TRAUMA GLYCEMIC CONTROL PROTOCOL

Background:

Hyperglycemia is commonly seen in the intensive care unit (ICU) as part of the stress response. For some time, the presence of diabetes and hyperglycemia has been known to be a risk factor for infectious complications in surgical patients. Insulin therapy has been demonstrated to improve outcomes in critically ill trauma patients[1-3].

In 2001, Van den Berghe evaluated 1,548 consecutive mechanically ventilated surgical ICU patients[4]. Patients were randomized to either control (180-200 mg/dL) or treatment (80-110 mg/dL) managed by an insulin infusion. The treatment arm or "tight" glucose control resulted in a significant reduction in mortality, particularly in the population with prolonged ICU stays (> 5 days). Tight glucose control resulted in a 32% adjusted risk reduction for mortality, demonstrated fewer overall infections, required less dialysis, and experienced less critical illness polyneuropathy.

In 2009, the NICE-SUGAR study randomized 6,104 adult patients expected to receive ICU care for at least 3 days to receive intensive glucose control (goal 81-108 mg/dL) or conventional glucose control (goal ≤ 180mg/dL)[5]. At 90 days after randomization, 27.5% in the intensive-control group died, as compared with 24.9% in the conventional-control group. The adjusted odds ratio for 90-day mortality was 1.14 (95% CI, 1.01-1.29, p = 0.04). The median survival time was lower in the intensive-control group compared to the conventional-control group (HR 1.11; 95%CI, 1.01-1.23, p=0.03). There was also a significantly reduced rate of severe hypoglycemia in the conventional-control group versus the intensive-control group (0.5% vs. 6.8%, p < 0.001).

As a result, the Society of Critical Care Medicine (SCCM) published guidelines on the use of insulin infusions for the management of hyperglycemia in critically ill patients[6]. The authors suggest using an insulin protocol to target a blood glucose goal range of 100-150 mg/dL, while maintaining blood glucose values less than 180 mg/dL. These guidelines also focus on the importance of avoiding hypoglycemia, defined as a blood glucose < 70 mg/dL[7,8]. To avoid adverse effects of hypoglycemia, the guidelines recommend frequent blood glucose monitoring and the restoration of normoglycemia through the administration of dextrose (50%) while avoiding increases in glucose variability. High glucose variability has been associated with increased infections, prolonged ventilator and ICU length of stay, and increased mortality[9]. Additionally, studies at Vanderbilt have also shown that provision of balanced nutrition rather than simply carbohydrate reduces hypoglycemia rates[10].

TICU Guidelines for Maintenance of Euglycemia:

All patients in Trauma ICU (TICU) will have blood glucose levels checked upon admission via point-of-care device. Each patient in the unit will be considered as high risk or low risk depending on their clinical status. The high risk group will receive more frequent blood glucose monitoring. It should be noted that patients may change between risk categories as their clinical course unfolds.

Category 1 – High Risk

- Sepsis
- Acute resuscitation (need for ongoing resuscitation within 24h)
- Inotropic/Vasopressor support
- Acute organ dysfunction
- Acute respiratory failure

Exception being:

- Multi-trauma patients requiring mechanical ventilation with planned extubation within 12-24 hours after admission

Category 2 – Conservative Management

- Hemodynamically stable
- Not mechanically ventilated

High Risk Patients – Category 1

- Begin blood glucose monitoring every 4 hours via point-of-care device
- Initiate sliding scale insulin if any blood glucose value is > 150 mg/dL
- If blood glucose values remain elevated > 150 mg/dL, consider adjusting sliding scale insulin to help achieve target blood glucose
- If two successive blood glucose values are ≥ 200 mg/dL, a continuous insulin infusion should be considered using the TICU insulin infusion protocol
- Consider discontinuing q4h blood glucose monitoring and sliding scale insulin if:
    - Blood glucose remains < 150 mg/dL AND tube feed goal has been met for 24 hours and off vasopressors

Low Risk Patients – Category 2

- Begin blood glucose monitoring every 4-6 hours via point-of-care device
- Initiate sliding scale insulin if blood glucose value is between 111-250 mg/dL
- If blood glucose values remain elevated > 150 mg/dL, consider adjusting sliding scale insulin to help achieve target blood glucose of 110-160 mg/dL
- If two successive blood glucose values are ≥ 250 mg/dL, a continuous insulin infusion should be considered using the TICU insulin infusion protocol
- Consider discontinuing q4-6h blood glucose monitoring and sliding scale insulin if:
    - Blood glucose remains < 150 mg/dL AND tube feed goal has been met for 24 hours

Considerations for Continuous Insulin Infusion

- Patients should have a glucose source (i.e. D10 at 30 mL/hr), unless D5LR or D5NS are ordered at > 50mL/hr., tube feeds at 50% of goal or PN can also serve as a glucose source.
- Consider transitioning continuous insulin infusion to sliding scale insulin if:
  - Provider order has been placed to discontinue insulin infusion
  - Critical illness resolved, subcutaneous absorption appropriate, and without new clinical deterioration
  - Insulin infusion requirements of ≤ 3 units/hr for 24 hours AND on a stable source of nutrition
- Consider addition of basal insulin by calculating 50% of total insulin dose received over past 24 hours via continuous insulin infusion and scheduling the basal insulin as qam or qhs depending on when order is being placed.

<u>Stepdown (T2, T3, or T4) Guidelines:</u>

1. On admission, the following patients should have an HbA1c and scheduled POC glucose monitoring ordered:

- Known diabetics regardless of admission BG
- Patients without known diabetes with hyperglycemia (BG ≥150) at any point during admission

2. Based on admission/inpatient blood glucose levels and patient's history of diabetes, they will be classified and treated according to the following groups:

- Group 1: non-diabetic with or without hyperglycemia
- Group 2: diabetic and euglycemic (BG<140)
- Group 3: diabetic and hyperglycemic (BG>150)

3. Initial Treatment

- Group 1 (non-diabetic with or without hyperglycemia)
  - Insulin
    - Order Trauma sliding scale insulin **if single BG > 150 at any time during admission**
    - Consider discontinuing sliding scale insulin if BG < 150 for 48 hours AND receiving goal nutrition
  - Monitoring
    - POC BG monitoring TID AC plus qHS (if taking PO) or q6h (if NPO or on tube feeds)
    - If A1c > 6.5%, then switch patient to group 2 or 3 based on BG levels

- Group 2 (Type 2 diabetic with euglycemia on admission)
  - Insulin
    - Order Trauma sliding scale insulin regardless of admission BG
    - IDDM: Resume insulin glargine at 50% of home dose in addition to sliding scale insulin
    - NIDDM: Start insulin glargine 0.1 units/kg/day in addition to sliding scale insulin
    - If BG remains >180 mg/dL, consider scheduled prandial insulin with meals if on a diabetic diet OR scheduled short-acting insulin q4-6h if on continuous tube feeds.
    - *Use of only a sliding scale insulin regimen in the inpatient hospital setting in patients with diabetes is strongly discouraged.*

  - Monitoring
    - POC BG monitoring TID AC plus qHS (if taking PO) or q6h (if NPO or on tube feeds)

- Group 3 (Type 2 diabetic with hyperglycemia on admission)
  - Insulin
    - Order Trauma sliding scale insulin regardless of admission BG
    - IDDM: Resume insulin glargine at 75% of home dose in addition to sliding scale insulin
    - NIDDM: Start basal-bolus regimen at insulin total daily dose (TDD) of 0.3 units/kg/day divided half as insulin glargine once a day and prandial insulin administered prior to meals (if eating) or q4-6h (if on continuous tube feeds) in addition to sliding scale insulin
      - Reduce initial insulin TDD to 0.15 units/kg/day for the following patients:
        - ≥ 70 years old
        - SCr ≥ 2 mg/dL
  - Monitoring
    - POC BG monitoring TID AC plus qHS (if taking PO) or q6h (if NPO or on tube feeds)

<u>General Recommendations for all Trauma Patients:</u>

Treatment of Hypoglycemia (BG ≤ 70 mg/dL)—Always notify house officer

- If patient is on basal and/or sliding scale insulin:
  - Juice 4 oz (120 mL) by mouth every 15 minutes as needed
  - Glucose chewable tablet 16 grams by mouth every 15 minutes as needed (if unable to tolerate oral juice)
  - Dextrose 50% 25 mL intravenous every 15 minutes as needed (if unable to take oral juice or glucose)
  - Glucagon 1mg intramuscular as needed (if unable to take oral juice or glucose and unable to place or use IV); give one dose
- If patient is on continuous insulin infusion:
  - Dextrose 50% 5-40 mL intravenous as needed (dose based on protocol calculation)

Notify providers if:

- Any blood glucose value below 60 mg/dL
- Two successive blood glucose values less than 80 mg/dL
- Two successive blood glucose values greater than 250 mg/dL
- A recommended insulin infusion rate greater than 22 units/hr

Consider Endocrine consult if a patient meets the following criteria:

- Patient's blood glucose values are not adequately controlled AND patient is a known diabetic with A1C > 9%
- Continuous insulin infusion rate remains ≥ 4 units/hr despite addition of long acting and prandial insulin
- Patient has type 1 diabetes mellitus
- Patient has an insulin pump
- Newly diagnosed diabetes (A1c ≥ 6.5% and not on treatment prior to admission)

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