Hypoglycemia and the Rapid Response Team

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Recognition of the Problem 2001

- A review of condition calls by the hospital safety committee revealed the occurrence of several episodes of severe hypoglycemia in the hospital that were associated with a poor patient outcomes.
- The Endocrine Division was approached to create recommendations for treatment and prevention of hypoglycemic events in the hospital.
- Initial review of computerized database revealed hypoglycemia as a frequent, dangerous event for which there was no reporting mechanism and no standard treatment approach.

Hypoglycemia in the hospital

What we learned

- Unrecognized and inappropriately treated hypoglycemia can be associated with severe morbidity and mortality
- There is an under appreciation of the contribution of sulfonylureas as a risk for severe and prolonged hypoglycemia
- There was no published data on the frequency of hypoglycemia in the inpatient setting
- Concern for hypoglycemia represented a major barrier to glycemic control in the hospital

Patient Case

82 year old woman with type 2 diabetes treated with glyburide and metformin admitted with BG 26 mg/dl
Diabetes Consult called for persistent hypoglycemia despite IV D50 and IV Dextrose infusions over a period of 6 hours.
Treated with Octreotide 50 mcg SQ
Hyperglycemia developed 24 hrs following Octreotide prompting start of scheduled insulin therapy

The beginning of the Diabetes Inpatient Safety Committee

A multidisciplinary committee was formed with representation from
Endocrinology
Nursing
Pharmacy
Critical Care Medicine
General Medicine

What was the frequency of hypoglycemia at UPMC?

Initial tasks for the committee:
- Define the frequency of hypoglycemia
- Create a treatment algorithm for hypoglycemia that will be used by nurses and physicians.
Frequency of hypoglycemic events
Hypoglycemia Treatment Protocol 2001

Frequency and severity of hypoglycemia during the month of May 2001 conducted using MARS database

<table>
<thead>
<tr>
<th>Severity</th>
<th>&lt;70 mg/dl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>50-69 mg/dl</td>
</tr>
<tr>
<td>Moderate</td>
<td>40-49 mg/dl</td>
</tr>
<tr>
<td>Severe</td>
<td>&lt;40 mg/dl</td>
</tr>
</tbody>
</table>

Database screened for all bedside blood glucose values (GLUP/GLUT) ≤ 70

Events defined by intervals of 4 hours
Nadir BG during 4 hr period defines severity of event
Data for patients identified as being in a critical care unit at time of event subtracted from total data set

Nurse Initiated Hypoglycemia Treatment Protocol Introduced 2001

For mild (50-69 mg/dl) hypoglycemia, give one of the following:
- 4 oz Orange/Apple Juice
- 3 Graham Crackers
- 1 tube Glucose Gel

If NPO or unable to swallow:
- 20 ml D50 IV & start IV D5W @100 mL/h

For moderate (40-49 mg/dl) hypoglycemia, give one of the following:
- 8 oz milk (or juice) & 3 graham crackers
- 2 tubes Glucose Gel (if able to swallow only thickened liquids)

If NPO or unable to swallow:
- 50 ml D50 IV (1 amp) and start IV D5W @100 mL/h

For severe hypoglycemia (< 40 mg/dl), give:
- 50 ml D50 IV (1 amp) and start IV D5W @100 mL/h

Hypoglycemia Treatment Protocol

- Repeat BG & treatment every 15 minutes until BG ≥ 70
- If hypoglycemia persists following third treatment, call Diabetes Consult Service
- Notify physician after treatment started and patient stabilized
- Allowance for Glucagon injection in patients who are NPO and/or without IV access
- Diabetes Consult suggested for patients receiving sulfonylureas

Hypoglycemia Treatment Protocol

Hypoglycemia events outside critical care units
Number of events per 1000 patient days

Hypoglycemia Treatment Protocol

Hypoglycemia Unawareness in the Hospital

Case control retrospective study
60 patients age > 65
Hospitalized on an acute medical or geriatrics ward
Hypoglycemia defined as BG < 50 mg/dl
Mean nadir BG 39 ± 7 mg/dl

Only 23/60 (38%) hypoglycemic episodes noted at time of occurrence
Mortality in group experiencing hypoglycemia 48%

Hypoglycemia Recognition and Treatment
Nurse Confidence

Baseline testing
Post test
3 month follow up

p < 0.003


Nurse Knowledge of Hypoglycemia Recognition and Treatment

Baseline testing
Follow up
3 month follow up

p < 0.001
p = .002
p < 0.001


Hypoglycemia events outside critical care units
Number of events per 1000 patient days
May 2001 and 2002 corrected for patient days

Hypoglycemia events outside critical care units
Number of events per 1000 patient days
May 2001-2006 corrected for patient days

Targeted Review of Inpatients Experiencing Severe Hypoglycemia

Causes of hypoglycemia

• Sliding scale insulin 7(33%)
• Change in nutrition without insulin adjustment 4(19%)
• Infrequent BG monitoring 2 (10%)
• Patient refusal 1 ( 5%)
• Other illness 5 (24%)
• Unable to determine cause 2 (10%)

Evolution of the DPSC
Summary and conclusions

• The Hypoglycemia Treatment Protocol (HTP) was an important first step in addressing uncontrolled blood glucose in the hospital
• An investigation of the causes of hypoglycemia helped to direct the activities of this committee in addressing hyperglycemia
Targeted Review of Inpatients with Hyperglycemia

<table>
<thead>
<tr>
<th>Reason for Hyperglycemia</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home diabetes medications not continued in the hospital</td>
<td>21 (22%)</td>
</tr>
<tr>
<td>Inadequate insulin dose adjustments based on obtained BGs or change in clinical status</td>
<td>18 (19%)</td>
</tr>
<tr>
<td>Initiation of corticosteroid therapy</td>
<td>13 (14%)</td>
</tr>
<tr>
<td>Sliding scale monotherapy for &gt;48 hours</td>
<td>10 (10%)</td>
</tr>
<tr>
<td>No prandial insulin ordered in patients who were eating</td>
<td>9 (9%)</td>
</tr>
<tr>
<td>Medication error</td>
<td>7 (7%)</td>
</tr>
<tr>
<td>Poor glycemic control prior to admission</td>
<td>6 (6%)</td>
</tr>
</tbody>
</table>

Reduction of Time Spent in Hypoglycemia Following Implementation of the HTP

<table>
<thead>
<tr>
<th>Age group</th>
<th>Year</th>
<th>Hypoglycemic States</th>
<th>Normal or At-risk</th>
<th>Hypoglycemic States</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;30</td>
<td>2001</td>
<td>9.0%</td>
<td>57.8%</td>
<td>33.3%</td>
</tr>
<tr>
<td></td>
<td>2006</td>
<td>4.3%</td>
<td>59.6%</td>
<td>36.1%</td>
</tr>
<tr>
<td>30-65</td>
<td>2001</td>
<td>5.9%</td>
<td>60.7%</td>
<td>33.4%</td>
</tr>
<tr>
<td></td>
<td>2006</td>
<td>4.4%</td>
<td>62.7%</td>
<td>32.9%</td>
</tr>
<tr>
<td>&gt;65</td>
<td>2001</td>
<td>25.4%</td>
<td>44.1%</td>
<td>30.5%</td>
</tr>
<tr>
<td></td>
<td>2006</td>
<td>4.1%</td>
<td>66.9%</td>
<td>29.0%</td>
</tr>
</tbody>
</table>

Summary

- The HTP was associated with a reduced frequency and severity of hypoglycemia in each age group.
- There was an increase in the amount of time spent with BG 80-180 mg/dl.
- The use of the HTP in adult inpatient reduces costs.

While other factors may have contributed to these changes, this type of analysis may be useful in allowing hospitals to monitor the safety of glycemic interventions over time.

The HTP and the Rapid Response Team

- Prior to implementation of the HTP, there was no standardized treatment for the management of patients with a bedside BG < 70 mg/dl.
- Delays in treatment of hypoglycemia resulted in progression to severe hypoglycemia with a change in level of consciousness prompting an alert to the RRT.
- The HTP resulted in a decrease in the frequency of alerts to the RRT.
- In those instances of hypoglycemia requiring the RRT, treatment by the nurse is initiated once there is confirmation that a low blood glucose is the cause of the change in clinical status.

Print on Demand Order Sets at UPMC Diabetes Management

- Diabetes Management Order Sets
- Hypoglycemia Treatment Protocol
- Diabetes Admission Order Set
- Insulin Order Set
- Insulin Pump Order Set and Guideline
- IV Insulin Order Set
- Regular Insulin Sliding Scale Order Set
- Perioperative glycemic management
- Diabetic Ketoacidosis
Recommendations for success

- Involve personnel directly involved in the daily use of the Hypoglycemia Treatment Protocol in plans for implementation and dissemination
- Educate physicians and nurses on all inpatient services where protocol will be used
- Reinforce education regarding the recognition and treatment of hypoglycemia
- Train all incoming personnel