

THE PENDULUM SWINGS BACK TO HYPERGLYCEMIA WHEN INSULIN INFUSIONS ARE DISCONTINUED.

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PURPOSE

The purposes of this study were to:

1. Describe methods used to transition off IV insulin infusions in the ICU.
2. Describe post- insulin infusion blood glucose management.

BACKGROUND and SIGNIFICANCE

Blood glucose (BG) control between 80-110 mg/dl with an intensive intravenous (IV) insulin infusion reduces morbidity and mortality in surgical intensive care unit (ICU) patients (van den Berghe; 2001). Methods to transition patients safely off IV insulin infusions have not been studied as noted in the American Diabetes Association 2007 Standards of Medical Care Position Statement. Stanford Hospital has an established intensive IV insulin protocol to maintain blood glucose within a range of 80-110 mg/dl in the ICU (MA Li; 2004). The Stanford protocol includes a method to transition off the IV insulin infusion by giving subcutaneous (SQ) NPH insulin prior to discontinuation. In addition, an adjusted daily insulin dose requirement can be determined (80% of the total daily dose of insulin, which is calculated by multiplying the average of final hourly insulin infusion rates by 24). This value can be used to estimate individual patient SQ insulin requirements for the following 24 hours after discontinuing insulin infusions. Anecdotal reports from ICU nurses and residents suggest that these transition steps are infrequently used.

This study monitored current methods used to transition off intensive IV insulin infusions in the ICU and the effectiveness of BG management in the first 24 hours after insulin infusions are discontinued.

METHODS

Sample: 30 consecutive patients from Stanford Hospital's 33-bed medical/ surgical/ trauma/ transplant/ neuroscience ICU between April and June 2007 were included in this study. Inclusion criteria included: On intensive IV insulin protocol to achieve BG 80-110 mg/dl/ for 8 consecutive hours or longer, and age 18 years or older. Exclusion criteria included patients with the following conditions: type 1 diabetes mellitus, total pancreatectomy, diabetic ketoacidosis, hyperglycemic hyperosmolar coma, total parental nutrition (TPN) therapy with insulin added to the TPN bags, end-of-life care, and ICU discharge directly to an outside facility while on IV insulin infusion (post-infusion data could not be obtained).

Patient identification: Eligible patients were identified by cross-referencing Stanford pharmacy records of insulin infusions and the ICU's electronic patient care database.

Method: Retrospective chart review.

Data Collection:

- 1) Demographics: gender, age, APACHE II scores, co-morbidities, physician services, length of ICU stay, and disposition after discharge out of the ICU.
- 2) BG before the IV insulin infusion was started.
- 3) BG during the last 24 hours on the IV insulin infusion.
- 4) BG during the 24 hours after the IV insulin infusion was discontinued.
- 5) Transition method to discontinue the IV insulin infusion.
- 6) Post-IV insulin infusion BG management.
- 7) Total insulin administered in the 24 hours after discontinuation of IV insulin infusion.
- 8) Adjusted daily insulin dose requirement was calculated.

Instruments: Bedside point of care testing was done with i-Stat (Abbot) or Precision PCx (Medisense) glucometers. Both devices internally convert the arterial, venous, or capillary whole blood result to a value comparable to a standard laboratory plasma glucose value.

Statistics: SPSS program, version 15 for Windows was used for data analysis.

RESULTS

Thirty ICU patients (12 male and 18 female) with a mean age of 57.7 years were included in the study. The average APACHE II score was 23 with a mean ICU length of stay of 8.7 days (range 1-37); 70% had type 2 diabetes mellitus and 10% were septic.

Transfer destination out of ICU after IV insulin infusion was stopped:

- 33% (n=10) transferred to a medical floor.
- 37% (n=11) transferred to a surgical floor.
- 27% (n=8) transferred to an intermediate ICU or close observation unit.
- 3% (n=1) transferred to an outside facility.

BG values at specific time points in the study are reported below:

- BG pre-IV insulin infusion averaged 241 mg/dl (range 133 to 420 mg/dl).
- BG prior to coming off IV insulin infusion averaged 109 mg/dl (71-220 mg/dl).
- BG in the 24 hours post-IV insulin infusion averaged 181 mg/dl (84 to 359 mg/dl).

Transition off the IV insulin infusion occurred in the following ways:

- 10% (n=3) received SQ NPH insulin before stopping IV insulin infusion.
- 87% (n=26) did not receive SQ NPH insulin before stopping IV insulin infusion.
- 3% (n=1) received one-time SQ NPH insulin after stopping IV insulin infusion.

Post-IV insulin infusion BG management:

- 83% (n=25) received SQ regular insulin sliding scale protocol.
- 17% (n=5) received a combination of SQ long and SQ short acting insulin.
- 7% (n=2) received oral hypoglycemic medications.
- 13% (n=4) received no hyperglycemic treatment.

Adjusted daily insulin dose requirement:

There was a large difference between the calculated adjusted daily insulin dose requirement and the quantity of insulin administered in the first 24 hours after the infusion was stopped. The adjusted daily insulin dose requirements averaged 58 units (range 12-130 units). The SQ insulin administered in the 24 hours after the insulin infusions were discontinued averaged 15 units (range 0-59 units). This difference was reflected in the low interclass correlation coefficient (ICC = 0.09).

CONCLUSIONS

BG control between 80-110 mg/dl can successfully be achieved with an intensive IV insulin protocol in the ICU. In this study after the IV insulin infusion was discontinued, the BG values rose by an average of 70 mg/dl in the next 24 hours. In most cases, a transition dose of SQ NPH insulin was not given. The average amounts of SQ insulin administered in the 24 hours after the insulin infusion was stopped did not match the calculated adjusted daily insulin dose requirements. Not unexpectedly, the inadequate insulin provision resulted in a corresponding increase in BG values. This suggests that without a concerted plan to transition off the intensive IV insulin infusion and institute a post-infusion BG management regimen, hyperglycemia will quickly occur.

REFERENCES

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