Northern Neonatal

Operational Delivery Network

Guideline

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This guideline has been developed to ensure appropriate evidence based standards of care throughout the Northern Neonatal Operational Delivery Network (NNODN). The appropriate use and interpretation of this guideline in providing clinical care remains the responsibility of the individual clinician. If there is any doubt, please discuss with a senior colleague.

It is the responsibility of all users of this guideline to ensure that the correct version is being used.

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1.0 Introduction

Germinal matrix-intraventricular haemorrhage (GMH-IVH) is a significant and common complication of preterm birth, often leading to severe outcomes such as periventricular haemorrhagic infarction (PVHI) and post-haemorrhagic ventricular dilatation (PHVD)(1). Preterm brain injury represents 40% of the total number of serious brain injuries recorded in infancy(2). Complicated GMH-IVH is strongly linked to poor outcomes, often resulting in long-term disabilities or even death, similar to cystic periventricular leukomalacia (cPVL)(3). Even extremely preterm infants with low-grade GMH-IVH (Grades I-II) have poorer long-term neurodevelopmental outcomes as compared to those with normal cranial scans (3–5).

According to the 2023 National Neonatal Audit Programme (NNAP) report, 6.7% of preterm neonates born before 32 weeks gestational age experienced intraventricular haemorrhage (Grade III-IV), while 13.8% had a combined outcome of significant GMH-IVH (Grades III-IV) or death, based on available scan data. Similarly, 2.6% of preterm infants born before 32 weeks developed cystic periventricular leukomalacia (cPVL), and the combined outcome of cPVL and death was reported as 10.1%.

Overall, serious preterm brain injury was identified in 9% of very preterm babies nationwide (6). In 2015, the Department of Health in England and the UK Government announced a national ambition to reduce 'brain injuries occurring during or soon after birth ' by 50% by 2030 (2). Data of the 'Northern' neonatal network for 2024 shows a rate of 11.1% for IVH and 11.7% for the c-PVL, which is slightly higher than the national average. But there are variations with individual NICUs.

IVH care bundles aiming at perinatal optimisation of care and targeting the preventable causes of preterm brain injury (such as GMH-IVH and c-PVL) are described in the literature and currently in practice at various neonatal units across the UK and Internationally. These bundles typically include a combination of nursing and medical interventions (within 72 hours or up to 7 days) aiming to provide targeted perinatal, neonatal intensive and developmental care to preterm infants (7–10). Studies evaluating the effectiveness of IVH care bundles have shown mixed results (7,9,11,12).

While some studies have shown significant reductions in preterm brain injury secondary to GMH-IVH (7,9,12), others have found no improvements(11). These bundles can be complex, requiring coordinated care and the execution of multiple tasks by an interdisciplinary team, which may result in variations in adherence. As a result, poor adherence may explain the lack of effectiveness observed in studies reporting no preventive benefit from IVH care bundles.

Figure 1: IVH Prevention Care Bundle Components

Perinatal Optimisation	Nursing Interventions	Medical Interventions
Preterm Care Bundle	Head position	Intubation and Ventilation
Optimal Birth Setting	Posture change	Management Of Hypotension
	Developmental Care & Pain Management	
	Preventing Rapid Fluid Shifts	

2.0 Guideline Scope

The aim of this guideline is to promote the provision of care based on best practices and the best available evidence to reduce rates of preterm injury caused by intraventricular haemorrhage. It is intended for use by neonatal professionals involved in the care of preterm infants. While antenatal optimisation is outside the scope of this guideline, it is addressed in the NENC Management of Preterm Birth guideline available on the Nornet website. The key areas covered in this guideline include:

1. Preterm care bundle
2. Optimal birth setting
3. Head position
4. Posture change
5. Intubation and ventilation
6. Developmental care and pain management
7. Preventing rapid fluid shifts
8. Management of hypotension

3.0 Main Guideline Content

3.1 Preterm Care Bundle:

Recommendation:
Implementation of a standardised preterm care bundle to optimize perinatal care and reduce preterm brain injury.

- The use of a standardised approach toward preterm perinatal care has been shown to improve outcomes (14–16).
- We recommend the following perinatal interventions, which have been shown to reduce preterm brain injury, and are also part of the BAPM framework for the 'Perinatal Management of Extreme Preterm Birth before 27 weeks of gestation'.

3.1.1 Antenatal Steroids:

Recommendation:

Mothers who give birth at a gestational age of <34 weeks should receive two doses of corticosteroids, administered 12 to 24 hours apart, and given more than 24 hours but less than 7 days before delivery.

- Evidence shows that antenatal steroids decrease the risk of severe IVH (15,17), especially in extremely preterm neonates.

3.1.2 Magnesium Sulphate

Recommendation:

Mothers delivering at a gestational age of less than 30 weeks should receive antenatal magnesium sulfate between 4 and 24 hours before delivery.

- It has been shown to reduce the risk of cerebral palsy by 32%(15,18) and probably reduces the risk of severe IVH in infants(19)

3.1.3 Deferred Cord Clamping:

Recommendation:

All babies should be offered deferred cord clamping for at least 60 seconds where feasible.

- Deferred cord clamping reduces the risk of any grade of IVH by improving the cerebral autoregulatory function (20,21).

3.1.4 Thermoregulation:

Recommendation:

Ensure normothermia (36.5°C - 37.5°C) in all babies at all times.

- A 28% increase in mortality has been reported for every 1°C drop in body temperature. Moderate hypothermia is associated with higher odds of intraventricular haemorrhage (OR 1.3) and death (OR 1.5) compared with a normothermic temperature in babies(15,22,23).

3.2 Optimal Birth Setting:

Recommendation:

Whenever possible, extreme preterm births should be managed in a maternity hospital co-located with a designated neonatal intensive care unit.

- Survival rates are highest for very preterm infants, especially those born at <28 weeks gestation, when cared for in centres with more experienced staff and higher patient numbers. A significantly higher risk of severe IVH has been reported for neonates born at <28 weeks and those who had ex-utero transfer within the first 72 hours of life (24,25).
- To prevent IVH, a strategy of in-utero transfer below 30 weeks gestation for birth in a maternity unit with a co-located NICU or HDU, where staff are trained to look after these vulnerable preterm infants is recommended(14,26,27).

3.3 Head Position:

Recommendation:

a) Preterm infants with a gestational age (GA) <30 weeks should be nursed in a midline position with the head elevated between 15–30 degrees during the first 72 hours of life.
   - In practice, most incubators can only achieve a tilt of 10–12 degrees. Therefore, aim for maximum achievable tilt, not exceeding 15-30 degrees recommendation.
   - Do not use additional device or improvised methods to increase head elevation beyond what the incubator safely provides.

b) To facilitate positional changes, preterm babies can be positioned supine or laterally, ensuring that the head stays aligned with the midline.

- Rotation of the head can lead to obstruction of the jugular venous-drainage system, leading to increased intracranial pressures and significant fluctuations in cerebral blood flow(7,28).
- This has been supported by early Doppler studies demonstrating occlusion of the jugular vein upon turning the head out of the midline position. This could lead to raised intracranial pressures and increased cerebral blood volumes altering cerebral oxygenation (29).
- Maintaining a midline position and elevating the head of the incubator by 15-30 degrees can aid cerebral venous drainage and reduce the risk of IVH(30,31).
- Although there were no effects on the rates of IVH (all grades), a small-scale systematic review performed to explore the impact of a midline position showed a reduced mortality rate for preterm babies who received the intervention (RR 0.49, 95% CI 0.25 to 0.93). Unfortunately, due to the size of the review, data was limited for a true assessment of the intervention (32).
- Further to this, a recently published RCT explores the relationship between an elevated midline position and all grades of IVH. Although there was no significant reduction seen in for Grade 1, 2, and 3 IVH, nursing preterm babies in an elevated position for the first 96 hours of life was found to be associated with a reduced risk of developing severe (Grade 4) IVH (p=0.036) (33).

3.4 Posture Change:

Recommendation:

a) Rapid lifting of the legs or sudden 180 turns should be **avoided** during handling, and the legs should **not** be raised above the level of the head.

b) Aim to perform **two-person** cares where possible under 30 weeks, ensuring 90-degree posture changes and side-lying nappy changes.

- Cerebral autoregulation is not fully developed in preterm babies due to their pressure-passive cerebral circulation. In addition to their fragile vasculature, this predisposes preterm babies to brain injury when rapid changes in blood flow occur (34,35).
- Routine procedures in extremely preterm babies such as endotracheal suctioning, repositioning, and nappy changes have been associated with significant fluctuations in cerebral blood flow (33,36).
- Raising the legs above the level of the head and heart can lead to increased venous return and preload, impacting cerebral blood flow and oxygenation (7,36).
- Side-lying nappy changes and skin-to-skin are safe and effective alternatives for the first 72 hours of life. (37).
- A multi-centre cohort study assessing the effectiveness of IVH care bundles, consisting of two aspects; 1) Posture (midline head, elevated head, avoidance of sudden leg elevation), 2) avoidance of rapid intravenous/arterial flushes/blood withdrawal. A significant reduction in the rate of IVH (of any grade), cystic PVL and/or mortality was observed in the intervention group (adjusted OR 0.42, 95% CI 0.27 to 0.65) (7).

3.5 Intubation and Ventilation:

3.5.1 Intubation by a Senior Staff Member

Recommendation:

In extreme preterm babies, ensure that intubation is carried out by experienced staff or by staff under supervision of consultant.

- Increased number of intubation attempts was linked to a greater risk of mortality and severe IVH in infants with birth weights between 750 and 1500 grams (38,52).

3.5.2 Avoid Unplanned Extubations

Recommendation:

a) Two-person handling and position changes is encouraged where possible.
b) Ensure the ETT is secure before position changes and moving babies for skin-to-skin.
c) Check ETT positioning regularly and document at the beginning of each shift.

- Unplanned extubation and repeated intubation have been associated with IVH, increased intracranial pressure, increased arterial pressure, hypercarbia, and hypoxia(39).
- Additionally, they extend the number of ventilation days for preterm babies, which further increases the risk of IVH and cPVL (40).

3.5.3 Volume Targeted ventilation (VTV)

Recommendation:

a) VTV should be the preferred mode of invasive ventilation for the high risk preterm infants.
b) Avoid carbon dioxide (CO_2) fluctuations (hypo and hypercarbia) in the first 72 hours.

- VTV has been shown to reduce the incidence of brain injury secondary to significant IVH and PVL (41).

- Fluctuations in carbon dioxide levels, including hypo- and hypercarbia, during the first 48 to 72 hours of ventilation in preterm infants are associated with an increased risk of brain injury, especially due to significant intraventricular hemorrhage (IVH) or periventricular leukomalacia (PVL). These fluctuations then directly affect cerebral blood flow, vascular resistance, and cerebral perfusion pressure. Volume-targeted ventilation (VTV) can help reduce the risk of IVH in high risk infants by minimizing hypocarbia and stabilizing carbon dioxide levels (41–43).

3.6 Developmental Care and Pain Management:

Recommendation:

a) Minimise exposure to excessive noise and light stimulation.
b) Ensure minimal handling and limit unnecessary and painful interventions.
c) Aim for optimal pain management – assess and document pain scores, offer non-nutritive sucking with breastmilk, sucrose, parental touch and comfort care.
d) Positive parental touch and comfort care should be encouraged at every opportunity to promote optimal neurodevelopmental care

- Reducing noise levels within the neonatal unit can promote neurological growth and reduce the risks of IVH. Excessive noise levels have been associated with heightened stress levels, increased oxygen requirements, apnoea, bradycardia, and tachycardia, all of which can contribute to adverse outcomes such as IVH, hearing impairment, and poor growth. Although recommended noise levels should not exceed 45 decibels, recordings of up to 100 decibels have been observed in neonatal intensive care units (44).
- Skin-to-skin contact, non-nutritive sucking, and breastmilk have all been linked to reducing the pain response in preterm babies. Specifically, skin-to-skin parental contact has been associated with longer periods of sleep and reduced crying time (45).
- Crying can cause an increased cerebral blood flow, elevated intracranial pressures, reduced venous draining, and therefore reduced cerebral oxygenation.
- A systematic review of 17 studies compared parental skin-to-skin contact with standard neonatal care. Results showed that during painful procedures, skin-to-skin contact significantly reduced heart rate, crying duration, and pain scores, highlighting the effectiveness of parental touch (46).
- Murthy et al. (2020) 'Drive to Zero' IVH bundle incorporated methods to reduce sensory overstimulation and minimise handling. Although not the only aspects within the bundle, an improvement in IVH and death rates was seen in both the initial study (adjusted OR 0.34; CI 95%, 0.20 to 0.59; P value < 0.001) and follow-up study assessing long-term neurodevelopmental impairment (adjusted OR, 0.34; CI 95% 0.17-0.68; P = 0.002) (9,47).

3.7 Preventing Rapid Fluid Shifts:

Recommendation:

a) Fluid shift as a consequence of rapid flushes through the venous lines or quick withdrawal of blood from the arterial lines should be avoided.
b) Slow withdrawal and flushing of lines over 60 seconds is recommended to promote physiological stability
c) This also includes giving empiric fluid boluses without clear indication, blood transfusions, and rapid sodium bicarbonate replacement, outside the context of an acute cardiopulmonary resuscitation scenario.

- Volume expansion could benefit infants with hypotension due to decreased preload, metabolic acidosis, and poor perfusion(48).
- There is no evidence from various randomised trials to support routinely giving early fluid volume expansion to preterm babies without cardiovascular compromise (49).
- The *rate* of volume expansion should always be carefully adjusted based on the clinical condition of the preterm infant. Rapid fluid boluses or blood transfusions should be avoided during the first week of life (especially within the first 72 hours) to prevent fluid overload in the pressure-passive cerebral circulation, which is prone to bleeding (50).

3.8 Management of Hypotension:

Recommendation:

a) A holistic approach should be used to monitor and manage systemic hypotension in preterm neonates, with an emphasis on addressing its underlying causes.
b) Where possible, central arterial access is the preferred method to monitor blood pressure in critically ill and vulnerable infants. In extremely preterm infants, cuff blood pressure readings should be interpreted with caution(51).

- Systemic hypotension has been linked to increased risk of IVH in preterm infants. Infants who have more significant instability in mean arterial blood pressure and spend extended periods outside the optimal blood pressure range have a higher risk of severe IVH (51).
- It is important to consider the underlying pathophysiology, instead of solely relying on stepwise, regimented protocols (52).

4.0 Monitoring & Audit

- Provision of antenatal measures will be monitored via the National Neonatal Audit Programme (NNAP)
- Volume Targeted Ventilation (VTV) will be monitored via the Saving Babies Lives (SBL) annual audit.

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