Newborn Glucose Management
Clinical Decision Support System

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2:45 PM
Objectives

1. Describe a newborn hypoglycemia risk protocol to assess, monitor and assure glucose homeostasis

2. Measure the value of Clinical Decision Support Systems that automate newborn glucose management and reduce human error
Health System Summary

• 3 Hospitals
  – 3700 births/year
  – 500 NICU admissions/year
  – 17,300 admissions/yr
  – 45,500 ED visits/yr

• 21 Clinics
  – 500,000 clinic visits/yr

• Staff
  • Medical 1,150
  • Mid level 250
  • All other 2,800
Newborn Hypoglycemia

– Current evidence does not support a specific concentration of glucose that can discriminate normal from abnormal or can potentially result in acute or chronic irreversible neurologic damage. (Adamkin, 2011)
  • Ranges from <28mg/dL to <45mg/dL. (Cornblath, 2000, Kalhan, 2000)
Newborn Hypoglycemia

• Definition
  – Dr. Adamkin and the Committee on Fetus and Newborn state “a rational definition of [newborn] hypoglycemia must account for the fact that acute symptoms and long-term neurologic sequelae occur within a continuum of low plasma glucose values of varied duration and severity (Adamkin, 2011)
  – Early identification of the at-risk infant and institution of prophylactic measures to prevent neonatal hypoglycemia are recommended since there is no consistent definition of hypoglycemia in the literature (Adamkin, 2011)
Newborn Hypoglycemia

- Affects 3-43% of all full term newborns (Johnson, 2003)
  - Prolonged and untreated hypoglycemia in the newborn may result in acute systemic effects and serious, long term adverse neurologic sequelae. (Cornblath, 2000)

- Literature
  - American Academy of Pediatrics suggests that routine screening for hypoglycemia in newborns should first include an assessment of the mother and infant for risk factors and not be performed in the absence of such factors. (Hoops, 2010)
    - This approach is also supported in the Clinical Report produced in March, 2011 on “Postnatal Glucose Homeostasis in Late-Preterm and Term Infants”
Newborn Hypoglycemia

• Risk Factors
  – Most commonly occurs in infants with impaired glucogenesis and/or ketogenesis
  – Newborn hypoglycemia occurs most often in the following infants:
    • Small for gestational age
    • Infants born to mothers who have diabetes
    • Late-preterm infants
  – Infants who are large for gestational age are also at risk
Newborn Hypoglycemia

• Clinical Signs
  – Not specific
  – Include a wide range of local or generalized manifestations that are common to sick newborns
  – Signs & Symptoms include:
    • Jitteriness
    • Cyanosis
    • Seizures
    • Apneic episodes
    • Tachypnea
    • Weak or high-pitched cry
    • Floppiness or lethargy
    • Poor Feeding
    • Eye rolling
Newborn Hypoglycemia

• When to screen and for how long?
  – Data on optimal timing and intervals for glucose screening are limited
  – What we do know
    • Normal transition of newborn glucose values
      – 1-2 hours after birth: values can go as low as 30 mg/dL
      – Increase to higher and more stable concentrations (generally > 45 mg/dL) by 12 hours of age
  – Controversy
    • Do we screen the asymptomatic at-risk infants during the normal physiologic nadir period?
Newborn Hypoglycemia

• Bottom Line…
  – At-risk infants should be screened for newborn hypoglycemia with a frequency and duration related to risk factors specific to the individual infant. (Adamkin, 2011)
  – The point at which interventions are indicated needs to be tailored to the clinical situation and the particular characteristics of a given infant. (Adamkin, 2011)
    • Prompt intervention is necessary for infants who manifest clinical signs and symptoms.
Local data for % of hypoglycemia per risk factor
Protocol Development

- POC Glucose 30-60 minutes after birth
- Identification of infant risk factors
  - High Risk
    - SGA/IUGR
    - Prematurity (< 37 weeks by dates or exam)
    - 5 minute Apgar < 5
  - Infant of a Diabetic Mother (includes Gestational Diabetes, Type 1 and Type 2)
  - LGA or Postdates
    - Large for Gestational Age
    - Postdates (> 42 weeks gestation)
- Protocol with low risk, high risk, and LGA/Postdates blood sugar frequencies
- Assessment of risk factors done by nursing
- Selection and initiation of appropriate protocol done by nursing
- Protocols on paper
6 months after initiation
Medical Staff Dissatisfaction with protocol process
Problem Addressed

- **Dissatisfaction** with current protocol process validated
- **21% error rate**
  - The breakdown of errors included:
    - no protocol orders entered when indicated=43 34%
    - >30 minutes before orders entered=37 29%
    - wrong protocol orders entered=26 21%
    - duplicate protocol orders entered=10 8%
    - POC glucose not collected=6 5%
    - risk factors not recorded=4 3%
Develop a method to support the appropriate newborn hypoglycemia risk assessment, protocol selection and protocol initiation by nursing
Intervention/Change implemented

• Automation of newborn glucose protocol based on hypoglycemia risk factors rather than relying on human factor.

• Automation via Clinical Decision Support in Electronic Medical Record (EMR)
  – Hypoglycemia Subcommittee and Pediatric department approval for the Clinical Decision Support automated in EMR
  – Medical Executive approval for Clinical Decision Support automated in EMR
Newborn Glucose Management
Clinical Decision Support System

- Rules based
- Boolean logic - "if → then"

Knowledge Base (rules)

Data entered → Inference Engine → Decision
EMR Changes

- Moved documentation to baby chart
- Required fields guide documentation
- Logic included to avoid duplication in the event multiple risk factors evoked multiple protocols.
- Protocol orders directly entered into the chart.
- Protocol orders printed for provider signature
Original Risk Factor Documentation on mother’s Chart
Manual graphing on paper growth chart
Documentation moved to baby chart
Newborn Hypoglycemia Risk Factors

Infant of Diabetic Mother (IDM)?

☐ No
☐ Yes

An Infant of a Diabetic Mother Includes:
- Gestational Diabetes (Including Diet Controlled)
- Type 1 Diabetes
- Type 2 Diabetes

Was 5 Minute Apgar less than 5?

☐ No
☐ Yes

Intrauterine Growth Restricted (IUGR)?

☐ No
☐ Yes

Intrauterine Growth Restriction (IUGR) is a Physician Diagnosis Prenatally. After Birth, Determine if the Infant Still Meets This Criteria (i.e. SGA). If Not, Clarify With MD That This is No Longer a Risk Factor.
Online growth chart in EMR

Standardize determination of Weight per Gestational Age

<table>
<thead>
<tr>
<th>Table</th>
<th>Plot by Corrected Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight-for-age, 0-36 months, Girls</td>
<td></td>
</tr>
</tbody>
</table>

Weight-for-age, 0-36 months, Girls

![Graph of Weight-for-age, 0-36 months, Girls](image)

Preterm Weight-for-Age 22-50 Weeks. Fenton, 2003

![Graph of Preterm Weight-for-Age 22-50 Weeks.](image)
Clinical Decision Support Automates Orders directly into EMR

<table>
<thead>
<tr>
<th>Status</th>
<th>Description</th>
<th>Date/Time Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordered</td>
<td>Newborn Glucose</td>
<td>08/30/11 14:40:54, Feed newborn by 1 hour of life. Offer feeds a minimum of every 3 hours. Ordered from Rule</td>
</tr>
<tr>
<td>Completed</td>
<td>Glucose POC - RN</td>
<td>08/30/11 19:40:54, Q3H, 3, Dose(s)/Time(s). 08/31/11 4:59:00, 1, do ACG glucose every 2-3 hours x 3 f... Ordered from Rule</td>
</tr>
<tr>
<td>Completed</td>
<td>Glucose POC - RN</td>
<td>08/30/11 16:40:54, ONCE AT. 08/30/11 16:40:54, 1 Ordered from Rule</td>
</tr>
</tbody>
</table>
Orders auto print and are placed on chart for provider co-signature
Staff Education

• Scenario training included in annual nursing competency education
• Target audience L&D and Mother/Baby staff nurses
• Ongoing monitoring and follow up education provided as needed
• Development of support tools
Outcomes

- Decrease in error rate
- Increased awareness by nursing of hypoglycemia risk factors and associated protocols for follow up
  - Proactive surveillance vs reactive care based upon signs/symptoms
# Improvements Noted

<table>
<thead>
<tr>
<th>Breakdown</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Error Rate</td>
<td>21%</td>
<td>7%</td>
</tr>
<tr>
<td>Omission</td>
<td>34%</td>
<td>0%</td>
</tr>
<tr>
<td>Timing over 30 minutes</td>
<td>29%</td>
<td>62%</td>
</tr>
<tr>
<td>Wrong Protocol</td>
<td>21%</td>
<td>0%</td>
</tr>
<tr>
<td>Duplicate</td>
<td>8%</td>
<td>23%</td>
</tr>
<tr>
<td>Glucose not drawn</td>
<td>5%</td>
<td>0%</td>
</tr>
<tr>
<td>Risk factors not documented</td>
<td>3%</td>
<td>15%</td>
</tr>
</tbody>
</table>
Lessons Learned

• While automation of hypoglycemia protocol assured a higher level of care and surveillance for the newborn, changing nursing documentation behavior is challenging and real time monitoring of documentation error leading to CDS error is essential to change behavior.
Next steps

• Ongoing monitoring to validate effectiveness of protocol
• Standardization across health system
• Automation of orders for electronic provider signature
References

Questions

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