Simplified approach to incorporating glycemic response within a continuous insulin infusion algorithm to improve incidence of hypoglycemia in a single burn center.

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BACKGROUND

Background

- A recent single center evaluation of continuous insulin infusion (CII) protocols revealed four were in use, a 0.6 percent hypoglycemic rate, and two-thirds of patients experiencing at least one incident[1]
- The authors speculated consolidation to a single algorithm accounting for hourly glucose change would facilitate improvement
- The algorithm evolved through six iterations over two years

Objective

- Assess the post-implementation impact on hypoglycemia and glycemic control of the single, dynamic insulin infusion algorithm

METHODS

- Dual Institutional Review Board approval
- Retrospective, single burn center, electronic chart review

Inclusion Criteria

- Admitted between August 1, 2016 and August 31, 2018
- Received a CII

Exclusion Criteria

- Less than 18 years of age
- Received less than 24 hours of CII
- Incorrect CII protocol selected
- Incomplete or missing data

Statistical Analysis

- SigmaPlot 11.2
- Nominal data analyzed by Fisher's exact test
- Mann-Whitney U test or student's t-test for continuous data

RESULTS

Included

- Twenty-seven patients met inclusion criteria

Excluded

- Four patients received less than 24 hours of CII
- Two patients received a different CII protocol
- One chart had incomplete data

RESULTS

Demographics

	Pre-Implementation (n = 32)	Post-Implementation (n = 20)	p value
Age (years) [a]	51.8 ± 17	58.9 ± 17.5	0.15
Male [c]	18 (56)	14 (70)	0.49
Weight, kg [a]	95.0 ± 27.4	87.4 ± 26.7	0.33
Caucasian [c]	17 (53)	10 (50)	0.95
% TBSA [b]	25 (14, 55)	21 (8.3, 40.6)	0.19
Thermal injury [c]	18 (56)	16 (80)	0.15
Inhalation injury [c]	7 (22)	3 (15)	0.72
APACHE II [b]	17 (11, 28)	15 (12, 22)	0.53
Diabetes [c]	19 (59)	13 (65)	0.91
Hemoglobin A1c (%) [b]	7.2 (5.7, 9.2)	6 (5.6, 6.5)	0.09
WBC (10^3/cm^3) [b]	13.2 (9.3, 20.5)	12.1 (8.5, 17.3)	0.58
Albumin (g/dL) [a]	3.3 ± 0.7	3.4 ± 0.7	0.70
Prealbumin (g/dL) [b]	9.9 (6.9, 12.8)	7.7 (5.0, 10.4)	0.19
CRP (mg/L) [b]	11 (6.9, 19.9)	12.2 (7.6, 20.2)	0.94
Creatinine (mg/dL) [b]	1.3 (0.7, 2.2)	1.1 (0.8, 1.6)	0.42
Creatinine Clearance (mL/minute) [b]	84.4 (40.4, 163.2)	64.9 (50.4, 97.9)	0.28
AKI [c]	21 (66)	11 (55)	0.64

[a] Mean ± SD
[b] Median (interquartile range)
[c] n (%)

Secondary Outcomes

	Pre-Implementation (n = 32)	Post-Implementation (n = 20)	p value
Hypoglycemia [a]	16 (50)	6 (30)	0.26
Glucose < 70 mg/dL [a]	21 (66)	9 (45)	0.16
CII duration (days) [b]	6.1 (3.1, 13.8)	7 (2.1, 14.8)	0.28
Insulin usage (units/hour) [b]	4.7 (3.3, 7.0)	3.8 (2.7, 5.1)	0.19
Carbohydrate intake (g/day) [b]	180.0 (168.0, 204.5)	121.0 (109.1, 165.3)	< 0.001
Survived [a]	21 (66)	9 (45)	0.16
Infection [a]	28 (88)	19 (95)	0.64
Length of stay (days) [b]	27.5 (19, 59)	41.5 (23, 59)	0.49

[a] n (%)
[b] Median (interquartile range)

- 20 patients post exclusions
- 5,239 point-of-care glucoses assessed
- Hypoglycemia rates were significantly lower post implementation (0.6% vs 0.2%, <0.001)
- Twenty percent decrease in number of patients that experienced a hypoglycemic event post-implementation
- One hour/day more spent within goal glycemic range was not statistically significant

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RESULTS

Glycemic Outcomes

	Pre-Implementation (n = 6540) [a]	Post-Implementation (n = 5239) [a]	p value
Hypoglycemia [b,c]	38 (0.6)	9 (0.2)	< 0.001
Glucose < 70 mg/dL [c]	77 (1.2)	24 (0.5)	< 0.001
Serum glucose (mg/dL) [d]	149.9 (144.3, 162.9)	146.5 (141.8, 155.2)	0.56
Time within 70-149 mg/dL (hours/day) [e]	13.8 ± 2.9	14.7 ± 1.9	0.23

[a] Point-of-care blood glucoses
[b] Blood glucose < 60 mg/dL
[c] n (%)
[d] Median (interquartile range)
[e] Mean ± SD

DISCUSSION

- Time to achieve goal glycemic range was not excessive, but several patients required large initial infusion rates
- Excessively elevated initial glucoses seen possibly warrant incorporation of a series of insulin boluses at initiation of CII for further improved glycemic control
- Per algorithm, CIIs are held for glucose < 100 mg/dL and glucose monitoring changes to every 30 minutes until ≥ 100 mg/dL and resuming CII at half the previous rate
- For all instances of held infusions, only 3 % had follow up glucoses within 30 minutes.
- Frequency of delayed follow up glucose monitoring possibly lead to rebound hyperglycemia
- Twenty percent demonstrated rebound glucoses surpassing 200 mg/dL

CONCLUSIONS

- Consolidation, education, and implementation of a single, dynamic CII algorithm successfully reduced hypoglycemia
- Education and diligence with follow up monitoring will likely further improve time within goal glycemic range by preventing significant rebound hyperglycemia
- This simplified approach can be utilized within other centers and populations without additional equipment or cost burden

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Disclosure
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