EVALUATION OF BASAL-NUTRITIONAL-CORRECTION INSULIN PRE-PRINTED ORDER OVER STANDARD CARE ON VASCULAR SURGERY PATIENTS

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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 (T8) 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 (10-11.9mmol/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 T8 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 I 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

	Pre-BNC PPO (n=41)	Post-BNC PPO (n=46)
Age – mean (± SD)	68.8 (10.2)	69.2 (8.6)
Male – no. (%)	21 (51)	30 (65)
Mean BMI (kg/m²)*	26.1	29.1
Diabetes– no. (%)		
• Type I Diabetes	6 (14.6)	8 (17.4)
• Type II Diabetes	34 (83)	38 (82.6)
• Unspecified	1 (2.4)	0 (0)
Comorbidities – no. (%)		
• Hypertension	30 (73.2)	39 (84.8)
• Dyslipidemia	13 (31.7)	20 (43.5)
• Coronary artery disease	23 (56.1)	24 (52.2)
• Peripheral vascular disease	33 (80.5)	29 (63.0)
• Chronic kidney disease	16 (39.0)	16 (34.8)
Diabetic medications – no. (%)		
• Insulin (basal)	33 (80.5)	36 (78.3)
• Insulin (mixed)	6 (14.6)	10 (21.7)
• Insulin (regular/rapid)	18 (43.9)	19 (41.3)
• Oral Hypoglycemics	22 (53.7)	25 (54.3)
• Injectable GLP-1 agonist	0 (0)	1 (2.2)
Type of Surgery		
• Elective	17 (41.5)	21 (45.7)
• Non-Elective	21 (51.2)	24 (52.2)
• No surgery	3 (7.3)	1 (2.2)
Length of stay – mean (± SD)	13.0 (11.4)	15.4 (14.5)

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

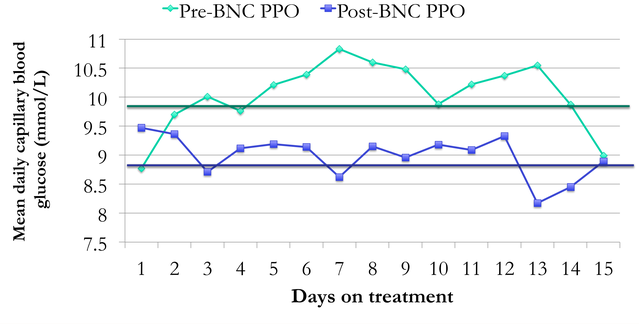

Figure 1: Mean daily blood glucose during the first 15 days on treatment. Mean blood glucose over length of stay(straight line): 9.83 ± 1.74 (Pre-BNC-PPO) and 8.79 ± 1.60 (Post-BNC-PPO); P-value=0.005.

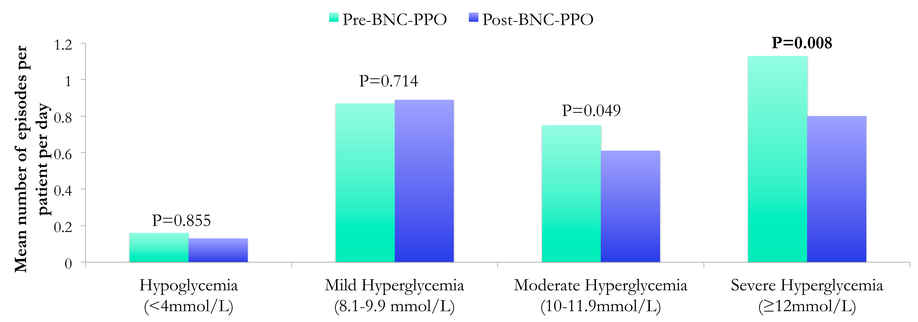

Figure 2: Mean number of hypoglycemic & hyperglycemic episodes per patient per day on treatment. Severe hyperglycemic episodes per day were statistically significant with Bonferonni correction (P<0.01 is significant).

	Pre-BNC-PPO (n=41)	Post-BNC-PPO (n=46)	P-value
Mean day of initiation of basal insulin (day ± SD)	2.57 (2.85)	1.58 (0.72)	0.295
Total daily insulin given as basal and nutritional (%)	51.7	83.7	<0.0001
Total basal insulin held during admission(i.e. NPO) (%)	41.9	14.2	<0.0002
Patients with Hemoglobin A1c ordered – no. (%)	7 (17)	13 (28)	0.216
Patients receiving HS insulin- no. (%)	27 (65.9)	25 (54.3)	NS
• Dose appropriate? – no. (%)*	27 (20.0)	23 (36.5)	0.018
• Blood glucose re-checked at 0300H? –no. (%)*	19 (14.1)	22 (34.9)	0.002

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

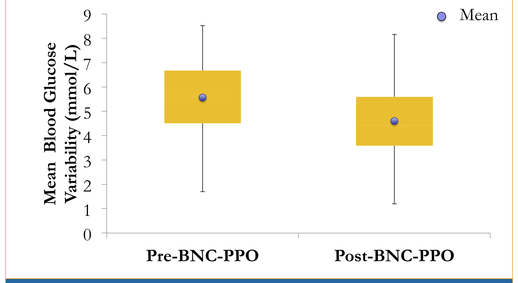

Figure 3: Mean glucose variability (range) over length of stay: 5.57 ± 1.58 (Pre-BNC-PPO) and 4.6 ± 1.45 (Post-BNC-PPO); P-value= 0.004.

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

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 hypoglycemic episodes.
- 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.

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