Insulin Use in Diabetes Management

Catie Prinzing
MSN, APRN,
Clinical Nurse Specialist
September 27, 2013

Disclosure Statement

No Conflict of Interest to Disclose

Objectives

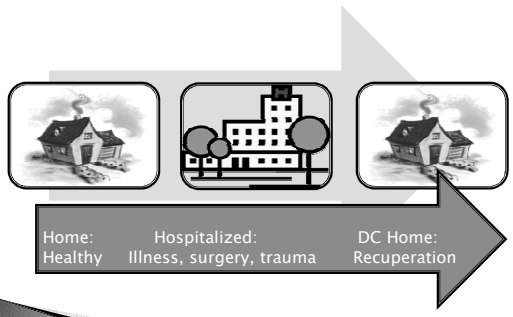
- List key concepts to determining patient insulin doses during transitions in care
- Identify 5 points to consider when prescribing anti-hyperglycemic therapy for patients with Type 2 DM
- Describe basic components of the ADA-EASD Position Statement for Management of Type 2 DM
- Describe issues surrounding the safe use of U-500 Regular Insulin

Diabetes Background

- It is estimated that nearly 26 million people in the United States have diabetes*
  - 8.3% of U.S. population
- Total estimated cost of diabetes in 2012 was $245 Billion**
  - $176 billion in direct medical costs
  - $69 billion in reduced productivity
  - 43% of medical expenditures attributed to hospital inpatient care

*Centers for Disease Control: National Diabetes Fact Sheet, 2011
** American Diabetes Association. (2013). Economic Costs of Diabetes in the U.S. in 2012. *Diabetes Care*, 36(4), 2013. 1033-104620.

Transitions In Care



Diabetes and Hospitalization

- People with DM are hospitalized 3x more frequently than patients without diabetes
- Health care expenditures for people with DM are 2.3% higher than for those without **
- Hyperglycemia in hospitalized patients is associated with poor clinical outcomes
- Severe hypoglycemia (≤50) associated with poor clinical outcomes *
- Insulin therapy is the preferred method of glycemic control for most hospitalized patients

* Seaquist, ER, et.al. (2013). Hypoglycemia, With or Without Insulin Therapy, Is Associated With Increased Mortality Among Hospitalized Patients. *Diabetes Care*, (36)5. 1107 – 1110.
** American Diabetes Association. (2013). Economic Costs of Diabetes in the U.S. in 2012. *Diabetes Care*, 36(4), 2013. 1033-104620

Pathophysiology of Type 2 DM

- Dysfunction of beta cell insulin secretion
- Insulin resistance in muscle, fat, liver
- Increased endogenous glucose production from liver
- Deranged adipocyte biology
- Decreased incretin effect

ADA Definitions and Target Goals for Hospitalized Patients

- Hyperglycemia: >140 mg/dl
- Hypoglycemia: $\leq$ 70 mg/dl.
- A1 of 6.5% upon hospitalization signifies pre-existing diabetes on admission
- Critical Care BG goals:140 to 180 mg/dl.
- Non-critical Care BG goals:
  - Pre-meal <140 mg/dl
  - Random < 180 mg/dl

American Diabetes Association. Standards of Diabetes Care – 2013. *Diabetes Care.* (36) S1. S45 – S47.

Obstacles to Glycemic Management:Hospital Setting

- Unanticipated nutrition changes
- Medication changes & meds that increase insulin resistance
- Physiologic stress response
- Co-morbid events
- Multiple system/organizational barriers
- Inadequate glycemic control prior to hospitalization

Draznin,et al., *(2013).* Pathways to Quality Inpatient Management of Hyperglycemia and Diabetes: A Call to Action. *Diabetes Care,* (36) 7, 1807 – 1814,

Considerations for ALL Diabetes Patients upon Hospital Admission

- Home oral diabetes medications, non-insulin injectable medications and insulin doses
- A1C on admission
- Blood glucose on admission
- Reason for admission and co-morbidities
- Weight
- PO status
- IV fluids and medications
- Activity level

Oral Medications in the Hospital Setting

- Oral medications for diabetes not appropriate for the acute or critically ill hospitalized patient
- Oral medications **only** appropriate for patients who are stable, able to consume majority of meals at regular times and are close to discharge

GOLD STANDARD: Insulin

- Long and Intermediate
  - Lantus (glargine), Levemir (detemir), NPH
- Short Acting
  - Regular insulin
- Rapid Acting
  - Novolog (aspart), Humalog (lispro) and Apidra (glulisine)
- Mixed Insulin's
- Insulin U-500
  - 5x concentration of other insulin's

What We Hear. . .

From Patients:

- "My blood sugars get out of whack every time I go in the hospital."
- "They didn't give me the same doses of insulin I use at home."
- "They put me on insulin and stopped my diabetes pills."
- "They won't let me use my own insulin/pills from home."
- "They don't take my blood sugars at the right times."
- "The nurses don't understand diabetes."
- "I don't get to eat what I want to."

What We See……..

Patient's admitted:

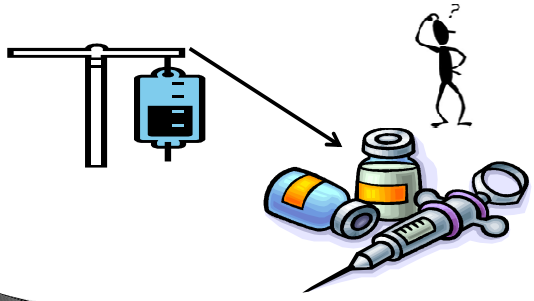
- Unable to state diabetes medications and/or doses of diabetes medications they are on
- No understanding of how their diabetes medications work
- Unaware of last A1C and/or do not know what an A1C is
- Prescribed large doses of long acting insulin and no/minimal rapid acting insulin to cover meals
- No formal diabetes education
- No medical nutrition therapy education
- No sick day management plan

Appropriate Insulin for Clinical Situation: ICU

- Insulin infusion with Regular insulin
- No advantage to rapid acting insulin – more expensive
- ½ life of insulin is 5-7 minutes; biological effect 20 minutes
- Safest way to quickly gain control of hyperglycemia
- Infusion started at no greater than 180 mg/dl.
- Computerized protocols i.e. Glucomander or GlucoStabilizer or paper infusion protocols for patient safety
- Blood glucose checked hourly and titrated

Endocrine Practice Vol 17(S2) March/April 2011, pp10
American Diabetes Association. Standards of Diabetes Care – 2013. *Diabetes Care.* (36) S1. S45 – S47.

Transitioning from IV to SQ……



Transitioning from IV to SQ……..

One method:

- Divide total daily dose into basal and bolus
  - Usually about 50% basal, 50% bolus
  - If on steroids, less basal and more bolus
- Add correction scale
- Give basal insulin 3-4 hours before discontinuing the infusion
- Monitor and titrate frequently

Appropriate Insulin for Clinical Situation: Acute Care

- Discontinue all oral meds and non-insulin injectables upon admission
- Basal, bolus, correction recommended
- Basal
  - Long acting usually preferred; NPH sometimes appropriate
- Meal bolus
  - Rapid acting insulin analogs preferred
  - Insulin to carb dosing is safest for hospitalized patients
    - PO intake unpredictable in many patients
    - Less chance of stacking insulin which decreases risk of hypoglycemia
- Correction
  - Choose scale based on patient insulin sensitivity

Titrate, Titrate, Titrate……

Other Situations

- Enteral and Parenteral Feeding
  - All patients have blood sugars routinely checked
  - Regular, Rapid Acting, long acting??
  - Is feeding continuous? Bolus?
  - Patient has diabetes? No diabetes?
  - Choice of insulin depends on situation.
- Steroids
  - PO or IV
  - Once daily, 24 hour dosing?
  - Choice of insulin depends on situation
- Renal Failure
  - Lower doses

No!

Sliding Scale

No!

Discharge Planning for Diabetes Starts on Admission

Points to Ponder:

- A1C on admission and home admission diabetes meds
- What is nutrition status on discharge
- Type and severity of diabetes
- Effects of patient's illness on blood glucose levels
- Other discharge meds i.e. steroids
- Who will follow DM management after discharge
- What resources does patient have
  - insurance, financial, diabetes management support and assistance if needed
- What is patient willing and able to do to manage his/her diabetes?

Discharge Medications

- Will patient go home on insulin?
  - Determine type(s) of insulin
  - Must consider what the can patient afford
    - If changing to less expensive insulin, begin transition before discharge
  - Pens vs. vial/syringe
- Will patient go home on oral medications? non-insulin injectable?
  - Must consider what patient can afford
  - Begin transition when patient is stable and eating

Essential Prior to Discharge: DM Education

Education Focused on Survival Skills

- DM medications
- Hypoglycemia/Hyperglycemia and treatment
- Blood glucose testing
- Nutrition
- Exercise
- Sick Day Management
- Who to call for DM emergency
- Follow-up plan for DM management

Education: DM Medications

- Type of medication and how it works
- Dosing
- When to take and why timing is important
- What to do if a dose is missed
- What to do if hypoglycemia is experienced
- What to do if blood sugars remain elevated

Diabetes Education: Injections

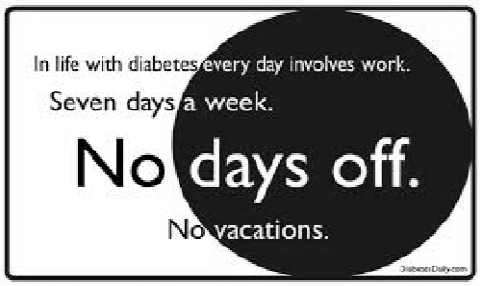
Pen Device	Vial and Syringe
▸ Ability to dial to dial pen ▸ 2 unit air shot each time ▸ Correct administration at 90 degree angle ▸ Hold in place for 10 sec following administration of full dose	▸ Draw up dose correctly in insulin syringe ▸ Administer correctly

✓Storage of opened & unopened pens
✓Proper disposal of pen needles
✓Expiration dates of insulin's

Management of Hyperglycemia in Type 2 Diabetes: A Patient-Centered Approach

Position Statement of the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD)

Diabetes Care. 2012 Jun;35(6):1364-79. doi: 10.2337/dc12-0413. Epub 2012 Apr 19



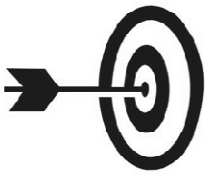
Patient Centered Approach

- "*….providing care that is respectful of and responsive to **individual** patient preferences, needs, and values – ensuring that patient values guide all clinical decisions.*"
- Determine patients preferred level of involvement
- Explore therapeutic choices
- Utilize decision aids
- Share decision making – final decisions re: lifestyle choices ultimately lies with the patient

Aniti-Hyperglycemic Therapy

Glycemic Targets

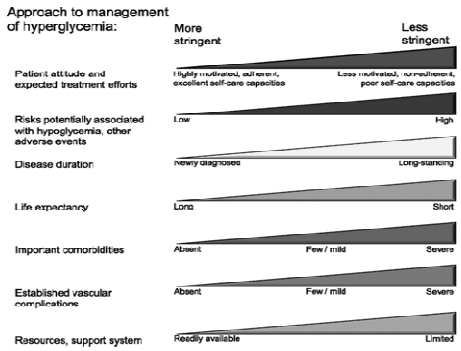
- **A1C <7%** (mean PG ~150-160 mg/dl)
- Pre-prandial PG <130 mg/dl
- Post-prandial PG <180 mg/dl



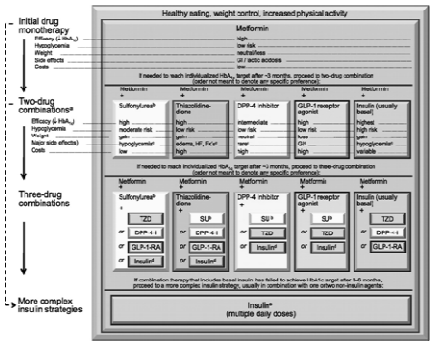
Anti-hyperglycemic therapy . . .

Individualization is key:

- **Tighter targets** (6.0-6,.5%) – younger, healthier
- **Looser targets** (7.5 – 8.0%+) – older, Transitions in CARE, hypoglycemia prone, etc.
- **Avoidance of hypoglycemia**



Diabetes Care. 2012:35: 1364 – 1379
Diabetologia. 2012:55: 1577 -1596

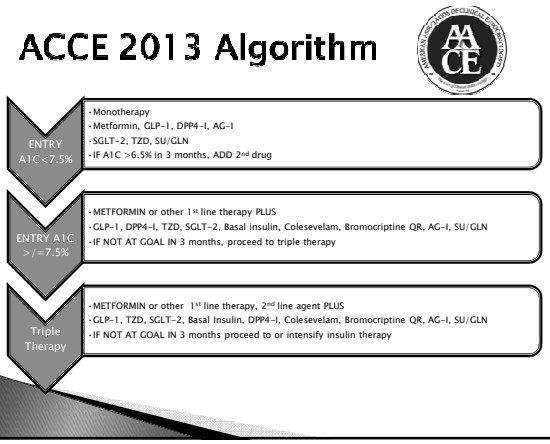


Diabetes Care. 2012:35: 1364 – 1379
Diabetologia. 2012:55: 1577 -1596

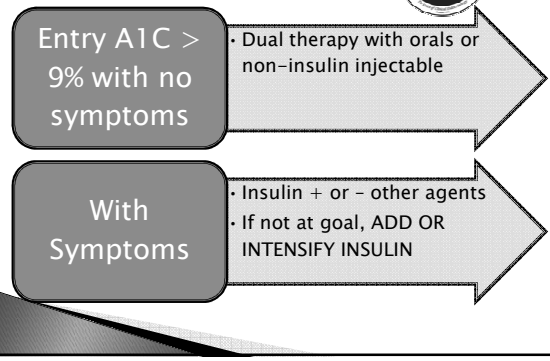
AACE 2013 Type 2 DM Management Algorithm

AACE Comprehensive Diabetes Management Algorithm, *Endocrine Pract.* 2013; 19(No.2)

ACCE 2013 Algorithm



AACE continued . . . .



AACE continued. . . .

Start Basal: A1C <8% TDD: 0.1 – 0.2 U/kg	• Titrate every 2–3 days to reach goal •Fixed regime: 2 units •Adjustable regime: FBG>180, add 4 U; 140 to 180, add 2 U, 110 to 139, add 1 U •For Hypoglycemia, reduce TDD: BG <70, 10%; <40, 20 %
Start Basal: A1C >8% 0.2 – 0.3 U/kg	•Same titration doses as above •May need to discontinue or reduce SU after basal insulin started •IF NOT AT GOAL – INTENSIFY ADDING PRANDIAL CONTROL
PRANDIAL CONTROL	•Add GLP – 1 or DPP4–I •Add Prandial insulin: TDD: 0.3 – 0.5 U/kg w/50% basal and 50% Prandial •Increase prandial dose by 10% for any meal if the 2–hr PP or next premeal BG is >180 mg/dl

Choices!!!

Super Strength–Insulin: U–500

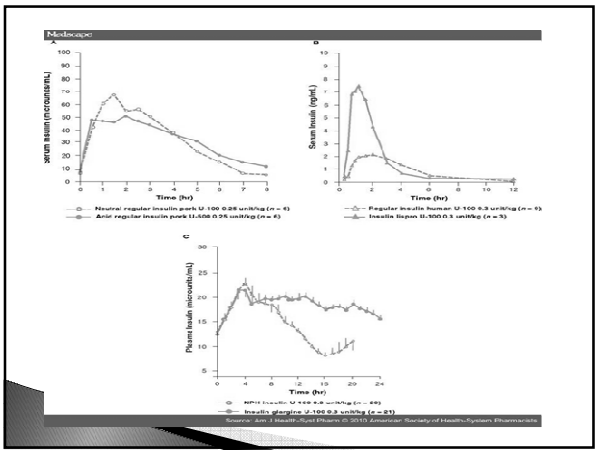
Insulin U-500

- 5 x more potent than standard U-100 insulin.
- 1 mL = 500 units
- Prescribed for patient's with extreme insulin resistance requiring large doses of insulin

Insulin U-500

- Non-modified regular insulin
- Initial effects similar to regular insulin with onset of 30 minutes and peak w/in 1-3 hours
- Long duration of action - up to 24 hours following a single dose
- High concentration results in delayed absorption

It Takes…….. How Many???



Dosage and Administration

- Should only be administered subcutaneously
- Institute for Safe Medication Practices recommended exclusive use of tuberculin syringes to avoid dosing confusion
- Many in the outpatient setting continue to use insulin syringes**. Proceed cautiously** and ensure patient understanding whichever syringe type is used.

1. Eli Lilly and Co.: *Humulin R regular U-500 prescribing information. Available online from http://pi.lilly.com/us/humulin-r-u500-pi.pdf*
2. Cochran E, et al. (2005). *Diabetes Care.* 2005;28(5): 1240-44.
3. Segal, R. et al. (2010). Use of concentrated insulin human regular (U-500) for patients with diabetes. *Am J Health-Syst Pharm.* (67) Sept.15, `1526 - 1535

When Writing Prescription

Include amount of insulin to be taken in both dose and volume form:

"Human Regular insulin U-500.
Sig: Inject 0.3 mL (150 units) subcutaneously, 3 times daily ac meals.
Concentrated insulin. Do not adjust dose".

Cochran E, et al. (2005). The use of U-500 in patients with extreme insulin resistance. *Diabetes Care.* 28(5): 1240-44.

U-500 Insulin Dosage Conversion Charts

Conversion Using Tuberculin Syringe

Volume (mL)	U-500 insulin dose (units)
O.1	50
0.2	100
0.3	150
0.4	200
0.5	250
0.6	300
0.7	350
0.8	400
0.9	450
1.0	500

Conversion Using U-100 Insulin Syringe

U-100 Syringe (units)	U-500 insulin dose (units)
10	50
20	100
30	150
40	200
50	250
60	300
70	350
80	400
90	450
100	500

Dosing Algorithm: U-500 Regular Insulin

Total Daily Insulin Dose (Units/day)	U-500 Regular Insulin Dosing
200 – 300	2x daily: 50/50 or 60/40 (ac breakfast & dinner)
300 – 750	3x daily: 40/30/30; 45/35/20 or 40/40/20 (ac meals)
750 - 2000	4x daily:30/30/30/10 or 25/25/25/25 (ac meal & HS)
>2000	Consider delivery via insulin pump *Off label use

Cochran E, et al. (2005). The use of U-500 in patients with extreme insulin resistance. *Diabetes Care.* 28(5): 1240-44.

Dosing Algorithm: U-500 Regular Insulin

Total Daily Insulin Dose (Units/day)	U-500 Regular Insulin Dosing
150 - 300	2x daily: 50/50 or 60/40 (AC breakfast & dinner) 3x daily: 33/33/33 (AC meals) *CSII: 3 meal bolus doses = 50% TDD plus 24 hr basal = 50% TDDD
300 – 600	3x daily: 33/33/33 (ac meals) 4x daily: 30/30/30/10 (ac meals and HS) *CSII: Same as CSII in 150 – 300 column
>600	4x daily: 30/30/30/10 (ac meals and HS)

Segal, R. et al. (2010). Use of concentrated insulin human regular (U-500) for patients with diabetes. *Am J Health Syst Pharm.* (67) Sept.15, 1526 – 1535
* Off label use

Transitioning from U-100 to U-500

A1C ≤8% at baseline	Decrease TDD by 10-20% prior to conversion to U-500
A1C>10% at baseline	Increase TDD by 10 to 20% prior to conversion t U-500

Insulin U-500: Safe Use in Hospital Setting

- U-500 home dose verified
- Order written as the dosage in actual units and volume in mL
- U-500 vials not dispensed to the nursing units
- Pharmacy pre-fills tuberculin syringes and delivers to the nursing unit
  - High alert labeling on syringe
  - Both units and volume dose written on syringe label
- Pharmacy sends education information to the unit with each dose
- Independent double check by nursing staff

Pharmacist's Checklist for U-500

- Assure other basal-bolus insulin discontinued by prescriber.
- Verify that last dose of basal-bolus insulin exceeded 200 U.
- Label prescription to express dose in volume & actual units. Double check calculations
- Provide clear instruction to patient and family.
  - Reiterate that U-500 is a concentrated form of insulin
  - Explain dose in both volume (mL) and units
  - Demonstrate drawing-up dose. Have patient repeat action
  - Remind patients to discard vials 30 days after opening
- Dispense tuberculin syringe
- Sequester U-500 stock away from standard insulin
- Appropriately mark electronic drug file to distinguish U-500

Garg, R, Johnston V, McNally PG, etal. U-500 insulin: why, when and how to use in clinical practice. *Diabetes Metab Res Rev.* 2007;23:265-268.

Pharmacist's Checklist cont. . . .

IF a tuberculin syringe is not dispensed and an insulin syringe is used

- Make sure patient understands the dose at the unit mark that is to be drawn up
- Make sure patient understands the actual units he/she is injecting
- Recommend providing a U-500 conversion sheet

Example:

Draw up to 40 unit mark.

Total insulin units injected = 200 units

Case Study: Janice

- 60 yr old female
- NSTEMI
- Type 2 DM 15 yrs
- A1C 10.2
- BMI: 48.2
- HTN
- Hyperlipidemia
- Asthma
- DJD

Diabetes Medications

- Glargine: 100 units 2x/day
- Aspart: 5 units with meals
- No correction Novolog
- No oral diabetes medications

Admission Evening

- Taken to cath lab with x2 stents placed
- Returned to floor and able to eat dinner
  - 1800 Consistent Grams Carb Diet Ordered
- Cardiologist decreased HS glargine dose by 20% and ordered 80 units at HS
- 4 am BG check was 42 mg/dl
- Glycemic Team ordered by cardiologist the next morning

Day 2 of Admission

- Glycemic Team (GT) CNS interviewed patient
- AM glargine insulin held
- Aspart correction ordered
  - +2 units for every 50 mg/dl > 150 mg/dl
- GT notified at each meal with BG value
- At dinner that night, BGs remained in low 100's with no correction used
- At HS, BG remained in low 100's.
- Held glargine at HS

Day 3 of Admission

- AM fasting BG was 110 mg/dl
  - Held AM glargine
- Continued with Novolog correction
- Continued GT called with each BG
- Pre-dinner BG was 182 mg/dl
  - Initiated bolus dose of 4 units with meals plus correction
- HS BG was 170 mg/dl
  - Restarted glargine at 15 units HS

Over the next few days . . . . .

- Continued to slowly titrate Lantus and Novolog upward
- Diabetes Educator provided much needed education for Survival Skills
- MNT education with RD

Discharge Insulin Doses

Glargine: 20 units 2/day

Aspart: 10 units + meal correction

Added to insulin

Metformin ER 500 mg with instructions to titrate up to 2 grams daily as tolerated

MOST IMPORTANT!

Every patient clinical situation must be viewed individually, with the patient, to create a diabetes management plan which meets the specific needs of each patient.

What's Coming????

- New guidelines for use of metformin to be consistent with European, Canadian and Australian guidelines have been presented to the FDA for approval [1]
- Several new rapid acting insulin's under development [2]

1. Lipska, K; Bailey, C. & Inzucchi, S. (2011). Use of Metformin in the Setting of Mild-to Moderat Renal Insufficiency. *Diabetes Care* (34)6, 1431 – 1437.
2. Hinnen, D. et. al (2012) Insulin Therapy: Current challenges, new solutions. Accessed online at:*www.diabeteseducator.org/export/sites/.../SUPP1301_FINAL_online.pdf*

What's Coming????

- Studies on use of IV GLP-1 (exenatide and liraglutide) in Type 2 patients having major surgeries and cardiac ICU patients [1,2]
- Studies on use of DPP-4 inhibitors in controlling glycemia in hospitalized patients with pre-diabetes and diabetes = to 20-30 units of insulin [1]

1. Schwartz, S, & DeFronzo, R. A new approach to the care of Hospitalized Patients with Type 2 Diabetes. Practical Diabetology, 2013. Vol 32, No. 1; pp . 10 – 18.
2. 2. Draznin, B., et.al. Pathways to Quality Inpatient Management of Hyperglycemia and Diabetes: A Call to Action. Diabetes Care, Volume 36, July 2013. PP 1807 -1817

Questions?

Contact Information:

Catie Prinzing
cathprin@sarmc.org
Office: 208-367-7293