

Management of Hyperglycemia and Diabetes in Hospitalized Patients

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Introduction

In the United States, 34.2 million have diabetes and 88 million have prediabetes. Patients with diabetes have a 3-fold higher chance for hospitalization. Hyperglycemia and diabetes is found in 38-40% of non-critical care and 70-80% of critical care and cardiac surgery patients and they have a higher length of stay and are at increased risk for adverse outcomes. Management during hospitalization is important for reducing the risk for adverse outcomes and readmission and reducing length of stay and cost.

Hyperglycemia

- Definition: BG persistently > 140 mg/dL
- Treat conservatively with diet or changes to medications causing hyperglycemia
- HbA1c \geq 6.5% suggests previous DM

Structured Order Set

- Computerized provider order entry
 - Electronic insulin order templates
 - Type of diabetes
 - HbA1c if appropriate
- Consult with a specialized DM or BG management team when possible.
 - Reduced length of stay
 - Improved glycemic control
 - Improved outcomes
 - Reduced readmission
 - Reduced cost of care
- Assess diabetes self care skills
- Refer to diabetes educator if needed

Evidence for Glycemic Targets

- Van den Berghe: critical care post surgery patients showed target of 80-110 mg/dL better than 180-215 mg/dL
- NICE-SUGAR critical care patients: showed no benefit and significantly increased mortality and 10-15-fold increased hypoglycemia with 80-110 mg/dL compared to 140-180 mg/dL
- Target BG 110-140 mg/dL if no hypoglycemia
- Consider > 180 mg/dL in terminally ill patients

Glycemic Targets

- 140-180 mg/dL for most
- 110-140 mg/dL if no hypoglycemia
- Consider > 180 mg/dL in terminally ill patients

Bedside Glucose Monitoring

- If eating: before meals
- Not eating: q 4-6 hours

Continuous Glucose Monitoring

- Insufficient data to support use
- Hospitals need to have guidelines for patients wearing their own CGM

Medical Nutrition Therapy

- Goal: Provide adequate calories & Control BG
- ADA does not specify % of macronutrients
- Consistent carbohydrate diets helps to match prandial insulin doses

Noninsulin Therapies

- Some evidence for use of GLP-1 RA and DPP-4i
- Discontinue saxagliptin and alogliptin in pts with heart failure
- Avoid SGLT2i in severe illness, and if positive ketones, prolonged fasting, and DC 4 days before surgery
- Sulfonylurea and meglitinides can cause hypoglycemia

Insulin Therapy

- Do not use "sliding scale" for prolonged period
- Use basal insulin if fasting hyperglycemia
- Use prandial insulin if postprandial hyperglycemia
- If needed a lot of correctional insulin, adjust the base doses

Starting Total daily dose

- 0.2-0.3 U/kg: age \geq 70, eGFR < 60 mL/min
- 0.4 U/kg: age < 70, eGFR 60+ BG 140-200 mg/dL
- 0.5 U/kg: age < 70, eGFR 60+ BG 201-400 mg/dL
- No steroids: 50% basal 50% bolus
- Steroids: low dose 40% basal 60% bolus, high dose 25% basal 75% bolus

Insulin Therapy

Critical Care: IV insulin

- based on written or computerized protocols

Transition from IV to subcutaneous

- SC basal insulin 2-4 h before DC IV insulin
- Convert 60-80% of daily infusion dose to determine total dose

Noncritical Care

- Subcutaneous insulin
- Basal: intermediate or long acting insulin
- Prandial (rapid or short acting insulin)
- Rapid/short acting insulin q 4-6 h if not eating
- Correction: rapid or short acting insulin

Type 1 Diabetes

- Will always need basal insulin to prevent DKA
- May need a reduced basal dose – usually 30-50% of the total daily dose before admission

Insulin Pumps

- Remove for critical care - IV insulin
- Remove for MRI, cover with lead apron for X-ray, CT, pacemaker, AICD
- Can stay in place for colonoscopy, EGD, laser surgery
- Remove for surgery > 2 h – IV insulin
- Stay in place surgery < 2 h
- Pt must be able to operate. If not, switch to basal/bolus

COVID-19

- 20-50% of COVID-19 pts have diabetes
- COVID-19 associated with hyperglycemia
- Monitor new onset DM
- Use IV insulin if severe COVID-19
- Glucose goal: 72-144 mg/dL for most
- CGM: time in range > 70%, hypoglycemia < 4%
- Stop metformin, SGLT-2i, GLP-1 RA
- Can give DPP-4i
- Don't stop insulin
- Consider CGM to reduce staff exposure

Enteral nutrition

- Start with 1 unit rapid/short acting insulin per 10-15 gm CHO per 6 hours
- Adjust dose based on BG patterns
- Use correctional scale for hyperglycemia
- May need basal/prandial insulin

Parenteral nutrition

- Start with 1 unit Regular insulin in the bag per 10 gm CHO
- Adjust based on BG patterns
- Use correctional scale for hyperglycemia
- May need basal/prandial insulin

Steroids

Hydrocortisone affects BG ~ 8-12 hours

- NPH or 70/30

Prednisone affects BG 1 day

- Basal/bolus for 1-2 d
- Dexamethasone affects BG 1-3 days
- Basal/bolus for 1-3 d

Hypoglycemia

- Level 1: 54-70 mg/dL
- Level 2: < 54 mg/dL
- Level 3: altered mental/physical function

Common Causes

- Reduction in steroids
- Interruption in enteral/parenteral nutrition
- Errors in insulin, timing of insulin
- Poor oral intake/ nausea / vomiting
- Hospital wide hypoglycemia protocol
- Adjust treatment regimen to prevent
- Document all hypoglycemia

Perioperative Care

- BG target 80-180 mg/dL
- Preoperative risk assessment should be done
- Optimize glycemic control prior to surgery is ideal
- Metformin should be withheld the day of surgery
- SGLT-2i should be held 4 days before surgery
- Hold all oral agents on the day of surgery
- Give 50% of NPH insulin, 60-80% of long-acting insulin, 60-80% pump basal rate
- Monitor BG frequently while NPO and correct hyperglycemia with short/rapid acting insulin, taking precautions not to stack the doses

DKA and HHS

- IV insulin for most
- If SC insulin: make sure adequate fluids, frequent testing, and treat cause of DKA i.e. infection
- Give basal insulin 2-4 hours before DC drip
- Bicarbonate is not recommended

Transition from Hospital to Home

- Provide education for any needed
 - Prescribed diabetes regimen
 - Sick day management
 - Prevention of hypo/hyperglycemia/DKA
 - Disposal of needles
- Prescribe all needed diabetes meds/supplies
- Provide contact information if BG not controlled after discharge
- Follow up appointment within 1 month if:
 - Glycemic medications were changed during hospitalization
 - Hyperglycemia/hypoglycemia during hospitalization

Abbreviations

- BG = blood glucose
- CGM = continuous glucose monitoring
- DC = discontinue
- DM = diabetes mellitus
- DKA = diabetic ketoacidosis
- DPP-4i = Dipepd
- GLP-1 RA = glucagon like peptide 1 receptor agonist
- HHS = hyperosmolar hyperglycemic state
- SC = subcutaneous
- U/kg = units per kilogram

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