Reducing Intraventricular Hemorrhage in a Level III Neonatal Intensive Care Unit

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Background: Intraventricular hemorrhage (IVH) is a common complication of prematurity, with 10% to 30% of all premature infants receiving a diagnosis of IVH and 3% to 10% receiving a diagnosis of severe IVH (grade III or grade IV) during their NICU stay. IVH has been associated with adverse short and long term outcomes, including post-hemorrhagic hydrocephalus, cerebral palsy, global developmental delay, and death. Despite the identification of risk factors for IVH, the overall rate of IVH has remained stable for the last 10 years.

Aim: To reduce the incidence of severe (grade III or IV) intraventricular hemorrhage (IVH) in preterm infants (<30 weeks) in our NICU from 8% to 4% between October 2014 and December 2015.

Setting: The Intensive Care Nursery (ICN) at the Hospital of the University of Pennsylvania (HUP) is a 38 bed, level III NICU with approximately 660 admissions per year. Compared with similar NICUs, our unit has maintained an average overall rate of IVH. However, our rate of grade IV IVH has been in the top quartile of similar Vermont Oxford Network NICUs for the last 2 years.

Mechanisms and drivers of change: Premature infants are predisposed to IVH due to the fragility of the germinal matrix vasculature in conjunction with abrupt alterations in cerebral blood flow that may occur in the transitional period. Lower gestational age and birth weight, absence of antenatal corticosteroids, postnatal transport, severe RDS, hypotension, acidosis, patent ductus arteriosus, and coagulopathy are all clinical variables that increase the risk of developing IVH (Fig 1). Our team specifically addressed abrupt alterations in cerebral blood flow as a driver leading to development of severe IVH.

Methods: A multidisciplinary team drafted a project charter using the Model for Improvement framework. We implemented midline head positioning (MHP) as a technique to prevent occlusion of cerebral venous drainage during the first 7 days of life. We also developed a minimal handling bundle, which included a multidisciplinary admission huddle to avoid multiple physical assessments and avoid unnecessary changes to the plan of care (Fig 2). We also increased IVH awareness through the use of a readily available, web-based risk calculator (www.neqic.org/sivh-calculator). Finally, our unit standardized the length of time over which boluses and blood products are administered to high-risk infants, and standardized the volume of flushes to administer following medications.

Measures: Measures were collected retrospectively prior to the start of the project and then prospectively.

Outcome measures:
- Severe IVH rate (%) by birth month
- Overall IVH rate (%) by birth month

Balancing measure: Rate of unplanned extubation

Process measures:
- MHP compliance (%)
- Admission huddle compliance (%)
- Use of IVH risk calculator (%)

Data/Results: Project implementation began in October 2014. The average monthly rate of severe IVH has decreased from 8.3% in FY 14 to 5.1% in FY 15 (Fig 3). Our unit completed a run of 227 days and 37 infants <30 weeks without severe IVH despite infants with similar IVH risk during the intervention period. Our MHP compliance remains at 100% based on random audits, and admission huddle for infants <30 weeks has also remained at 100% (Fig2).

Discussion: Historically, IVH has been viewed as an inevitable complication of extreme prematurity. By raising awareness of categorical risk and implementing potentially better practices, we have been able to demonstrate a measureable reduction in severe IVH rates in our unit. Future directions include implementation of delayed cord clamping to minimize perinatal fluid shifts, re-examining the use of prophylactic indomethacin for IVH prevention, and expanding monthly meetings to include on service providers and nursing to review IVH cases.
Figure 1. Driver diagram.

Aim: To reduce the incidence of severe (grade III or IV) IVH in preterm infants (<30 weeks) in the Intensive Care Nursery from 8% to 4% by December 2015.

Primary drivers:
- Impaired cerebral autoregulation
- RDS

Secondary drivers:
- Rapid increases in intravascular volume
- Rapid changes in CO2/pH
- Blood loss (bleeding, large volume blood draws)
- Suboptimal developmental care
- RDS

Interventions:
- Limit infusion rate of blood products to 3 hours or greater*
- Limit infusion time of saline boluses to 30 minutes or greater*
- Minimum infusion time for bicarbonate: 30 minutes*
- Multidisciplinary team meetings**
- Use of IVH risk calculator to increase awareness of IVH risk*
- Prophylactic indomethacin (0.1 mg/kg q24 hrs x 3 doses, initiated within 6 hours of birth)**
- Delayed cord clamping**
- Midline head positioning for 7 days*
- Elevate head of bed 30 degrees*
- Minimal handling bundle:
  - Multidisciplinary admission assessment
  - Multidisciplinary admission huddle
  - O6-8 hour care (when appropriate)
  - Eliminate 4 extremity BP's on admission
- Preferential use of volume targeted ventilation**

*Current practice
**In process
Figure 2. Admission huddle checklist.
The admission huddle occurs within 15 minutes of admission. The infant is assessed by the nursing and medical teams, followed by a brief recap of the history and the admission plan for the infant with special attention to the items below. This is the 7th version of the admission huddle form.

HUP Intensive Care Nursery Admission Huddle

Date: ________________ Time: ________________

Present:
- RN
- Attending MD
- Resident MD
- Fellow MD
- NP/PA
- RT
- Lactation

Recap of plan (Complete AT THE BEDSIDE at time of admission):

**FEN:**
- TFL: ______ ml/kg/day
- Fluids: D10, starter TPN (<1500 g) Other Feeds: NPO, BM, formula
- 34 weeks: Please see separate guidelines.
- **Is mom planning to breastfeed? Please notify lactation ASAP!**

**Heme:**
- Blood products needed?
- Phototherapy?

**Resp:**
- Vent settings: ________________
- Will the ETT be adjusted?
- Vitamin A (<1000 g)
- Caffeine
- Surfactant next due: ______
- Pro/post sets needed?

**Neuro:**
- Midline head position needed (<30 weeks)?
- Calculate IVH risk if <30 weeks: ______ %
  (http://www.necqic.org/sivh-calculator)

**CV:**
- Access needed?
- Will the lines be adjusted?

**Lab:**
- Blood culture drawn?
- Antibiotics:
- Maternal hep B/HIV status known?

**Have the parents been updated?**
- Consents needed:
  - Blood
  - PICC
  - DBM
- Vitamin K/Erythromycin given?

**ID:**
- UDS needed? (Scant PNC, maternal history or UDS positive for substance use)
  - Next OXR/babygram due at: ______ 

**Were there any issues during the resuscitation? What went well?**

Please place in folder located in physician's work area! Thank you!

6.23.15
Figure 3. IVH by patient. This figure denotes the IVH grade, assessed up to 28 days of life, for each patient <30 weeks admitted to the HUP ICN from January 2014 to June 2015. Specific interventions are indicated as below.

Figure 4. Admission huddle compliance, by month.