

REVIEW OF SEVERE NEUROLOGIC INJURY IN BC WOMEN'S HOSPITAL NICU: Identifying opportunities for improvement



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Canadian Neonatal Network (CNN) Definition of Severe Neurological Injury

- Grade III GMH-IVH and/or PVHI
- PHVD with VI > 97th centile + 4 mm OR AHW > 10 mm, or requiring surgical intervention
- Porencephalic cyst
- Grade 3 or 4 WMI
- Massive cerebellar hemorrhage (= 1/3 of the cerebellar hemisphere involved), unilateral or bilateral.

Clinical Practice Guidelines for CNN, March 2020

Objectives

- Use the EPIQ sentinel events review form to identify potential areas of improvement
- Analyze the implementation of evidence-based recommendations to prevent SNI
- Spanning the last 5 years, from 2015 to 2019.

Population

- <33 weeks of Gestational Age babies with SNI detected by head Ultrasound
- Born at BC Women and Children's Hospital (BCWH) or transferred here within 72 hours of birth and admitted to the BCWH NICU
- January 1, 2015 and December 31, 2019

Babies with major congenital malformations were excluded.

Method

- Retrospective cohort study
- Sentinel Event Review form from the CNN's Evidence-based Practice for Improving Quality (EPIQ 3) bundle was used to analyse
- Data of babies with grade 3 and 4 IVH and severe PVL.

Sentinel Event Review form for Severe Neurological Injury

Outcomes of concern: IVH G3, IVH G4, PVL

Demographics:						
CNN Case ID:		Date of Review:		Date of Birth:		Time of Birth:
Gestational Age:		Birth Weight:		Inborn/Outborn:		
Date of the diagnosis:						
REVIEW ELEMENTS						
Antenatal						
Did mother receive 2 doses of antenatal steroids?				Yes	No	Unknown/NA
Was there clinical or histological chorioamnionitis?				Yes	No	Unknown/NA
If yes, did mother receive antibiotics?				Yes	No	Unknown/NA
Was there placental abruption?				Yes	No	Unknown/NA
Was there cord prolapse?				Yes	No	Unknown/NA
Was there any documented fetal bradycardia?				Yes	No	Unknown/NA

Intrapartum			
Did mother receive intrapartum MgSO4?	Yes	No	Unknown/NA
Was there delayed cord clamping for ≥ 45 secs?	Yes	No	Unknown/NA
Was there milking of the cord?	Yes	No	Unknown/NA
What was the mode of delivery?	Vaginal_____ CS_____		
Did mother receive general anaesthesia?	Yes	No	Unknown/NA

Resuscitation (delivery room)			
Was there a trial of CPAP during resuscitation?	Yes	No	Unknown/NA
Did baby receive chest compression/ or epinephrine?	Yes	No	Unknown/NA
Was Apgar score <5 at 5 minutes?	Yes	No	Unknown/NA
Was the baby intubated?	Yes	No	Unknown/NA
If yes, number of attempts? Any recorded bradycardia?	Yes	No	Unknown/NA
Did baby receive surfactant within 60 minutes of intubation?	Yes	No	Unknown/NA
Did baby receive fluid boluses? If yes, volume ____ ml/kg	Yes	No	Unknown/NA
Was the cord pH below 7.0?	Yes	No	Unknown/NA

Post-resuscitation (in first 72h)			
Ventilation			
Was baby intubated in first 72h?	Yes	No	Unknown/NA
If yes, was premedications used?	Yes	No	Unknown/NA
If intubated, number of attempts? ____ Any recorded bradycardia?	Yes	No	Unknown/NA
Was baby re-intubated in first 72h?	Yes	No	Unknown/NA
Did baby develop an air leak requiring drainage?	Yes	No	Unknown/NA
Were there PCO2 below 35 ?	Yes	No	Unknown/NA
Were there PCO2 higher than 55 ?	Yes	No	Unknown/NA
Was there documented pH greater 7.40 ?	Yes	No	Unknown/NA
Was there documented PH less than 7.20 ?	Yes	No	Unknown/NA
What was the highest MAP in the first 72h: _____ cm H ₂ O	Yes	No	Unknown/NA

Attempts to minimize hemodynamic fluctuations			
Did baby receive inotropes?	Yes	No	Unknown/NA
If yes, did baby receive cardiac functional evaluation?	Yes	No	Unknown/NA
Did baby receive bicarbonate infusion?	Yes	No	Unknown/NA
Did baby receive prophylactic indomethacin?	Yes	No	Unknown/NA
Did baby receive fluid boluses? If yes, volume _____ ml/kg	Yes	No	Unknown/NA

Other			
Did baby have sugar <2.6 mmol/l? (Lowest sugar level ___) If Yes, Please specify	Yes	No	Unknown/NA
Was there documented hypothermia (<36° C)?	Yes	No	Unknown/NA
Was pain & agitation addressed as per unit guidelines?	Yes	No	Unknown/NA
Lowest platelet count in the first 72h: _____	Yes	No	Unknown/NA

At any time prior to severe neurological injury:

Did baby receive CPR after delivery room resus?	Yes	No	Unknown/NA
After 72 h did baby receive inotropes for hypotension?	Yes	No	Unknown/NA
Did baby have nosocomial infection?	Yes	No	Unknown/NA
Did baby develop significant PDA requiring treatment	Yes	No	Unknown/NA
<u>Adequacy of record documentation for proper evaluation</u>	Yes	No	

Domain	Intervention	Evidence
Avoid hypocapnia or hypercapnia	Avoid PCO2 below 35 or above 55, pH above 7.40 in the first week of life by: <ul style="list-style-type: none"> - monitoring blood gas closely when initiating ventilation (utilize non- invasive tcPCO2 if available) -using aggressive approach to wean the ventilation -avoiding hand bagging, particularly prolonged hand bagging 	1C
Avoid the use of bicarbonates	Avoid the use of bicarbonate <ul style="list-style-type: none"> -tolerate pH down to 7.20 -avoid reacting to a single blood gas, particularly if it is the first one after birth and/or a capillary blood gas -optimize ventilation if it is a mixed acidosis (with respiratory component) 	1C
Minimal handling & gentle care	Develop a team strategy in the NICU for minimal handling & gentle care of the extremely premature infant <ul style="list-style-type: none"> -Implementation of an intervention bundle -Focus on the first days of life where the risk of IVH is high and the events that increase the risk of PVL may occur. The first hours of life are crucial. 	1C
	Avoid significant rotation of the head especially for GA < 26 weeks for the first 72 hours. Consider raising the head by 30 degrees for the first 72 hours.	2B
Saline bolus	Avoid boluses of normal saline	2B
Antenatal Steroids	2 doses of steroids started 48h before delivery	1A
Delayed cord clamping	DCC for < 32 weeks GA DCC for 45 seconds to 1 minute	2A
Use antenatal MgSO4	Administer MgSO4 to mother at risk of premature delivery	1B
Prophylactic Indomethacin	Administer indomethacin 0.1 mg/kg/day for 72 hours starting within 6 h of age in baby < 1kg	2A

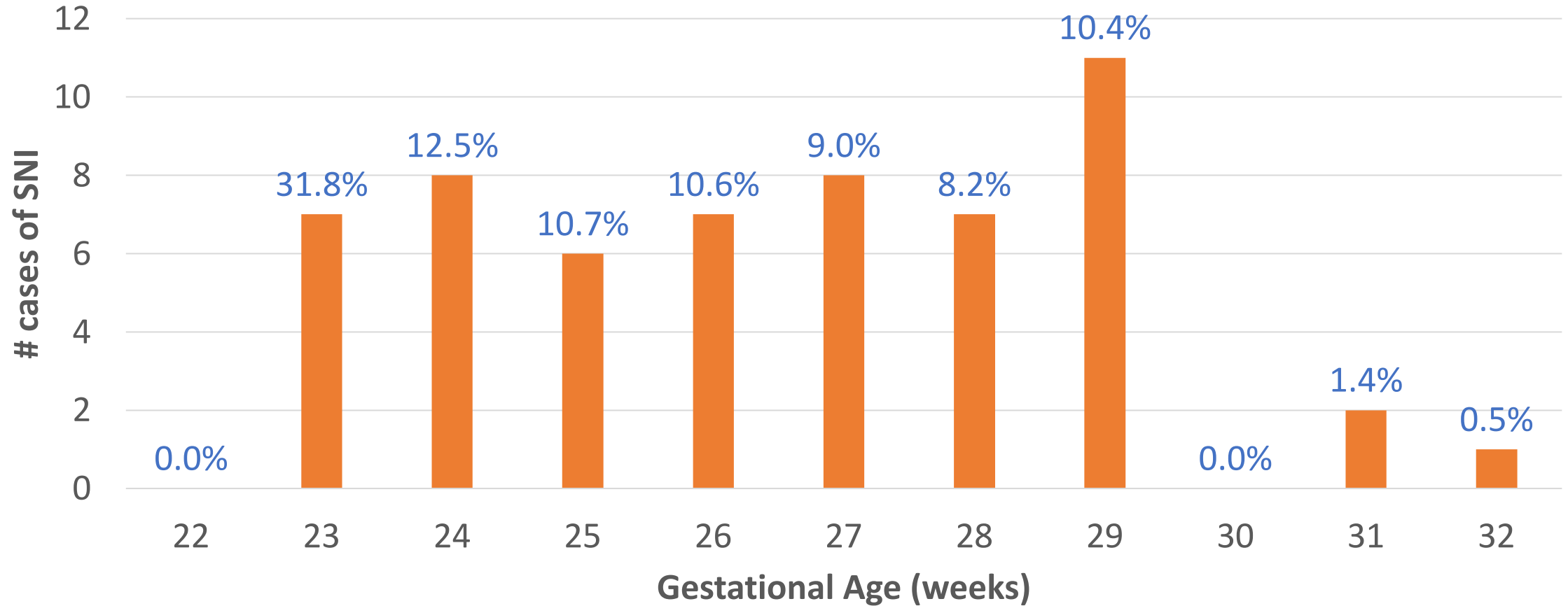
Statistical Analysis

- Exploratory analysis using descriptive statistics and chi-square, Fisher's exact tests, regression models
- Sub-group analysis
 - Inborn vs outborn
 - ≤ 26 weeks GA vs. > 26 weeks GA

Results

- 64 babies had SNI according to CNN data but 61 met inclusion criteria
- Often higher SNI rate than CNN network rate of 7.1-7.8% per year

Distribution of SNI by GA



Percentages above bars indicate % of SNI within each GA ($\# \text{ SNI} / \text{number of infants with same week GA}$)



Differing trends in
GA \leq 26
weeks GA

- 49.1% of infants were \leq 26 weeks
- Higher odds of hypernatremia (64.2% vs 20.0%, $p = 0.001$)
- Higher odds of hypercarbia (82.1% vs 53.3%, $p = 0.008$)

Conclusion

Factors that may contribute to SNI have largely remained prevalent and unchanged over time

Improvement in ANS and MgSO₄ over time in our cohort

Outborn infants were less likely to receive ANS and MgSO₄ and more likely to be hypothermic

≤26 weeks GA higher rates of hypernatremia and hypercapnia

Half of infants with SNI > 26 weeks → crucial to improve adoption of evidence-based neuroprotective strategies across GA

Improvement in documentation for interventions such as DCC required

Next steps

Create awareness

Present our findings to neonatal and obstetric/MFM team members to create awareness on opportunities for improvement

Implement change

Use the EPIQ process to identify strategies to target the contributing factors and implement interventions to reduce IVH in small baby care protocol being developed by our site

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