Background

For many years, insulin sliding scale is often used as the sole source of insulin to treat hyperglycemia due to diabetes, in the hospital setting. Practice guidelines have recommend a structured, proactive approach to manage, such as Basal-Nutritional-Correction (BNC).

The BNC approach mimics normal physiologic insulin secretion:
- Basal-long acting; to cover rise in glucose due to glucose metabolism
- Nutritional-short acting; to cover rise in glucose due to meals
- Correction-short acting; given for unanticipated hyperglycemia

A pre-printed order (BNC-PPO) was implemented on vascular surgery (TS) at Vancouver General Hospital (VGH) in January 2011. Evaluation of the BNC-PPO is a quality improvement step prior to expanding its use to other areas within the hospital.

Objectives & Outcomes

Primary:
- To determine if the BNC-PPO has resulted in improved glycemic control in comparison to standard care through mean daily blood glucose over length of stay.

Secondary:
- To determine if the BNC-PPO has resulted in:
  - fewer hypoglycemic episodes (BG < 4mmol/L)
  - fewer mild (8.1-9.9mmol/L), moderate (10.1-11.9mmol/L) and severe (≥12mmol/L) hyperglycemic episodes
  - reduced daily glucose variability

To determine if the BNC-PPO has improved prescribing and administration practices.

Methods

Design: Retrospective chart review at Vancouver General Hospital

Sample Size: n=33, effect size = 0.5, alpha=0.05, power=80%

Patient Population: Adult diabetic patients admitted to TS at VGH during the following periods:
- Pre-PPO period: June 2009-December 2010
- Post-PPO period: April 2011-August 2012

Inclusion Criteria: Adult patients (any visit), prescribed subcutaneous insulin, diabetic (type 1 or II) and on insulin prior to admission.

Exclusion Criteria: Endocrinology consult during admission, diabetic ketoacidosis as reason for admission, length of stay ≤ 3 days, ICU admission during stay and use of insulin pump.

Statistical analysis: Continuous variables: t-test, ordinal variables: nonparametric Mann-Whitney test and categorical variables: chi-square test

Results

- 628 patient charts were identified through health records
- 251 Pre-BNC-PPO and 377 Post-BNC-PPO

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Pre-BNC-PPO (n=41)</th>
<th>Post-BNC-PPO (n=46)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean BMI (kg/m²)</td>
<td>26.1</td>
<td>20.1</td>
</tr>
<tr>
<td>Diabetes (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type I Diabetes</td>
<td>6 (14.6)</td>
<td>8 (17.4)</td>
</tr>
<tr>
<td>Type II Diabetes</td>
<td>34 (83)</td>
<td>38 (82.6)</td>
</tr>
<tr>
<td>Unspecified</td>
<td>1 (2.4)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

Concomitants (%)
- Hypertension: 30 (73.2) vs. 39 (84.4)
- Dyslipidemia: 13 (31.7) vs. 20 (43.5)
- Coronary artery disease: 23 (56.1) vs. 24 (52.2)
- Peripheral vascular disease: 33 (80.5) vs. 29 (63.0)
- Chronic kidney disease: 16 (39.0) vs. 16 (34.8)

Diabetic medications (%)
- Insulin (basal): 33 (80.5) vs. 36 (78.3)
- Insulin (mixed): 6 (14.6) vs. 10 (21.7)
- Insulin (regular/rapid): 18 (43.9) vs. 19 (41.3)
- Oral Hypoglycemics: 22 (53.7) vs. 25 (54.3)
- Injectable GLP-1 agonist: 0 (0) vs. 1 (2.2)

Type of Surgery
- Elective: 17 (41.5) vs. 21 (45.7)
- Non-Elective: 21 (51.2) vs. 24 (52.2)
- No surgery: 3 (7.3) vs. 1 (2.2)

Length of stay (mean ± SD)
- 13.0 (11.4) vs. 15.4 (14.5)

Conclusions

Use of the BNC-PPO was associated with improved glycemic control through decreased mean daily blood glucose, less severe hyperglycemic episodes and less blood glucose variability in the vascular surgery diabetic population.

Improvement in glycemic control occurred without any apparent increase in correction doses.

Use of the BNC-PPO was associated with improved prescribing and administration practices: continuation of basal insulin when the patient is NPO and appropriate HS correction doses.

Limitations

- Retrospective chart review
- Unable to assess clinical endpoints such as symptomatic hypoglycemia, infection rates, and organ failure.
- Documentation
- Reliance on accuracy and timing of the BG reading
- Reliance on documentation of doses of insulin given

Table 1: Baseline Characteristics of all included patient visits. *Data available for n=21 Pre-BNC-PPO and n=32 Post-BNC-PPO.

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Table 2: Secondary-Process Outcomes. *Total doses = 135 (pre-BNC-PPO) and 63 (post-BNC-PPO)

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Figure 1: Mean daily blood glucose during the first 15 days on treatment. Mean blood glucose over length of stay (straight line): 9.83 ± 1.74 (Pre-BNC-PPO) and 8.79 ± 1.60 (Post-BNC-PPO); P-value=0.005.

Figure 2: Mean number of hypoglycemic & hyperglycemic episodes per patient per day on treatment. Severe hyperglycemic episodes per day were statistically significant with Bonferroni correction (P<0.01 is significant).

Figure 3: Mean glucose variability (range) over length of stay: 5.57 ± 1.58 (Pre-BNC-PPO) and 4.6 ± 1.45 (Post-BNC-PPO); P-value=0.004.