Neuroprotection Bundle

Guideline

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Neonatal Neuroprotection Bundle Guideline		Version number 1
Area: Neonatal Unit		
Written by: Nicola Bradford, Colette Jacobs, Julie-Clare Becher and Claire Adamson	Approved by Neonatal Guidelines group	
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Contents

Introduction

This guideline describes the Neuroprotection Bundle which ensures that all babies who are less than 30 weeks gestation receive standardised evidence-based neuroprotective care. The Neuroprotection Bundle begins prior to delivery and follows a continuum of care from birth through the first 72 hours of life. The Bundle encompasses care over three periods:

1- Antenatal optimisation
2- Stabilisation
3- First 72 hours of life

Background

Intraventricular Haemorrhage (IVH) is a leading cause of morbidity and mortality among extremely preterm newborns. Preterm babies are at high risk for developing IVH because their germinal matrix is not fully developed, making their blood vessels more prone to rupture. It is important to try and maintain cerebral autoregulation, which involves maintaining a consistent blood flow within the brain while being exposed to constant changes in cerebral perfusion pressure. However, the preterm infant has limited ability to autoregulate their cerebral blood flow due to immaturity of their autonomic and cardiovascular systems. This means that factors which affect blood pressure and cerebral perfusion have the potential to result in significant fluctuations in cerebral blood flow which may result in brain injury.

IVH is classified into grades 1-4 depending on size and regional brain tissue involvement:

- Grade 1 – Germinal matrix haemorrhage with no or minimal intraventricular haemorrhage
- Grade 2 – Blood which fills less than 50% of the ventricle without ventricular dilation.

- Grade 3 – Blood filling >50% of the ventricle and which usually results in ventricular distension.
- Grade 4 – Also called a periventricular haemorrhagic infarction (PVHI) and is caused when an IVH results in obstruction of venous drainage of the surrounding tissue.
- Post-haemorrhagic ventricular dilation (PHVD) - progressive dilation of the ventricles following IVH with enlarged ventricles >97th centile+4mm. PVHD may resolve spontaneously, or may go on to require drainage, either by LP, tapping or shunt.

Severe IVH (Grades 3 and 4) and PHVD are associated with increased risk of death, and of neurodevelopmental delay, cerebral palsy, deafness, and blindness. Around half of IVH is detected within the first 24 hours after birth, and 90% by 72 hours after birth. Effectively implementing evidenced-based measures including a Neuroprotection Bundle has been shown to decrease the risk of preterm brain injury within this critical period.

Premature babies, particularly those <30 weeks, are also at risk of other neurological morbidities such as periventricular leukomalacia (PVL) and other forms of white matter injury. The developing retina is also part of the nervous system and is prone to injury from the adverse consequences of prematurity and neonatal care.

All of the above neurological complications means that the premature baby has a higher risk of death, cerebral palsy, cognitive delay and both visual and hearing impairment.

The following guidelines aims to provide a framework by which caregivers can best provide care which reduces the modifiable risks that premature babies face in order to improve long term outcomes.

Service aims

The introduction of the Neuroprotection Bundle aims to reduce the occurrence of IVH, PHVD and PVL in babies <30 weeks' gestation that are admitted to the neonatal unit.

Values

The neonatal service upholds the core NHS Lothian values of care and compassion, dignity and respect, quality, teamwork, openness, honesty and responsibility.

Antenatal Optimisation

Prior to birth the important elements of the bundle include:

1. **Birth in a NICU setting** for infants < 27 weeks' and <28 weeks' multiples: reduces death and IVH.

2. Optimally timed **antenatal steroids**: reduces death, IVH and respiratory distress syndrome.

3. Antenatal **Magnesium Sulphate**: reduces cerebral palsy and may reduce IVH.

4. **Intrapartum antibiotics**: prevents sepsis including meningitis.

Stabilisation

At birth the emphasis is on supporting gentle transition and maintaining normothermia.

The **Delivery Room Pause** should be used prior to birth to ensure good communication between teams, to agree shared goals, allocate roles, ensure an optimal environment and ensure all necessary equipment is available.

The goal at stabilisation is to support gentle transitioning to promote physiological stability.

Careful attention should be given to limit swings in blood pressure and brain perfusion during stabilisation and transition at delivery. This includes:

a) Supporting **deferred cord clamping (DCC)** of at least 60 seconds where appropriate followed by gentle respiratory support. DCC reduces death by nearly a third and helps to improve cardiovascular stability in the first 24 hours of life.

b) Ensuring **appropriate airway pressures** are applied during mask ventilation may reduce the risk of pneumothorax and pulmonary haemorrhage. Both pneumothorax and pulmonary haemorrhage are associated with increased risk of IVH. Avoiding endotracheal intubation within the first 10 minutes of life is associated with improved outcomes where the infant is clinically stable.

c) Maintaining **a normal temperature** (36.5-37.5C) is linked to many important preterm outcomes including death and other morbidities. Hypothermia (< 36.5C) is associated with an increased IVH risk and increases the risk of other causes of IVH such as hypoglycaemia, hypoxemia and decreased cardiac output. Hyperthermia (> 38C) is also associated with poor outcomes, including poor neurodevelopmental outcomes. Best practice is described in the **'Goldilocks and the 3 BeAwares'** guideline and involves allocation of a 'Goldilocks role' to a team member who targets a temperature of 37C.

The First 72 Hours of Life (Appendix 1)

In the first 72h, the emphasis is on promoting cardiorespiratory stability and maintaining normothermia.

1. **Implement the 'Golden 120 Checklist'**

The 'Golden Hour' philosophy involves following a standardised stepwise approach which aims to complete the essential admission care tasks within the first 120 minutes of life to thereafter handle the baby minimally and reduce the risk of IVH. The medical and nursing team should work together to complete the tasks in a gentle, timely, and safe manner. This begins with prebirth preparation for admission, followed by important admission tasks (Appendix 2).

2- Promote Physiological Stability

Interventions include nursing cares, to medical interventions and family centred care as follows:

a. **Appropriate monitoring and assessment** including:

- Continuous monitoring of heart rate, respiratory rate, oxygen saturation.
- Non-invasive and invasive blood pressure monitoring appropriate to the level of care infants need.
- Blood gas monitoring for infants as per their clinical care plan.
- Monitoring of respiratory support to ensure infant is receiving optimal support, i.e. synchronisation with ventilator, optimal pressures on CPAP.
- Close monitoring for any change in any clinical observations and escalation to ensure prompt review and intervention. This helps to promote cardiovascular stability and limits the length of periods of instability.
- Monitoring of fluid balance and escalating concerns for prompt review.

b. **Minimal Handling**

   a. **Environment:** It is important to avoid sensory overstimulation to handling, noise and light.

b. **Cares:** After completion of the 'Golden Hour' tasks, babies should be handled as little as possible - routine cares should be carried out **12 hourly** unless required sooner within the first 72 hours.

c. **Handling:** During care episodes, nappies should be changed by 2 people, either 2 medical/nursing staff or a parent and medical/nursing staff. The baby should be lifted horizontally by one person while the other changes the nappy and sheets, thus preventing a sudden swing in blood flow to and from the brain. Legs must **NOT** be elevated above the heart at any point. Please see the demonstration video here

c. Positioning

Place incubator on full tilt (15 degrees). This prevents elevated intracranial pressures by preventing sudden increases in blood pressure and promoting venous drainage from brain.

i. Babies who are receiving **invasive ventilation:** position supine with head in the midline. Supine positioning facilitates drainage of blood from the brain by preventing restriction caused by narrowing/blocking of the neck veins which may happen when the head is turned. A gel ring should be used to support the baby's head - this position should not be changed for the 72 hours.

ii. Babies who are receiving **non-invasive respiratory support:** place prone using a prone position aid to avoid a full 90-degree rotation of the neck. Babies should be turned gently onto their back when having cares.

All babies should be supported with a deep, horseshoe boundary and use a bamboo sheet to promote flexion, midline and comfort.

Demonstrations of the positioning aids can be seen here

d. Reduce Pain

Minimise procedures which cause distress and pain to prevent physiological instability and blood pressure fluctuations. Apply interventions to prevent and lessen the effect of painful/uncomfortable procedures. Be mindful of the environment and noxious stimuli which can cause irritability and discomfort.

Use the NPASS tool to assess comfort and pain (Appendix 3 – also see Pain and NPASS Guideline).

e. Line sampling and flushing should be done slowly to prevent sudden changes in blood pressure and blood flow to and from the brain. All sampling and flushing should take place over **60 seconds**

f. Carbon dioxide:

a. **Hypocarbia** can cause vasoconstriction of the cerebral vessels. This leads to decreased perfusion of the brain which increases the risk of serious brain injury including IVH. Hypocarbia should be acted upon promptly with review of respiratory and ventilator support. Response to interventions must be closely monitored and needs senior discussion at the time. The accepted lower limit of pC02 is 4.5kPa and there should be an aim to maintain PCO2 above 5kPa.

b. **Hypercarbia** can cause vasodilation and increased blood flow into the brain. This can increase the risk of IVH due to injury to the fragile capillary blood vessels of the preterm brain. While permissive hypercapnia is a widely accepted practiced (PCO2 up to 8kPa), care should be taken to avoid severe and sudden hypercarbia which can occur secondary to failed intubation, tube obstruction or displacement, pneumothorax and pulmonary haemorrhage

g. Glucose: Hypoglycaemia and **hyperglycaemia** (thresholds as per NNU guidelines) should be monitored and avoided as both adversely alter cerebral blood flow.

h. Respiratory management: this should be planned to avoid cardiorespiratory instability particularly abrupt deterioration. Babies who are between 22-24 weeks

gestation should be maintained on invasive ventilation for the first 72hours. In all babies, care should be taken to avoid:

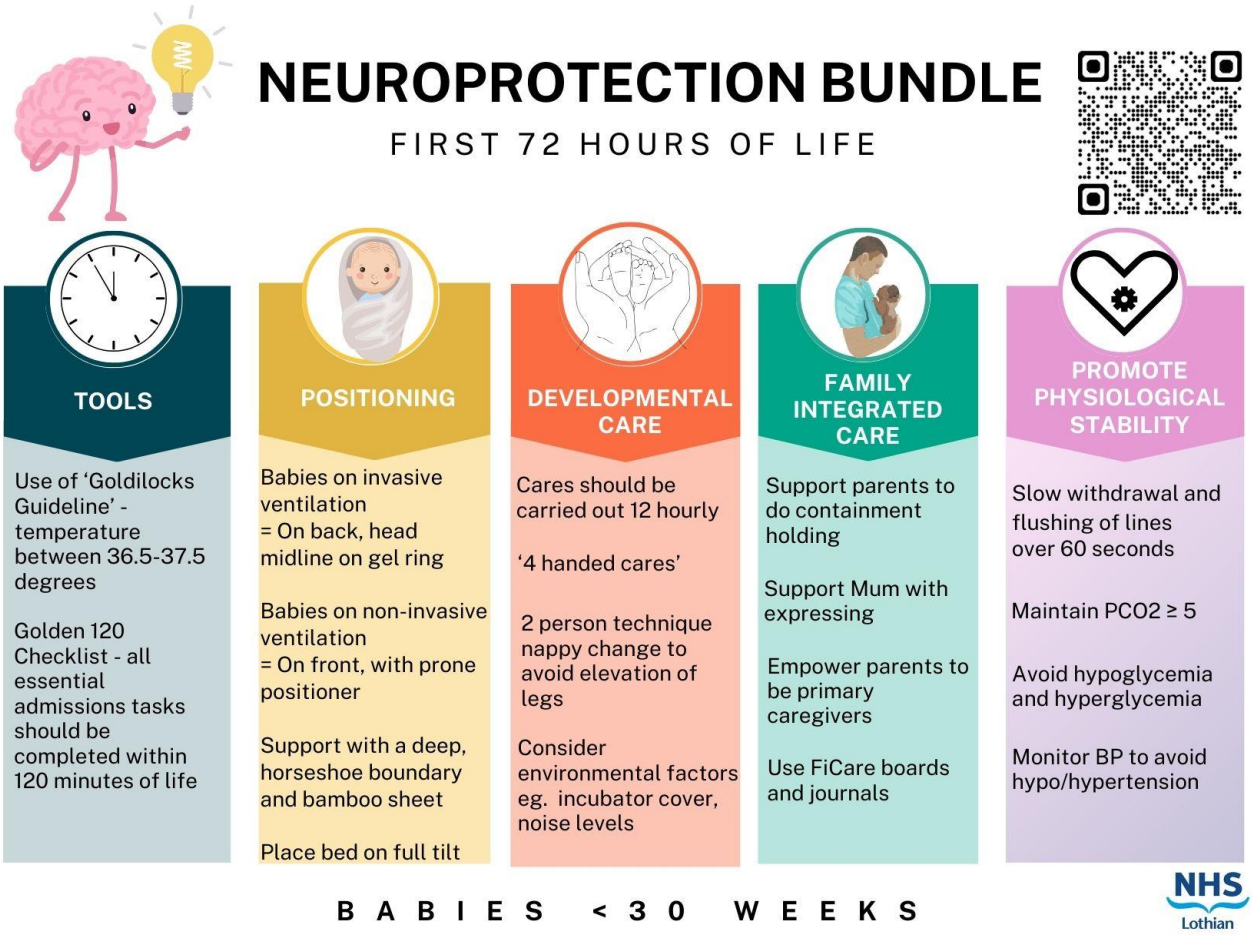
a. failed intubation
b. endotracheal tube obstruction
c. endotracheal tube displacement
d. pneumothorax and pulmonary haemorrhage: early treatment with surfactant, use of volume targeted ventilation; avoidance of fluid overload

i. Family Centred Care

Parents should be encouraged to be with and talk to their baby and provide positive touch. Support parents to do containment holding which has been shown to improve tolerance of procedures and maintain cardiovascular stability.

Supporting mothers with early expressing is a priority to facilitate early breastmilk feeds and establishment of lactation. Maternal breast milk provides many benefits including better brain outcomes and decreased risk of infection and NEC.

Appendix 1



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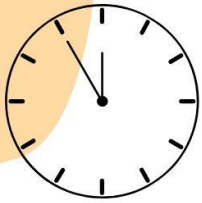
Appendix 2

Golden 120:

NAME:
DOB AND TIME:
TIME CHECKLIST COMPLETE:

PRE-BIRTH PREPARATION:

- ☐ Set up appropriate respiratory support
- ☐ Set up incubator with appropriate temperature
- ☐ Set up humidity – 80% (90% @ 22-24 weeks)
- ☐ Look out appropriate positioning aids
- ☐ Look out appropriately sized nasogastric tube and monitoring
- ☐ Look out drugs: vit K, caffeine +/- pen, gent, HC, fluconazole
- ☐ Set up trolley for PVC or central lines- cover with sterile towel
- ☐ Ensure appropriate blood bottles available
- ☐ Prepare fluid and prescription charts
- ☐ Look out fluids or PN
- ☐ Allocate person to admit on Trak and Badger after birth
- ☐ Conduct a pre-birth brief if time allows



ON ADMISSION:

MEDICAL	Tick
Measure OFC on resuscitaire	
Achieve peripheral access or start UVC/UAC Take necessary bloods	
Blood gas Early CXR if required Surfactant if required	
Prescribe fluids, caffeine, vit K and hydrocortisone and antibiotics as required	
Complete initial exam	

NURSING	Tick/ Complete
Temperature of Baby	°C
Weigh baby in incubator	g
Place NGT/OGT	
Position on appropriate positioning aid	
First set of observations	
Give vit K, caffeine, antibiotics and hydrocortisone as required	
Start fluids	

Additional Notes:

Appendix 3 NPASS Pain Assessment Scale					
Assessment	**Sedation**		**Normal**	**Pain/Agitation**	
Criteria	-2	-1	0	+1	+2
Crying/ **Irritability**	**N**o cry with painful stimuli, i.e. *needlestick, ETT/nasal suction/care giving*	**M**oans or cries minimally with painful stimuli, *i.e. needlestick, ETT/nasal suction/cares*	**A**ppropriate crying with normal stimuli. **N**ot irritable.	**I**rritable or crying at intervals. **C**onsolable	**H**igh-pitched or silent-continuous cry **I**nconsolable
Behaviour State	**N**o arousal to any stimuli **N**o spontaneous movement	**A**rouses minimally to stimuli **L**ittle spontaneous movement	**A**ppropriate for gestational age	**R**estless, squirming **A**wakens frequently with minimal stimuli	**A**rching, kicking Constantly awake or **A**rouses minimally / no movement(not sedated)
Facial expression	**M**outh is lax No expression	**M**inimal expression with stimuli	**R**elaxed Appropriate	**A**ny pain expression intermittent	**A**ny pain expression continual
Extremities Tone	**N**o grasp reflexes Flaccid tone	**W**eak grasp reflex **D**ecreased muscle tone	**R**elaxed hands and feet **N**ormal tone	**I**ntermittent clenched toes, fists or finger splay **B**ody is not tense	**C**ontinual clenched toes, fists or finger splay **B**ody is tense
Vital signs **HR, RR, BP and Sa02**	**N**o variability with stimuli **H**ypoventilation or apnoea	< 10% variability of baseline with stimuli	**W**ithin baseline or normal for gestational age	**I**ncreased by 10-20% from baseline **S**a02 76-85% with stimulation-quick increase	**I**ncrease > 20% from baseline with stimulation – slow increase **O**ut of sync with ventilator

NPASS Scale for Sedation			
Assessment	**Sedation**		**Normal**
Criteria	-2	-1	0
Crying/ Irritability	**N**o cry with painful stimuli, i.e. *needstick, ETT/nasal suction,*	**M**oans or cries minimally with painful stimuli	**A**ppropriate crying **N**ot irritable
Behaviour State	**N**o arousal to any stimuli. **N**o spontaneous movement.	**A**rouses minimally to stimuli **L**ittle spontaneous movement	**A**ppropriate for gestational age
Facial expression	**M**outh is lax **N**o expression	**M**inimal expression with stimuli	**R**elaxed Appropriate
Extremities Tone	**N**o grasp reflexes **F**laccid tone	**W**eak grasp reflex **D**ecreased muscle tone	**R**elaxed hands and feet **N**ormal tone
Vital signs **HR, RR, BP and Sa02**	**N**o variability with stimuli **H**ypoventilation or apnoea	**< 10%** variability of baseline with stimuli	**W**ithin baseline or normal for gestational age

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