

## **Critical Care for the Non-Critical Care Physician – Endocrine and Steroid Use Topics**

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### **Glycemic Control**

#### *General Considerations for Critically Ill Patients*

Patients with critical illness frequently develop stress-induced hyperglycemia, even in the absence of underlying chronic diabetes. Excessive hyperglycemia should be avoided. In general, glucose levels should be maintained below 180-200 mg/dL. More intensive glucose control is discouraged, as this can increase the risk of dangerous hypoglycemic events. Episodes of hypoglycemia should be aggressively managed with IV bolus of 50 percent dextrose +/- continuous IV infusion of dextrose containing crystalloids.

Diabetic Ketoacidosis (DKA) vs Hyperosmolar Hyperglycemic Syndrome (HHS): Patients with underlying diabetes (Type 1 or Type 2) are at risk of developing DKA and/or HHS in times of critical illness. Both forms of hyperglycemic crisis result in osmotic diuresis and urinary wasting of electrolytes. Patients should be evaluated for electrolyte abnormalities and metabolic acidosis. High anion-gap metabolic acidosis is typical of DKA and is generally not seen in HHS. Serum osmolality and the presence of serum and urine ketones may also be helpful in distinguishing between the two conditions. Although hyponatremia is common in both conditions, it is important to recognize that hyperglycemia will falsely lower serum sodium levels. The true serum sodium level should be calculated with the following equation prior to any attempts at correction:  $\text{Actual Na} = \text{Measured Na} + 0.024 \times (\text{Serum Glucose} - 100)$ . Additionally, patients with both DKA and HHS are prone to significant and potentially life-threatening hypokalemia, which may be underappreciated in patients who are acidotic due to the extracellular shifting of potassium. Treatment of DKA and HHS both require 1) volume expansion, 2) careful correction of electrolyte imbalances, and 3) insulin administration. Insulin should NOT be administered until potassium >3.3 mEq/L has been achieved, as this may precipitate dysrhythmias.

#### *Considerations in Patients with Suspected or Confirmed COVID-19*

The use of insulin infusions to control hyperglycemia is common in the ICU but should be carefully considered in patients with suspected or confirmed COVID-19, as this necessitates hourly glucose checks. When possible, consider using a combination of intermediate- or long-acting insulin with sliding scale correction scheduled every 4 hours if on enteral nutrition or AC/HS if taking food by mouth.

### **Thyroid Function**

#### *General Considerations for Critically Ill Patients*

Euthyroid Sick Syndrome: Patients in the ICU frequently present with abnormal thyroid function tests that do not represent chronic thyroid dysfunction. Typical findings include decreased T3 (most common), normal or decreased T4, and normal or slightly decreased TSH. Euthyroid sick syndrome does not require thyroid hormone supplementation, although it may warrant periodic monitoring and follow up.

Hypothyroidism: Patients with a known history of hypothyroidism should be continued on their home thyroid hormone replacement regimen if possible. The half-life of T4 (levothyroxine) is seven days, so brief interruptions in treatment need not be of significant concern. Due to cost, the enteral route of administration is preferred, although IV levothyroxine is also available if needed. Occasionally, patients with untreated hypothyroidism will develop persistent hypotension that resolves with adequate thyroid hormone supplementation. This can be considered in the differential diagnosis of unexplained hypotension. Critical illness in patients with unrecognized or untreated hypothyroidism can, in rare cases, precipitate myxedema coma, a life-threatening form of decompensated hypothyroidism characterized by altered mental status and hypothermia and potentially accompanied by hyponatremia,

hypoventilation, bradycardia, and hypotension. Myxedema coma requires immediate IV thyroid hormone supplementation and supportive care under the guidance of an endocrinologist. Stress dose steroid replacement may also be required.

Hyperthyroidism: Patients with a known history of hyperthyroidism should be continued on their home antithyroid regimen, most commonly methimazole or propylthiouracil. The half-lives of these medications are considerably shorter than that of levothyroxine, and care should be given to avoid significant interruptions in administration. The stress of critical illness in patients with unrecognized or untreated hyperthyroidism can sometimes precipitate thyroid storm, a potentially fatal form of thyrotoxicosis. Symptoms of thyroid storm are non-specific and may be difficult to distinguish from other causes of critical illness, for example sepsis. Patients are uniformly febrile, may be diaphoretic, are prone to tachycardia as well as dangerous tachyarrhythmias, and may develop signs of congestive heart failure. Management of thyroid storm includes supportive care, inhibition of peripheral thyroid hormone excess using beta blockade, and inhibition of thyroid hormone synthesis and release under the guidance of an endocrinologist.

### **Steroid use in Critical Illness**

#### *General Considerations for Critically Ill Patients*

Adrenal Insufficiency: During times of physiologic stress, cortisol production is expected to increase. Unfortunately, a variety of factors can blunt the effect of this response. Patients with either primary or secondary (e.g., chronic steroid use generally defined as a daily prednisone dose >5 mg for 3 months or longer) adrenal insufficiency are at significant risk for absolute adrenal failure/crisis when they become critically ill, due to the adrenal gland's inability to mount an appropriate stress response. In most cases, these patients should be started empirically on high-dose steroid replacement (proposed regimens include hydrocortisone 100 mg every 8 hours or hydrocortisone 50 mg every 6 hours) for the duration of their critical illness.

Patients without history of adrenal insufficiency remain at risk for developing relative or absolute adrenal insufficiency during critical illness. This presents as refractory hypotension despite vasopressor therapy. Although serum cortisol levels in these patients may be low, often they are within the normal range and may even be elevated, but nevertheless insufficient given the level of physiologic stress. Although the measurement of cortisol levels before and after stimulation with ACTH has been proposed as a means of identifying patients with relative adrenal insufficiency, the value of this test has been heavily debated. Empiric use of stress dose hydrocortisone (with either regimen described above) can be considered, regardless of cortisol level, in patients with profound hypotension refractory to vasoactive medications.

Acute Respiratory Distress Syndrome (ARDS): The role of steroid use in ARDS has been controversial. Currently, steroids are recommended for use in ARDS precipitated by a steroid-responsive condition (e.g., sepsis). Additionally, steroids may be used to treat early, moderate-severe ARDS that has not responded to other supportive therapies.

#### *Considerations in Patients with Suspected or Confirmed COVID-19*

Steroids are NOT recommended in cases of viral pneumonia and should NOT be used for the treatment of pulmonary injury/ARDS in patients with COVID-19, as they have been associated with prolonged viral clearance and increased mortality. However, in cases of refractory shock or underlying history of adrenal insufficiency, stress dose steroids may be considered.

## References

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