets
- If in bed: Use bed sheet like a tent to reduce light
- Before removing the blanket cover eyes with „eye blanket“ ready next to the head
- Dimm light at night



Simply look at the baby!

Preterm infants feel and express pain – but they stop if we don't apply appropriate analgesia



I am scared!
Leave me alone!

That hurts !

General measures - procedural support

- Do not touch without warning
 - Initial gentle touch of head or feet with full hand
- Hold tight
 - Hold head and feet with full hand
 - Wrap up if unhappy
- Respect resting times of baby
 - Is this intervention really necessary?
 - Is it necessary NOW?
 - How can I prevent pain during the intervention?



Perspectives

- The acceptance of pain as an inevitable part of NICU hospitalization being part of the culture in many NICUs no longer acceptable
- „Minimal–pain“ NICU culture
- Ethical imperative to consider pain relief in infants
- Prevention of pain in NICU, decrease number of painful events

Perspectives

- Promoting shorter duration of ventilator treatment decreases number of painful procedures in preterm infants (Axelin 2009)
- Shorten time to full enteral feeds decreases number of painful procedures by reducing number of peripheral cannulas
- Insertion of central venous catheters
- Re-evaluate every intervention/procedure – is it really necessary? Now?

Yes, we can!



Pain management is a moral imperative – let us be advocates for our patients!



Thank you for your attention!

