

Care of Diabetic Patients in the Hospital Setting

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***Kathia Desronvil, BSN, MSN, FNP-BC
Hospitalist, Internal Medicine Department
Nash General Hospital
Rocky Mount, NC 27616
(H) 919-890-5561; (C) 781-363-6938
kathia_d@yahoo.com***

National Statistics

- Patients with Diabetes are more likely to be hospitalized and to have a longer hospital stay
- About 1/4 of all US patient admissions account for patients with Diabetes
- Majority of diabetic patients hospitalized present with hyperglycemia
- Inpatient management of the hospitalized diabetic patient must focus on safe glycemic targets to avoid adverse outcomes; primarily severe hypoglycemia

Objectives

- Achieve glycemic control to improve clinical outcomes for Diabetic inpatients
- Determine appropriate glycemic targets for different diabetic populations
- Evaluate treatment options available for achieving optimal glycemic control safely and effectively
- Present optimal strategies for transitioning to outpatient care
- Discuss approaches to manage the Diabetic patient presenting with hyperglycemic or hypoglycemic crises

Diabetic Patient Populations

- Known and nondiagnosed diabetic patient
- Type 2
 - Non-Insulin Dependent Diabetes Mellitus (NIDDM)
 - Insulin-Requiring Diabetes Mellitus
 - Newly-diagnosed diabetic patient
- Type 1
 - Insulin-Dependent Diabetes Mellitus (IDDM)
- Diabetic patient:
 - ICU vs acute medical/surgical ward

Hyperglycemia in the Hospital Setting



Hyperglycemia Crisis

- Any BG > 140 mg/dl
- *Severe* hyperglycemia (BG > 250 mg/dl)
- DKA (diabetic ketoacidosis)
 - BG > 300 mg/dl
 - Primarily Type 1, also uncontrolled Type 2
- HHS (hyperosmolar hyperglycemic state)
 - BG > 600 mg/dl
 - Type 2

Hyperglycemia Crisis

- Stress hyperglycemia
 - Elevated BG due to stress hormones
 - Nondiagnosed patients with A1c between 6.5 - 7.0%
 - Type 2
- Uncontrolled, hyperglycemia results in increased risk of poor outcomes in hospital setting
- Hyperglycemia, can have significant damaging implications to the vascular, hemodynamic and immune systems

Hyperglycemia Crisis

- Triggers are attributed to:
 - Medical stress (acute illness)
 - Infection
 - Medications (i.e. glucocorticoids, lactulose, IVF with Dextrose)
 - Supplementation (i.e. enteral and parenteral nutrition)
 - Miscoordination of insulin administration with meals

Remote Approach: Glycemic Control Using Intensive Insulin Therapy

- Pros:
 - Targeting goals near normalized levels
 - (BG 80-90 to 100-120 mg/dl)
 - Achieved via an insulin infusion pump (Regular)
 - Allows faster titration and more reliable absorption than subcutaneous administration
 - Recommended for critically ill patients
 - ICU, MICU, Postoperative, post AMI, etc.
 - Decreased mortality and complications

Remote Approach: Glycemic Control Using Intensive Insulin Therapy

- Cons:
 - Limited randomized trials with inconsistent findings
 - No reduction of mortality in critically ill patients with tighter glycemic control
 - Increases risk of adverse outcome of **severe** hypoglycemia (BG < 40 mg/dl)
 - Reports of **increasing mortality** resulting from intensive insulin glycemic control

2011 Management Approach for Glycemic Control

- In the hospital setting insulin therapy is the preferred method for achieving glycemic control.
 - Critically-ill patient (ICU)/severe hyperglycemia crises (DKA/HHS)
 - IV insulin infusion pump with appropriate adjustment
 - Transitioning to the acute ward, convert to subcutaneous insulin
 - (75-80% of previous total daily dose)

2011 Management Approach for Glycemic Control

- Acutely-ill patient(MedSurg ward)
 - Subcutaneous insulin administration
 - Components 50/50: **basal**/nutritional (prandial), with correctional dosages as needed (e.g. hyperglycemic spikes)
 - General goal of insulin regimen is to mimic the normal physiologic process of glucose metabolism in a nondiabetic

2011 Management Approach for Glycemic Control

- Insulin dependent diabetic patient (IDDM)
 - NPO patient:
 - Basal insulin, with Regular insulin administration every 6 hrs as necessary
 - Mandatory in Type 1
 - Suggested for type 2
 - Generally patients are placed on a long-acting insulin for basal control with a faster short-acting insulin (e.g. lispro) via sliding scale: reduce risk of overlap and hypoglycemia with Regular insulin

2011 Management Approach for Glycemic Control

– Patient eating

- Continue home regimen if previously well-controlled
- If BG > 200 mg/dl on admission; dosage should often be increased or change to a basal-prandial regimen
- Any patient with persistent BG 300- 400 mg/dl w/o DKA or HHS not responding to increases in subcutaneous administration more than 24 hours should be considered for intravenous insulin infusion

2011 Management Approach for Glycemic Control

- Patients on supplemental nutrition: Insulin
 - Enteral feeding (i.e. tube feeds, NGT)
 - Basal insulin, with correctional doses of Regular insulin every 6 hours as needed
 - Parenteral feeding (i.e. peripheral or central IV administration)
 - Regular insulin added to feeding solution
 - Titrate insulin in increments 5-10 units/l to achieve control
 - Generally managed in collaboration with a Nutritionist

2011 Management Approach for Glycemic Control

- NIDDM
 - Oral glycemic agents have limited role
 - Appropriate for the medically stable patient with expected consumption of regular meals
 - Oftentimes, patients on Metformin, glyburide are withheld secondary to higher risk
 - Hypoglycemia
 - Renal insufficiency
 - Increased acidosis if radiocontrast used for imaging

Recommended Protocol

- Upon admission, every patient should be screened for Diabetes Mellitus (e.g. basic chemistry panel)
 - Any patient with A1c 6.5-7.0% will be monitored
 - Any patient with A1c > 7.0% should be evaluated at discharge for optimal dosing on oral glycemics versus insulin initiation for better control outpatient
- All hospitalized patients with evidence of severe hyperglycemia should be managed per an insulin protocol if feasible but with precaution
 - More precise titration, quicker and reliable absorption, with tighter glycemetic control

Recommended Protocol

- Critical Care setting
 - On infusion pump, monitor BG every 1 to 2 hours
- Patients in the Acute care setting
 - managed by a basal-prandial regimen, resembling the natural physiologic patterns of glucose metabolism
 - Managed per subcutaneous insulin protocol: monotherapy with long-/intermediate acting insulin, combination insulin, solely on sliding scale (not recommended)
 - BG monitoring with use of point of care (POC) before meals and at bedtime (BG every 4-6 hrs frequency)

Recommended Protocol

- In general, BG target goals: 140 mg/dl and 180 mg/dl
 - Avoid target goals <110 mg/dl for safety concerns
 - Consider higher target goals for medical ward
- Insulin therapies available:
 - Basal rate control:
 - Long-acting: Lantus(Glargine), Levemir(Detemir)
 - Intermediate acting: NPH
 - Prandial (blunt postprandial spikes at mealtime)
 - Using sliding scale: premeal vs postmeal coverage
 - Rapid-acting: Lispro(Humalog), Aspart(Novolog)
 - Short-acting:Regular (Humulin/Novolin)

Recommended Protocol

- Intermediate and short-acting Combination
 - Humalog 75/25 or Novolog 70/30 and 50/50 NPH/Regular
- Sliding scale
 - Usually in combination with a basal rate insulin
 - Sometimes used as monotherapy
 - Insulin sensitive patients (i.e. Type 1, lean persons, frail elderly) are recommended adjustment via 1 unit increment scale
 - Patients with severe insulin resistance (i.e morbidly obese) may require 2 unit increment scale
 - Adjustments are based on postprandial glycemia



Hypoglycemia in the Hospital Setting

Hypoglycemia Crisis

- Any BG < 70 mg/dl
- Severe hypoglycemia:
 - BG <40 mg/dl
 - Cognitive impairment begins BG < 50 mg/dl
 - Often associated with adrenergic, cholinergic and/or neuroglycopenic symptoms (palpitations, sweating, and/or AMS/obtunded/comatose)
 - Symptoms and physiologic response vary among patients
 - Higher glycemic thresholds occur in sustained hyperglycemia (poorly controlled Diabetic)
 - Lower glycemic thresholds occur in sustained hypoglycemia (tightly controlled or insulinoma)

Hypoglycemia Crisis

- Key danger: “**hypoglycemia unawareness**”: loss of the warning signs/symptoms previously allowed patient to recognize impending hypoglycemia crisis
- Whipple’s triad criteria:
 - Symptoms of hypoglycemia are evident
 - Low plasma concentration of glucose via a precise measurement method
 - Resolution of symptoms with increased glucose level

Hypoglycemia Crisis

- Triggers are attributed to:
 - Treatment of Diabetes is the most common cause
 - NPO patient/inadequate nutritional intake while on insulin
 - Postprandial (reactive) occurs after meals
 - Critical illness, infection, Sepsis
 - Medications (i.e. oral antiglycemic agents, sulfa-based (ie. sulfa, quinine, quinolone antibiotics, etc.)
 - Patients with lean body mass (i.e. elderly patients)
 - Old age

Hypoglycemia Crisis

- Triggers are attributed to (continued):
 - Patients with kidney failure or liver insufficiency
 - Endocrine deficiencies
 - Ethanol binge
 - Insulinoma (tumors)

Hypoglycemia Crisis

- Type 1
 - Average 2 symptomatic hypoglycemic episodes on a weekly basis; especially when tightly controlled
 - At least one temporarily, seriously disabling (i.e. hospitalization) episode per year
 - BG may decrease to < 50 mg/dl before symptomatic
- Type 2
 - Less frequent hypoglycemic episodes
 - Especially attributed to those treated on insulin and sulfonylureas

Responding to an acute Hypoglycemic crisis

- Oral Glucose supplement (if possible)
 - 20 gm oral tabs, orange juice (4 o.z.), soda (8o.z.); 2 Tbs sugar/water solution, hard candy (no chocolate)
 - Parenteral glucose
 - Subcutaneous/intramuscular Glucagon injection (especially in type 1)
 - Intravenous glucose (1 ampule D50 solution)
 - Severe symptoms (obtunded/comatose): Insulin drip (5% or 10% dextrose) postadministration of SC/IM
- Food consumption ASAP - replete glycogen stores

2011 Management approach: Hypoglycemia Crisis

- Test BG at time of hypoglycemic symptoms
- Draw blood before administration of glucose
- Determine patient's diabetic status (i.e. known, type 1 or 2, IDDM vs NIDDM, home regimen)
- Determine cause of hypoglycemic event (i.e. triggers)
- Assess regimen for adjustment

Takeaways



Outpatient Transition of the Hospitalized Diabetic Patient

- Include education and establish a manageable home regimen
 - All literate patients should check BG TID/QID and keep diary of daily BGs
- Establish close post admission follow-up for patients if treatment was initiated, stopped or adjusted
 - 1-2 week follow-ups
 - If elevated HgbA1c then 1-2 months follow-up
- At discharge, patients on insulin regimen may need to be simplified for home management

Outpatient Transition of the Hospitalized Diabetic Patient

- Combination therapy, combination long-acting with oral meds/sliding scale, monotherapy, etc.
- Many patients are converted to oral antiglycemic agents, after stabilization with insulin during inpatient
- Oftentimes recommend discontinuation of sulfonylurea and other trigger for hypoglycemic
- Newly-diagnosed patients with modest HgbA1c are often first recommended lifestyle modification with medical nutritional therapy MNT with close monitoring every 3 months with Renal, Podiatry, and Ophthalmology follow-up

Thank You!

