Implementing of a Neuro-bundle In Level III Neonatal Intensive Care Unit

Dr. Asma Almazrooei
Neonatologist and Neonatal Neurologist
KFAFH, Jeddah
IVH is a major problem in premature infants specifically those born before 32 weeks gestation and weighing less than 1500 grams.

IVH is associated with long-term neurologic consequences such as hydrocephalus, seizures, and cerebral palsy.

(Towers et al. 2000)
With increasing survival rates for the most premature infants, IVH rates have remained stagnant at approximately 20% with severe IVH at approximately 5%
The incidence of IVH is highest within the first 24 hours of life.

Approximately 90% of cases occur within the first 3 days of life.
IVH is attributed to the intrinsic weakness of the germinal matrix vasculature and to fluctuations in cerebral blood flow.
WHY DOES THE RISK OF IVH REDUCE AFTER THE FIRST SEVERAL DAYS OF LIFE?

- The immature neovasculature are pruned within a few days of premature delivery resulting in stabilization of the germinal matrix microvasculature.

- These changes are attributed to increases in oxygen concentrations above intrauterine levels after birth which then may down-regulate VEGF levels in the germinal matrix.

(Ballabh 2014)
Interventions performed during the first minutes, hours and days can influence survival and long term morbidity.

The measures to prevent IVH are extremely important in the first 3-4 days of life because this is when the majority of IVH’s occur.
IVH remains a significant complication of prematurity.

IVH Bundle intervention have been proven to decrease the incidence of IVH.

Thus, Using a quality improvement methodology, there is an opportunity to reduce the incidence of IVH among infants within NICU.
The bundle components are based on measures that reduce the risk of IVH, primarily though measures that:
Maintain hemodynamic stability

prevent disruption of cerebral blood flow

Strengthen fragile germinal matrix vasculature
With implemented designed a bundle of care practices that promotes the use of a multidisciplinary, collaborative approach that when consistently implemented in the care of very small prematurely born infants.
Extremely premature born infants and ELGA in the first 4 days of life are expected to provide neuroprotection and reduced the incidence and severity of intraventricular hemorrhage, ischemic brain injury (periventricular leukomalacia) and poor neurodevelopmental outcome.
The bundle will be implemented for infants born <30 weeks gestation admitted to NICU level III.
OUR AIMS
1. Reduce the incidence of IVH as per unit target.

2. Reduce the ventricular enlargement and post-hemorrhagic ventricular dilation.

3. Parenchymal echogenicity as defined as persistent parenchymal echogenicity detected after 21 days of age.
Infants < 30 Weeks And < 72 Hours Of Age

Brain care recommendation

Antenatal

Brain care recommendation

Postnatal
MATERNAL TRANSFER

**Action:**
If possible, recommend in-utero transfer to a tertiary care center specializing in high-risk delivery

**Rational:**
Interhospital transport of extremely premature infants is associated with increased incidence and severity of IVH.  
(Mohamed & Aly 2010)
GLUCOCORTICOIDs (STEROIDS)

Action:
Recommend administration of antenatal steroids for all pregnant women between 24 and 34 weeks gestation who are at risk of preterm delivery within 7 days (SOGC 2003) (if active treatment of the neonate is planned).

Rational:
Reduces the incidence and severity of IVH (Roberts et al 2006; Shankaran et al., 1995). Effects attributed to stabilization of the germinal matrix microvasculature and reduced disruption of cerebral blood flow.
MAGNESIUM SULPHATE

**Action:**
Recommend administration of magnesium sulfate for women with imminent preterm birth (≤ 31 + 6 weeks) (SOGC 2011)

**Rational:**
Provides fetal neuroprotection, specifically, decreases the risk of childhood cerebral palsy (JOGC 2011)
<table>
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<th>Action:</th>
<th>Recommend delayed cord clamping for 45-60 seconds in preterm neonates who do not require resuscitation</th>
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| Rational: | Delayed cord clamping provides ~10-15% additional blood volume (Aladangady et al 2006)  
- There is less IVH and less need for transfusion in preterm infants with delayed cord clamping (SOGC 2009) |
BRAIN CARE RECOMMENDATIONS
POSTNATAL INTERVENTIONS

9 Ways
ACHIEVE AND MAINTAIN NORMOTHERMIA

**Action:**

Aim to prevent hypothermia (<36 °C) and hyperthermia (>38 °C)

Use heat provision measures with close monitoring and documentation eg polyethylene plastic bag on blankets, chemical warming mattress

**Rational:**

Hypothermia associated with a higher risk of IVH (Miller et al 2011)
**Maintain Neutral/Midline Head Positioning**

**Action:**
- Avoid prone positioning
- Maintain neutral/midline head position in sidelying or supine
- Maintain neutral/midline head position during handling and procedure
- Head of bed elevated 30 degrees after NICU admission
  • Complete x-rays with head of bed elevated
  X-ray completion a 2 person procedure
### MAINTAIN NEUTRAL/MIDLINE HEAD POSITIONING

**Rational:**

- Turning infant’s head to the side affects jugular venous return and may affect intracranial pressure and cerebral blood flow.

- Tilting the head up and down in preterm infants alters cerebral blood volume (Pichler et al, 2001)
- ICP lower with HOB elevated 30 degrees (Goldberg et al, 1983)
MINIMIZE HYPOXEMIA AND PREVENT HYPOCAPNIA

Action:

• Intubation by experts
• Avoid hypocapnia < 35 mmHg
• After stabilization, target blood gas values:
  • pH 7.20-7.40
  • PaCO2 40-60 mmHg
• Timely adjustment of ventilation to achieve targets
• Avoid routine suctioning; suction based on physiologic signs
MINIMIZE DISRUPTIVE PROCEDURES

Action:

-Umbilical catheter insertion by expert
- Avoid early PICC and lumbar puncture (ie first 72 hours)
- Obtain staff physician approval if required
- If undertaken, completion by experts
- Avoid rapid volume administration
MINIMIZE DISRUPTIVE PROCEDURES

Rational:

• Minimize hypothermia and alterations in cerebral blood flow

• Minimize agitation and potential effect on cerebral blood flow

• May lead to fluctuations in cerebral blood flow due to effects on heart rate and oxygen saturation
GENTLE DIAPER CHANGES

Action:

- Slightly raise buttocks to change diaper
  • Avoid lifting legs
  • Infants < 1000 grams: open diaper for 4 days to minimize
  • groin irritation and potential skin breakdown
GENTLE DIAPER CHANGES

Rational:

• Minimize alterations in cerebral blood flow

• Minimize agitation and potential effect on cerebral blood flow

• Abrupt changes in venous return and cardiac preload with elevation of lower extremities (Limperopoulos et al, 2008)
GENTLE CARE

**Action:**

- Minimal and gentle handling
- Care by nurses with expertise in VLBW infant care
- Gently weigh and change under sheet once daily
- A 2 person procedure for 72 hours
- Provide nesting and containment
MINIMIZE LIGHT:

**Action:**

- Prevent constant exposure to light
- Cover isolette
- No direct light in infants’ eyes
MINIMIZE NOISE:

Action:

• Mute alarms swiftly

• Do not place objects on isolette

• Speak softly at bedside
For all target infants audit the following over the first 72 hours of life:

- Standard order set initiated
- IVH card at bedside for 72 hours
IVH CARD

- Gel rolls used for 72 hours.
- Midline/neutral head positioning
- HOB maintained at 30 degree
- Temperature <36C
- Blood gas CO2 measurements < 35 mmHg or >55 mmHg
- Blood gas pH measurements >7.40 or <7.20
- Highest mean arterial pressure (MAP) via manual or arterial catheter
- Blood sugar < 2.6 mmol/L
- No PICC or LP x 72 hours unless rationale provided
NEXT STEPS AFTER IMPLEMENTED THIS BUNDLE
PRIMARY OUTCOME

- Compare the following outcomes between pre-implementation and post-implementation periods:
  - Incidence of severe IVH defined as grade 3 or 4 IVH as per definition (grade 3 IVH (intraventricular hemorrhage with ventricular enlargement) or grade 4 IVH (IVH and persistent parenchymal echogenicity detected after 21 days of age).
  - Neurodevelopmental outcome at 18-24 months as measured on Bayley score (MDI, PDI, language)
SECONDARY OUTCOMES

- Compare incidence of severe IVH in infant’s whose mothers who did and did not receive at least one dose antenatal steroids 12 hours prior to delivery.
  Incidence of post-hemorrhagic hydrocephalus requiring shunt placement
- Audit of target population in first 72 hours.
BALANCING INDICATORS

- These will measure system performance difference after implementation and any unexpected unwanted outcomes.
- BPD, NEC and ROP rates.
TAKE HOME MESSAGE
Focus on the first days of life when risk of IVH is high and the events causing PVL often occur.

Optimize antenatal management and delivery so infant is born in optimal condition.

Facilitate transition as smoothly and gently as possible.

Once stabilization is complete the goal is “HANDS OFF AND EYES ON”.
Provide measures that support adequate circulation, oxygenation and ventilation.

Ensure health care team members practice minimal handling.

Minimize disruptive and painful interventions; defer if possible.

Promote developmental care and parental presence and touch.


REFERENCES