DIABETES PITFALLS: CASE-BASED APPROACH TO CORRECTING COMMON INPATIENT ERRORS

Stephanie Neary, MPA, MMS, PA-C
Yale PA Online Program: Assistant Professor, Director of Didactic Education
Medical University of South Carolina: Endocrinology – Diabetes Management Service

Yale SCHOOL OF MEDICINE
Physician Assistant Online Program

Disclosures

- I have no relevant relationships with ineligible companies to disclose within the past 24 months. (Note: Ineligible companies are defined as those whose primary business is producing, marketing, selling, re-selling, or distributing healthcare products used by or on patients.)

Disclaimer

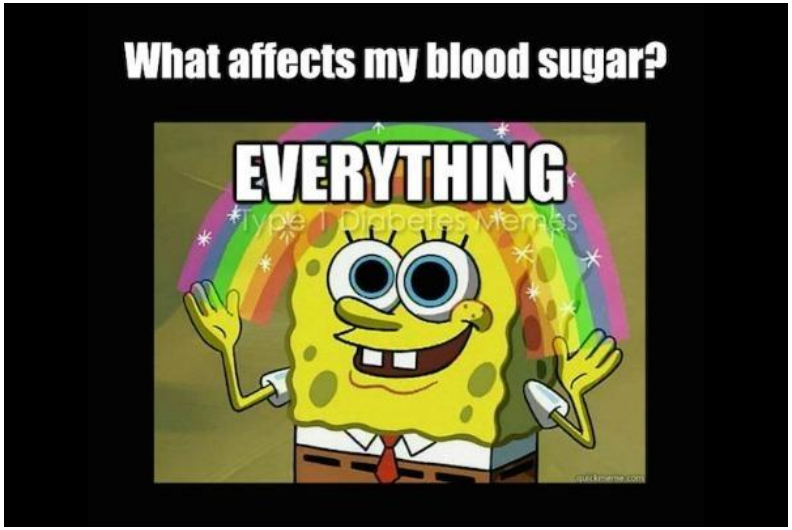
- While much of diabetes management is number-focused, please remember to always treat the patient, not the number!

Objectives

- Review the basics of inpatient diabetes management regimens
- Explore cases of inpatient diabetes management errors and discuss solutions for improved care

Things you probably already know…

- Over 8 million hospital discharges each year in the US include a diagnosis of diabetes
- Patients with type 1 diabetes **require** insulin
- Patients with type 2 diabetes ***may* require** insulin
- There are many, many, many other forms of diabetes and causes of hyperglycemia that do not include a diagnosis of diabetes



Quick Review: Pathophysiology

- Pancreatic islet cells (beta cells) produce insulin in response to elevations in blood glucose
- Type 1 diabetes: autoimmune destruction of beta cells
  - Results in an absolute insulin deficiency
- Type 2 diabetes: multi-factorial insulin resistance
  - Results in compensatory defect in insulin secretion

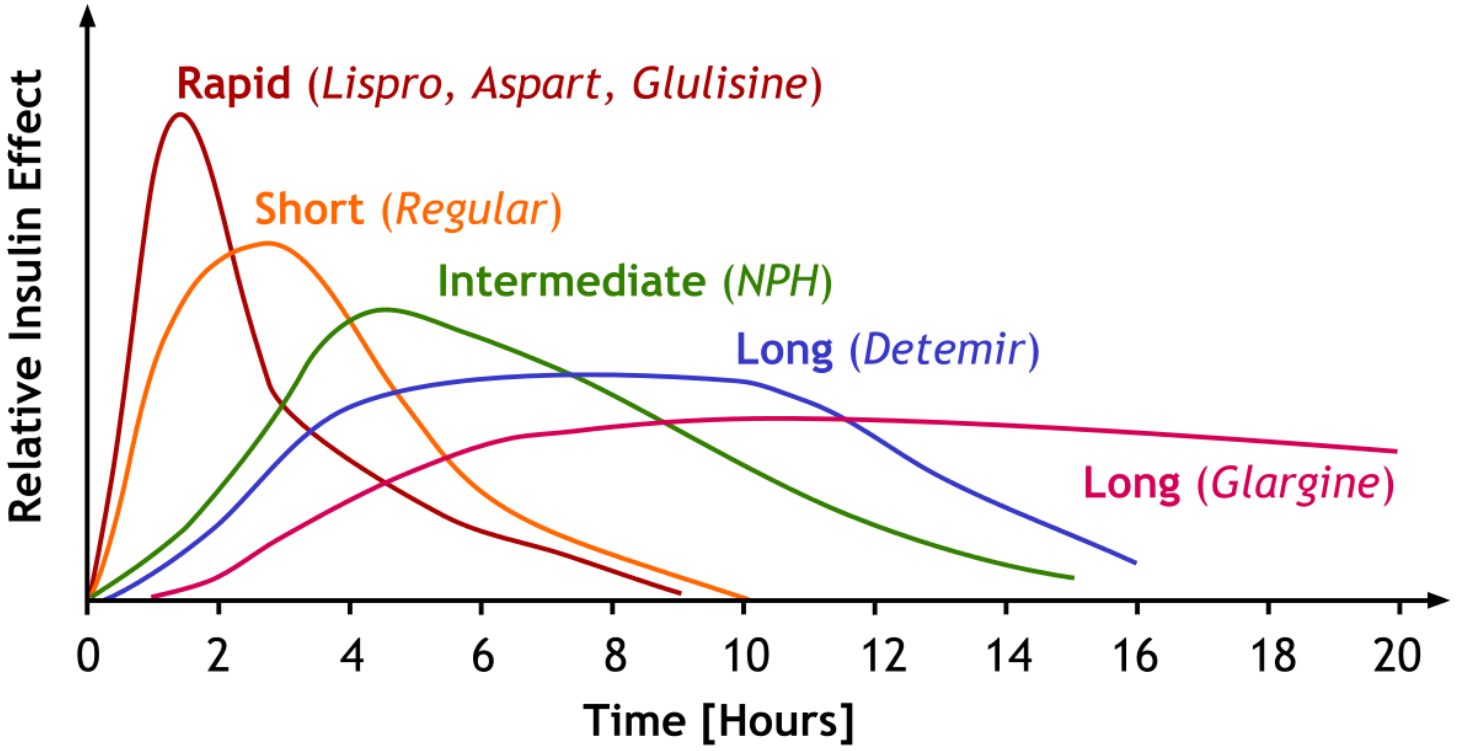
What lab can be used to measure endogenous insulin production?

What lab must be ordered at the same time?

Quick Review: Basal vs Bolus Insulin

- Basal insulin:
  - Keeps blood glucose stable during periods of fasting
- Bolus/prandial insulin:
  - Covers glucose from meals
- Correction insulin:
  - Adjusts basal insulin to goal

Quick Review: Insulin Types



Quick Review: Inpatient Insulin Tips

- Regular insulin: insulin drips, DKA protocol, hyperkalemic protocols
- NPH: the peak matches the peak of prednisone well
  - Use for patients who are taking morning steroids post-transplant
    - Insulin amount may increase up to 50% of what was needed prior to steroid use
  - Also allows for quicker adjustments while admitted

Quick Review: Additional Inpatient Tips

- Typically discontinue oral diabetes medications while admitted
  - Potential for drug interactions, renal impairment, changes in nutritional status
- Don't miss antibiotics in D5, hyperkalemic protocol, medications that increase blood glucose (like amiodarone, beta blockers, lithium, steroids, and many more)

Mini-case 1

- Page received: 60 yo F diabetic with endometrial cancer now s/p hysterectomy. DMS already following. Hoping to get final recs for dc today.
- What went wrong?
  - 60 yo F “diabetic”
- How can we fix it?
  - 60 yo F with diabetes

Mini-case 2

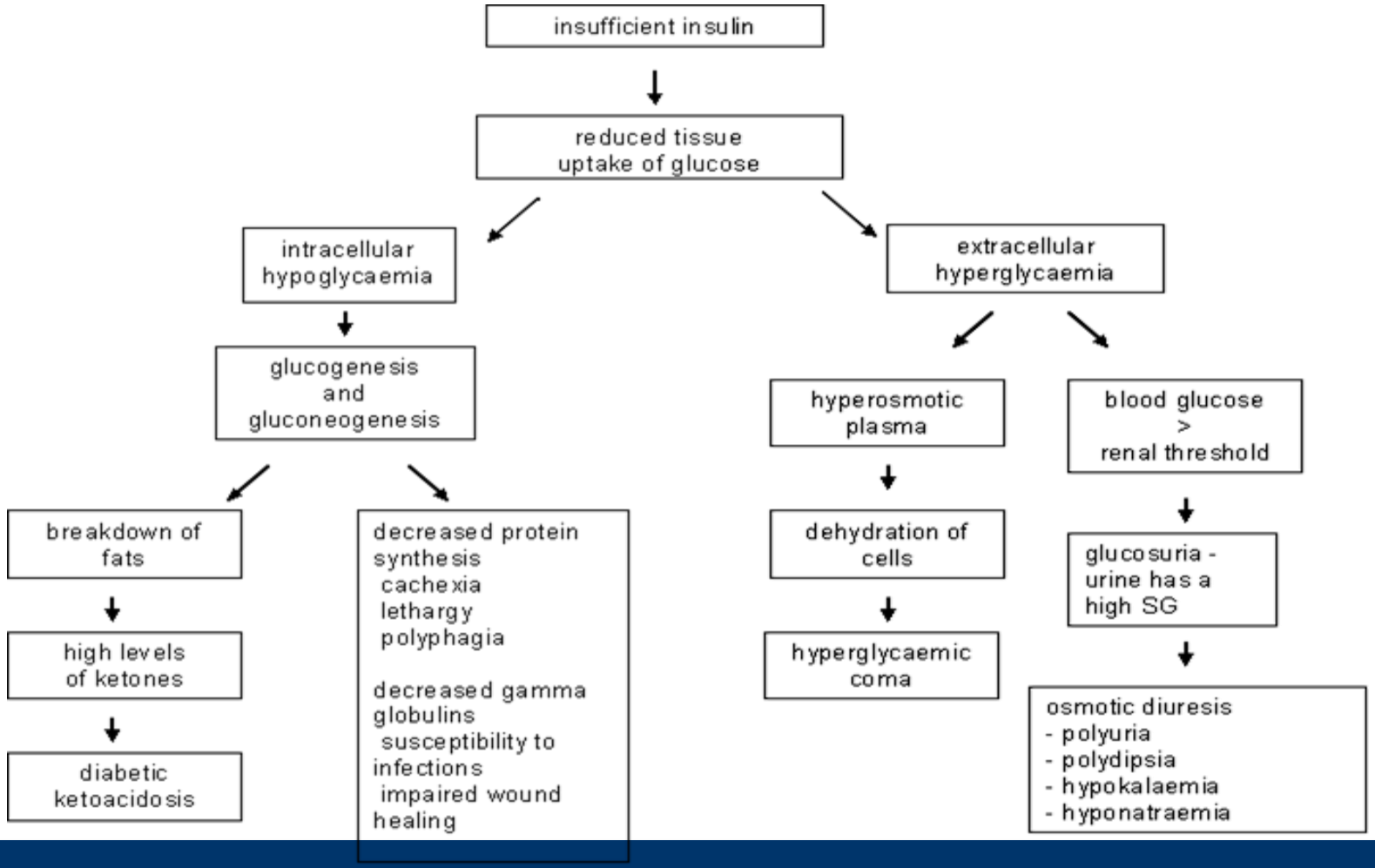
- Patient is a 48 yo female with a history of hypertension. Presents today for MVR.
- DM history: diagnosed type 1 DM 1992
- Current insulin regimen:
  - Lantus 10 units QHS, Novolog 1:7 CHO, Novolog 1:50>150ac>200hs
- Now NPO at MN for surgery
- What was done:
  - Hold glargine, hold prandial, continue correction scale achs
- What went wrong:
  - Patient has type 1 and all basal insulin was held. What else?
  - Correction scale remains achs

Mini-Case 2

- What could we do to fix it?
  - Patients who have type 1 should not have basal insulin held, should have continued the Lantus 10 units the night before
  - Change correction scale and POCT glucose to q 4 hours while NPO

- What is our concern for patients with type 1 diabetes when all basal insulin is held?
  - DKA!!!

Pathophysiology review…



Case 1: Background

- Patient is a 39 yo female with a history of kidney transplant (9 months ago) secondary to diabetic nephropathy and hypertensive nephrosclerosis. Presents today for rejection workup. Taking prednisone 10 mg PO QAM.
- DM history: diagnosed type 2 DM in 2005, now insulin dependent

Case 1: What was done

- Patient transitioned off of insulin gtt at 18:37 with blood glucose of 178
  - NPH 25 QAM, Novolog 8ac, and Novolog 1:30-50>140ac>170hs3am
  - POCT glucose achs3am

- Glucose checked again at 23:32 = 368
  - given 10 units Novolog as correction and 12 units NPH as a bridge
- Glucose checked again at 03:41 = 428
  - given 10 units Novolog as correction
- Now it's 08:00

Case 1: What went wrong

- It's 08:00 and the last glucose check was 428 at 03:41
- Called nursing team at 08:00 when arrived onsite for POCT glucose
  - 08:47 = 334
    - given Novolog 10ac + 10 correction, NPH 35
  - 12:13 = 310
    - given 13ac + 8 correction
  - 16:45 = 314
    - insulin gtt started

Case 1: How can we fix it?

- More aggressive checking once we correct for a high glucose
- POCT glucose checks were written for achs3am, but we have to think about what this means in the setting of the patient in front of us

- When we correct high glucose with rapid acting insulin, how rapidly do we expect to see a decrease?
- When should we recheck?

Case 1: Key takeaways

- Need to recheck glucose after correction within ~30 minutes if patient has been upward trending
- Clear nursing communication for when to page!

Case 2: Background

- Ms. A is a 46 yo female with a history of ESRD secondary to diabetic nephropathy, hypertensive nephrosclerosis, and SLE. She started dialysis 2 years ago (TRSa) with estimated urine output of 1 cup/day
- PMHx: T2DM (2005), SLE (2006), HTN (unknown date), CVA (2016), pericardial effusion, lymphadenopathy, sleep apnea, obesity, anemia, asthma (1997)
- Renal transplant completed 12/19/2021
- Diabetes management consulted 12/20/2021 – **POD 1**
  - Pre-op A1c 12/19/2021 = 8.2%
  - Pt unsure of current insulin type or dosing
  - Managed by private practice Endocrine, no records available

Case 2: Questions to Consider

- What is the affect, if any, of dialysis on hemoglobin a1c?
- What can we use instead?
- What medication did she receive intraoperatively for her transplant that she will continue to receive post-op that will dramatically impact her blood glucose?

Case 2: What was done

	12/19/21 09:58	12/19/21 20:16	12/20/21 06:57	12/20/21 08:30
Glucose	213	117	214	222
Novolog dosing		2 units		

Current orders upon consult:

- Level 2 CHO diet
- Novolog 1:30-50>140q4hrs
- POCT glucose achs

Changes made:

- Continue Level 2 CHO diet
- Change Novolog 1:30-50>140ac>170hs3am
- Begin Novolog 4ac
- Change POCT glucose achs3am

Why did we add glucose checks at 3am?

Case 2: What went wrong

- Original plan:
  - Level 2 CHO diet
  - Novolog 1:30-50>140q4hrs
  - POCT glucose achs
  - *This patient is eating, has q 4 hrs correction, and glucose checks with meals and bedtime*

- We put on Novolog 4ac and achs3am correction scale
- Glucose of 403 at 22:22 on 12/20
- New information: Patient was on Tresiba 15 QHS at home – discovered after started insulin dosing yesterday

Case 2: How do we fix it?

- Initially:
  - Confirm fasting versus eating
  - Make sure POCT checks match correction dosing
- Patient started on insulin gtt
- Further complication:
  - Correction insulin was then continued in addition to the insulin gtt

Case 2: Follow Up Questions

- Does the insulin drip cover basal or bolus insulin?
- How often do we typically check glucose while on an insulin drip?
- Do we use correction and/or prandial insulin while on an insulin drip?

Case 2: Key Takeaways

- Make sure all orders match on timing
- GET THE 3AM GLUCOSE!
- Insulin drips are meant to cover the basal insulin, not the prandial insulin

Case 3: Background

- Mr. P is a 78-year-old male who is in the CVICU POD 1 for CABG
- PMHx: angina, hypertension, hyperlipidemia, CAD with prior PCI (1990s)
- No prior pertinent surgical history
- CABG completed 1/31/2022
- Diabetes management consulted 2/1/2022 – POD 1
  - A1c = 7.2%
  - Takes Metformin 500mg PO BID at home
  - Managed by primary care, no prior records available

Case 3: What was done

- Patient started on insulin gtt during CABG and continued on insulin gtt post-op in CVICU
- Post-op patient was advanced to Cardiac Fitness Diet Level 2: 60g CHO/meal starting 6:30am

- What is **about** to go wrong?

Case 3: What went wrong

	2/1 00:02	2/1 2:24	2/1 4:08	2/1 8:06	2/1 9:10	2/1 10:16	2/1 11:17	2/1 12:22
Glucose	150	127	136	147	159	147	166	146
Insulin gtt rate (mL/hr)	1.8	0.7	0.8	1.9	1.9	2.6	4.2	4.3

- How often should we be checking glucose?
- Why are drip rates rising?

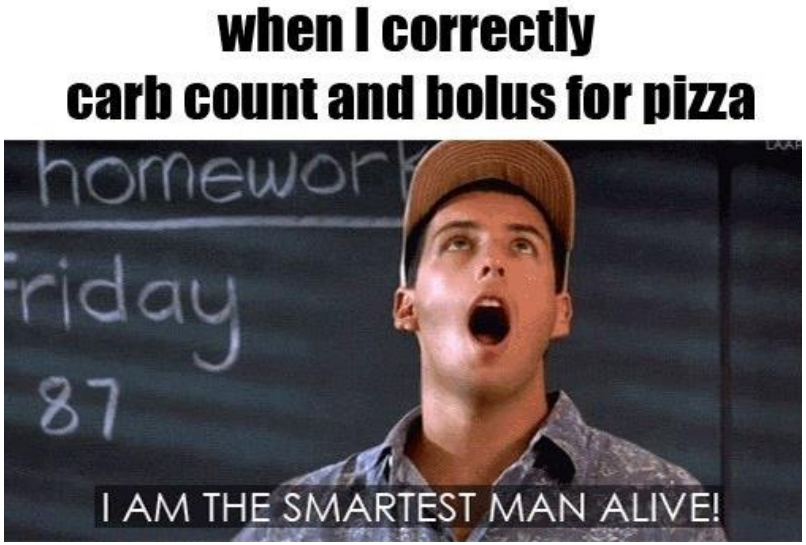
Case 3: How do we fix it?

- Need to add prandial insulin in addition to insulin gtt

- When do we transition off the insulin gtt to SQ insulin?
  - Blood glucose consistent <180 mg/dL for at least 4-6 hours
  - Normal anion gap, not in DKA
  - Consider other drips, is patient on vasopressors?
  - Patient is on stable feeding plan

Case 3: Key Takeaways

- Blood glucose should be checked every hour while on insulin gtt
- The insulin gtt controls basal insulin
  - Correction insulin is NOT needed
  - Prandial insulin IS needed



Case 4: Background

- Patient is a 47-year-old female who presents today for sleeve gastrectomy.
- DM history:
  - Diagnosed with type 2 DM in 2012
- Pre-hospital regimen:
  - Lantus 60 QHS
  - Novolog 40 ac
  - Novolog 3:50>150ac>200hs

Case 4: What was done

- NPO at midnight
- Pt given 30 units NPH night prior to surgery, all Novolog held
- Surgery performed – patient started on clear liquid diet post-op
- Insulin regimen adjusted:
  - Lantus 20 units QHS
  - Novolog 1:30-50>140ac>170hs3am
- Diet advanced to full liquid
  - Insulin regimen remained

Case 4: What went wrong

- Patient NPO at midnight and given half of glargine amount as NPH
  - Think about insulin action times…when is that NPH going to stop working?
- Correction insulin and prandial insulin were both held

Case 4: What went wrong part 2

- Patient was discharged by primary team to home with orders **to resume home insulin regimen**

- As a reminder:

	Home:	Pre-discharge:
Lantus	60 units	20 units
Prandial	40 units	none
Correction	3:50>150ac>200hs	1:30-50>140ac>170hs3am
Basal + Prandial Total	180 units	20 units

Case 4: How do we fix it?

- CONTACT THE PATIENT!!!! And…
- Patient should have been continued on current regimen modified for home
  - Lantus 20 units QHS, Novolog 1:50>150ac>200hs

Case 4: Key takeaways

- When NPO, stop prandial insulin but continue correction insulin
- For type 2 diabetes, typically give 25% of basal dose of glargine or full dose of NPH the night before NPO
  - Morning of NPO: give 25% dose of glargine or 50% dose of NPH
- For type 1 diabetes, basal dosing can typically remain the same

References

- Van Rhee J, Bruce C, Neary S. *Clinical Medicine for Physician Assistants.* Springer Publishing. 2022.
- Rushakoff RJ. Inpatient Diabetes Management. [Updated 2019 Jan 7]. In: Feingold KR, Anawalt B, Boyce A, et al., editors. Endotext [Internet]. South Dartmouth (MA): MDText.com, Inc.; 2000-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK278972/

CME Question 1

Which of the following patterns of results will present for a patient with diabetes who receives dialysis treatments?

A. Falsely high a1c
B. Normal a1c
C. Falsely low a1c

CME Question 2

- A patient is started on an insulin drip. Which of the following SQ insulins should **be continued**?
  A. Basal insulin
  B. Prandial insulin
  C. Correction insulin

CME Question 3

- A patient with type 2 diabetes will be NPO at midnight for a procedure in the morning. The patient currently takes NPH 20 units every morning. Which of the following is the best approach for the patient's basal insulin?
  - A. Discontinue morning NPH
  - B. Reduce morning NPH by 25%
  - C. Reduce morning NPH by 50%
  - D. Reduce morning NPH by 75%

Yale SCHOOL OF MEDICINE

Yale SCHOOL OF MEDICINE

Physician Assistant Online Program