



The Metabolic Effects of Glucocorticoids

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What are the indications for glucocorticoid therapy?

- Addison's Disease
- Congenital adrenal hyperplasia
- Secondary adrenal insufficiency
- Transplant rejection, reactive airway diseases, infections, cancer, autoimmune disorders

What are the metabolic effects of glucocorticoid therapy?

- Glucose
 - Leads to stimulation of gluconeogenesis and glycogenolysis
 - Leads to inhibition of glucose uptake by muscle
 - Post-prandial *hyperglycemia* predominates
 - Resulting *hyperglycemia* peaks 8-12 hours after glucocorticoid dose
 - Existing diabetes may be exacerbated or "steroid diabetes" may be induced
- Fat
 - Stimulation of lipase and increased lipolysis
 - Increased fat deposition and fatty acid release (*weight gain*)
- Protein
 - Stimulation of muscle catabolism and prevention of protein synthesis (*muscle breakdown*)
- Bone
 - Leads to inhibition of bone formation (osteoblast activity) and suppression of calcium absorption (*osteoporosis*)

What factors may predict glucocorticoid-induced hyperglycemia?

- Pre-existing diabetes
- Family history of diabetes
- Increasing age
- Increasing weight
- Increasing glucocorticoid dose

What are the treatment strategies for glucocorticoid-induced hyperglycemia?

- Thiazolidinediones/metformin may be effective with long-term glucocorticoid therapy (insulin sensitizers)
- Insulin is considered the drug of choice
 - Insulin infusion (inpatient only)
 - Provides continuous, immediate delivery of regular insulin
 - Allows for immediate dose adjustment
 - Increased risk of hypoglycemia
 - Requires extra resources to initiate and maintain
 - Rapid-acting insulin
 - Humalog®, Novolog®, or Apridra®
 - Provides prandial coverage
 - Alone, most effective in previously non-diabetic patients
 - Dose requirement may be less at breakfast due to diminishing effects of short-acting steroids (when steroid is administered in the morning)
 - Intermediate-acting insulin
 - Humulin N®, Novolin N®
 - Matches the insulin peak with the hyperglycemia peak
 - Useful in both diabetic and non-diabetic patients
 - Used once or twice daily based on number of steroid doses
 - Basal/bolus insulin
 - Lantus® or Levemir® combined with Humalog®, Novolog®, or Apidra®
 - Combinations useful in diabetic patients and those with expected steroid-induced diabetes
 - Initially, maintain previous basal dose while increasing prandial coverage in diabetic patients

***Note: Insulin dose adjustments will be needed often with steroid administration. Close monitoring of glucoses is required.*

Helpful Resources:

Improving Care of the Hospitalized Patient with Hyperglycemia and Diabetes from the SHM Glycemic Control Task Force. A Supplement to the Journal of Hospital Medicine, An Official Publication of the Society of Hospital Medicine. 2008;5(3):Supplement 5.

American Diabetes Association: Clinical Practice Recommendations. Diabetes Care. 2010;33:Supplement 1.

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