

Practical management of T2DM in Hospitalized non-ICU patients

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Outline

- ▶ Importance of optimal inpatient glycemic control
- ▶ I: From home to hospital: what to do?
 - ▶ Blood glucose monitoring: Who, how often?
 - ▶ HbA1c: Is it necessary? Factors affecting HbA1c?
 - ▶ What is the best goal: Fasting, premeal, random BG?



▶ II: In the hospital: how to control blood glucose?

- ▶ Diabetic diet
- ▶ Oral drugs: stop or continue?
- ▶ Insulin: tips and tricks
- ▶ Preoperative cases (NPO)
- ▶ NG tube feeding

▶ III: From hospital to home: how to prepare for discharge?



Goals in the hospital

- ▶ Avoid hypoglycemia
- ▶ Avoid severe hyperglycemia (DKA/HHS)
- ▶ Provide adequate nutrition



Definition of hospital dysglycemia

Terms

Definition

Hyperglycemia

Blood glucose > 140 mg/dl

Hypoglycemia

Blood glucose < 70 mg/dl

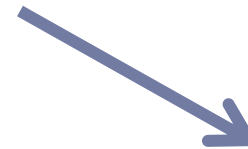
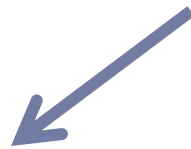


I: From home to hospital

What to do?

What to do when patient is admitted?

ALL patients:
Check history of DM
Check blood glucose level



No previous DM
BG < 140 mg/dl

CBG only if
necessary
(according to clinical)

No previous DM
BG > 140 mg/dl

CBG for 24-48 h

Check HbA1c

Known case DM

CBG premeal & hs

Check HbA1c
(If no result in past 2-3
months)

Steroids, NG tube feeding, TPN:
Monitor CBG for at least 24-48 h

HbA1c (glycated Hb): how is it useful?

- ▶ HbA1c < 6.5% : Stress-induced hyperglycemia
- ▶ HbA1c 5.7 – 6.4% : Prediabetes
- ▶ HbA1c ≥6.5% : Suggestive of DM

Diagnosis of DM requires NGSP certification



HbA1c: is it reliable?

False low

- ▶ Recent PRC transfusion
- ▶ Acute blood loss, hemolysis
- ▶ On hemodialysis
- ▶ Treatment of anemia with iron, erythropoitin
- ▶ Hypertriglyceridemia
- ▶ Liver cirrhosis
- ▶ Vitamin C, E
- ▶ HIV infection

False high

- ▶ Iron deficiency anemia
- ▶ Hyperbilirubinemia
- ▶ High dose aspirin
- ▶ Uremia
- ▶ Alcoholism

Glycemic targets

Timing

Targets

Fasting, premeal
blood glucose

< 140 mg/dl

Random blood glucose

< 180 mg/dl

* Safe lower limit

> 90-100 mg/dl

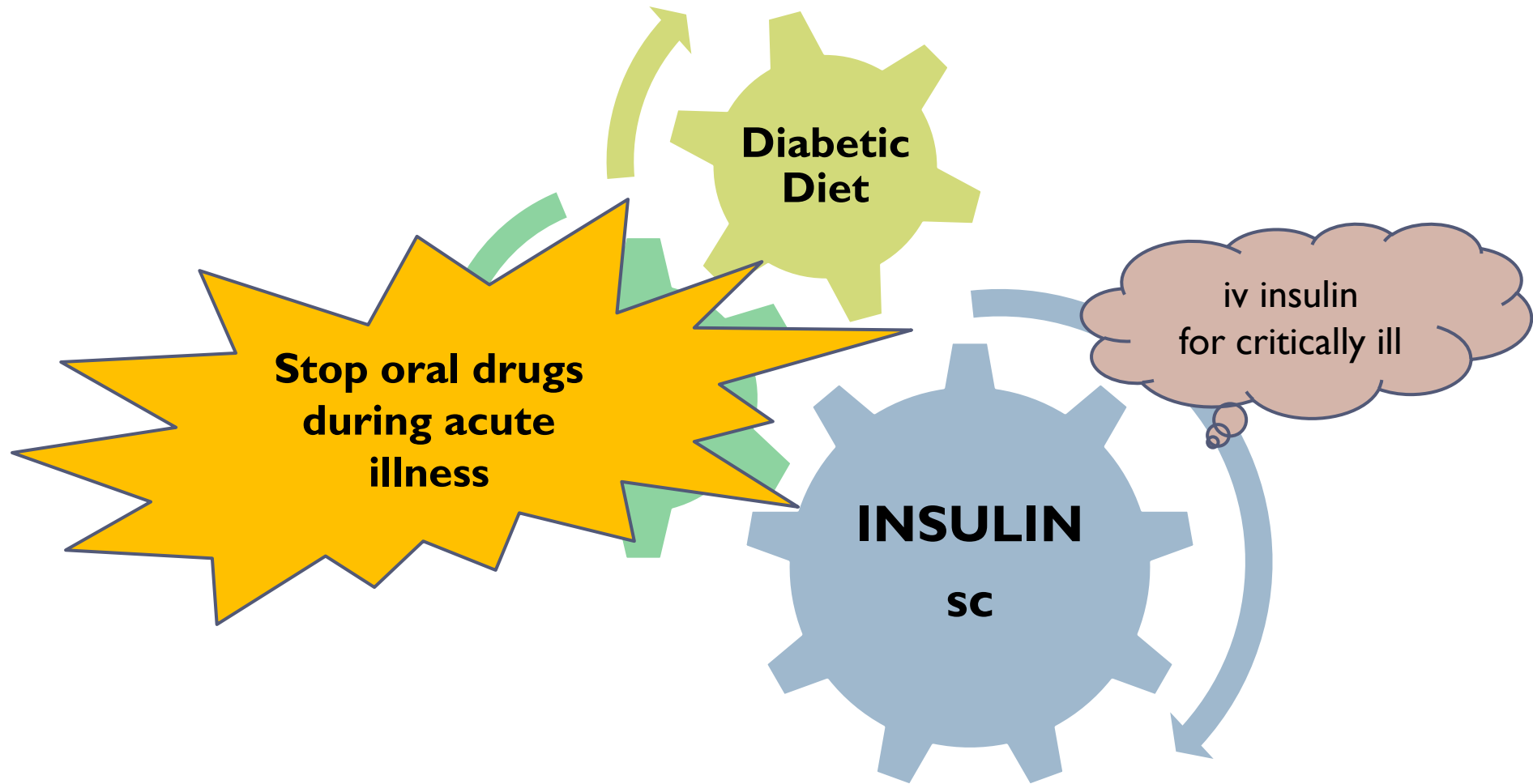
Glycemic target for critically ill pts: 140 – 180 mg/dl

Glycemic targets in non-IC pts: observational studies; no data from RCTs

II: In the hospital

How to control blood glucose?

Inpatient glycemic control (non-ICU)



Diabetic diet for inpatients

- ▶ **Same amount of carbohydrates for each meal**
 - ▶ “Carbohydrate-consistent” : easier to adjust insulin dose
- ▶ **No food from outside the hospital**

Oral medications

- ▶ **Usually stopped** during acute illness

- ▶ Consider continuing oral medications **only when:**
 - ▶ Clinically stable
 - ▶ Eating regular meals (at least ½ of each meal)
 - ▶ No contraindications to medications

Contraindications to non-insulin medications

Medication	Contraindications / limitations / adverse effects
SU	Severe and prolonged hypoglycemia (3-5 days), especially in elderly, AKI, poor intake
Metformin	AKI, iv contrast, poor tissue perfusion (inc risk of lactic acidosis): acute CHF, sepsis, dehydration May cause N/V in patients with already poor intake
TZD	CHF, not sure of ventricular function Duration of glucose-lowering and fluid-retaining: several weeks
AGI	Stop if Cr >2.0 mg/dl, GI side effects, only effective when eating
DPP4I	Only effective when eating, mainly postprandial glucose control Sitagliptin, vildagliptin: reduce dose if CrCl < 50 ml/min
GLP-I agonist	May cause N/V in patients with already poor intake Mainly postprandial glucose control

How to use insulin?

Tips and tricks

Scheduled sc insulin

Types of insulin	BG control	Examples
(1) Basal insulin	Controls BG in fasting state	Glargine q 24 h Detemir q 12-24 h NPH q 12 h
(2) Nutritional (prandial) insulin	Controls BG during food intake	Regular insulin q 6 h Aspart, Lispro, Glulisine q 4 h
(3) Supplemental (Correction) insulin	Corrects hyperglycemia (in addition to above 2 insulins)	Same as prandial insulin

Insulin time-profiles

Insulin	Onset	Peak	Duration
Nutritional and correction insulin			
Rapid-acting analog (aspart, lispro, glulisine)	5 – 15 min	1 – 2 h	4 – 6 h
Regular insulin	1/2 – 1 h	2 – 3 h	6 – 10 h
Basal insulin			
Glargine	2 – 4 h	Nearly peakless	20 – 24 h
Detemir	2 – 4 h	Nearly peakless	16 – 24 h
NPH	2 – 4 h	4 – 10 h	12 – 18 h

How to start insulin Rx for inpatients?

Diet control / oral drugs Well-controlled DM

Monitor CBG 24 – 48 h

If CBG persistently elevated
Start insulin Rx

Prior insulin use or Poorly controlled DM

Start scheduled insulin:

Basal + prandial + correction insulin
(Basal-bolus regimen)

Calculate total daily dose (TDD)

Half = **basal insulin**

Half = **prandial insulin** (divide equally 3 meals); **don't give if NPO**

Add **correction insulin** if CBG higher than target

Adjust dose if NPO or change in clinical status

Review CBG everyday : $\pm 10 - 20$ % of insulin dose

How to calculate total daily dose?

(1) According to body weight	Total daily insulin dose
Most patients	0.4-0.5 U/kg/day
Obese, on insulin > 80 U/day before admission, on steroids If obese use ideal body weight:	0.7 U/kg/day IBW Men: [Ht (cm) – 100] kg IBW Women: [Ht (cm) – 100] – 10% Δ
Elderly, renal impairment, NPO	0.2-0.3 U/kg/day
(2) According to prior insulin dose	
Well-controlled at OPD	Consider dec dose 25 – 50%
Poorly-controlled DM	Consider weight-based And adjust according to CBG
(3) Shifting from iv to sc	
If on stable dose of insulin No wide fluctuations	Insulin dose in past 6 h x 4 x 80% Must overlap 1-2 h

How to give correction insulin?

Blood glucose	High risk hypo NPO, elderly, renal insufficiency	Most patients	Insulin-resistant Obese, on steroids Poorly controlled
150 – 200	2	4	6
201 – 250	4	6	8
251 – 300	6	8	10
351 – 350	8	10	12
> 350	Notify doctor		

Sliding scale insulin alone, without basal and prandial insulin, not the same as correction insulin, should not be done.

It is retroactive; more hyper- and hypoglycemia, **worse outcomes.**

Correction factor: $1500 / \text{TDD}$ i.e. insulin 1 unit \rightarrow decrease ... mg/dl

Correction insulin: $(\text{CBG} - \text{target}) / \text{correction Fx}$

Which insulin to choose?

- ▶ Aspart / lispro / glulisine (vs. regular insulin)

Similarly effective glycemic control

Unsure intake: rapid-acting insulin immediately after food
Delayed gastric emptying / continuous drip enteral feeding:
use regular insulin

- ▶ Glargine / detemir (vs. NPH)

Similarly effective glycemic control

Less nocturnal hypoglycemia

RCT: NPH / RI vs. detemir / aspart :
No difference in glycemic control and hypoglycemia

How to adjust insulin?

Situations

Fasting BG not reach goal
> 140 mg/dl
< 100 mg/dl x 2 times
< 70 mg/dl anytime

Adjust basal insulin by 10 – 20%

Premeal BG not reach goal (as above)

Adjust prandial insulin by 10 – 20%

N/V, expect to eat < 50% of meal

Hold prandial insulin, or
Give immediately after meal if eat > 50%

NPO (pre-op)

Hold prandial insulin
Dec dose of basal insulin
 Evening dose: dec by 20%
 Morning dose: dec by 1/2 – 1/3
Consider iv dextrose ± insulin infusion

Important to coordinate timing of CBG, insulin, food

CBG near to mealtime, < 1h before meals

False high CBG if food or snack within 1-2h

Give insulin when food has arrived

III: From hospital to home

How to prepare?

Discharge plan

(1) Optimize Rx of DM, HT, DLP BG control before admit (HbA1c)

Suggested Rx

Well-controlled
and no contraindications
i.e. TZD and heart failure
metformin and renal failure

Same as OPD

Elevated HbA1c


Intensify OPD regimen
Oral Rx, insulin, or combined

(2) Patient education

Emphasize adherence to Rx and diet
Insulin regimen: oral and written
SMBG? How often?
What to do when hypoglycemia

(3) Discharge summary is important Ensure smooth F/U at OPD

Complete problem list, pending labs
Changes in drug regimen
Medication review at discharge
New hyperglycemia: retest for DM



Summary & checklist for inpatients

- ❑ Blood for glucose (central lab) on admission
- ❑ Blood for HbA1c if (1) known DM, no result in 2-3 mo
(2) non-DM but elevated BG
- ❑ Set glycemic targets: 100 – 140 (not over 180) mg/dl
- ❑ Stop oral medications (usually)
- ❑ Diabetic diet, same amount of carbohydrates per meal

Summary & checklist for inpatients

- ❑ Order scheduled sc insulin: basal + prandial + correction
If NPO: basal + correction insulin
- ❑ Review blood glucose levels every day and adjust insulin dose
- ❑ Avoid hypoglycemia
- ❑ Discharge: optimize treatment, patient education, discharge summary is important