

## Basics of Diabetes (Diagnosis and Management)

**Tamer Shalaby Boutrus\***

*Consultant Internal Medicine at The View Hospital, Al Qutaifiya, Doha, Qatar*

**\*Corresponding Author:** Tamer Shalaby Boutrus, Consultant Internal Medicine at The View Hospital, Al Qutaifiya, Doha, Qatar.

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### Quiz:

1. Fasting plasma glucose (FPG) of 5.7 mmol/L is considered prediabetes? T/F.
2. Target HbA1C for T2D on insulin is below 7%? T/F.
3. HbA1C is used to monitor diabetes in pregnancy? T/F.
4. Correction factor is amount of insulin required to lower above target glucose. T/F.
5. Weight loss can improve, but not treat diabetes. T/F.

### Prediabetes:

- HbA1C: 5.7% and 6.4% (39 - 46).
- FPG: 5.6 to 6.9 mmol/L (101 - 125).

### Diabetes

- Random glucose > 11.1 with Diabetes symptoms (e.g., polyuria, polydipsia, skin infection and unexplained weight loss) or
- FPG 7.0 mmol/l or more (126 or more) or
- HbA1C: 6.5% or more (48 or more).

### T2D:

- Middle age.
- Overweight.
- Insulin resistance due to metabolic syndrome followed by deficiency.

### T1D:

- Young/child.
- Antibodies against B cells in pancreas.
- Absolute insulin deficiency requiring insulin life long.

### **MODY:**

- T2D.
- Diagnosed age < 25.
- No insulin requirement.
- Strong family history.

### **? T1D versus MODY:**

- Antibodies (Islet cell antibodies, insulin autoantibodies, glutamic acid decarboxylase antibodies (GAD) present in T1D.
- C-peptide levels normal in MODY (preserved B cells in pancreas).

### **LADA:**

- Delayed T1D.
- Diagnosed age > 30.
- No insulin requirement - initially.
- Pancreatic islet cell autoantibodies.

### **GD criteria:**

- FPG 5.6 mmol/l or more (101 or more).
- 2-hour plasma glucose level of 7.8 mmol/l or more (140 or more).

### **Monitoring**

#### **Rapid acting insulin**

#### **Self-monitoring blood glucose (SMBG):**

- 7 points (FPG, 2 hours after breakfast, before lunch, 2 hours after lunch, before dinner, 2 hours after dinner and before bed).
- X3 weekly CBG 2 - 5 am.

#### **Gliclazide:**

- Check CBG 4 hours after dose.

#### **GD or otherwise:**

- 4 points (fasting, 2 hours post prandial).

#### **HbA1C target:**

Mainly depends on duration of diabetes, comorbidities and symptoms.

#### **T2D:**

- 7% or below if no hypoglycaemia, insulin, or sulfonylurea.
- 7.5% or below if hypoglycaemia, insulin, or sulfonylurea.

- 8% or below if elderly, duration of diabetes > 10 years.
- 9% or below if frail with limited life expectancy.

### T1D:

- 6.5% or lower if no hypoglycaemia, otherwise < 7%.

### Gestational diabetes (GD):

- Preconception HbA1C 6 - 6.5 if more high risk for GD.
- Very large baby (9 pounds or more), which can make delivery more difficult.
- Being born early, which can cause breathing and other problems.
- Having low blood sugar (baby's insulin responding to hyperglycaemia).
- Developing type 2 diabetes later in life (mother and baby).

### Screening:

- FPG and HbA1C if high risk at booking visit (first trimester).
- Glucose tolerance at 16 weeks if high risk (PPG is affected before FPG).
- Glucose tolerance at 24 weeks otherwise.

### Criteria:

- FPG 5.6 mmol/l or more (101 or more).
- 2-hour plasma glucose level of 7.8mmol/l or more (140 or more).

### Target for treatment:

- FPG 5.3 or less.
- PPG 6.7 or less (< 95 and < 120).
- Aim glucose 4 - 7 during delivery.

### Treatment:

- B12 supplement if level is below 220 pmol/L.
- Lifestyle intervention (dietician, exercise) + Metformin for two weeks.
- Check FPG and PPG (x4 in total).
- If still FPG 5.8 or PPG 6.8 then insulin Aspart and Detemir ranging from 0.7 to 2 units per kg (current pregnant weight):
  - 1<sup>st</sup> trimester TDD: 0.7 units/kg.
  - 2<sup>nd</sup> trimester TDD: 0.8 units/kg.
  - 3<sup>rd</sup> trimester TDD: 0.9 - 1 units/kg.
- Add Aspirin after week 12 for pregnant with DM or BMI 35 or above.

### Hyperglycaemia-new-CBG more than 11

1. Acute illness
2. Osmolality 300 or more
3. Ketones more than 0.6
4. Glucose > 15 and not improving with IVF.

Then sliding scale, IVF and HbA1C, subcutaneous sliding scale is multiple correction doses, in acute illness/perioperative IV insulin infusion is more likely to keep CBG in required range and less duration of hypoglycaemia, issue is frequent monitoring.

### Symptoms of hyperglycaemia (polyuria, polydipsia, weight loss)

Admit with IVF, four points SMBG (fasting and 2 hours postprandial) and check HbA1C.

#### HbA1C 6.5 - 8.5

Then metformin and gliclazide (as symptomatic hyperglycaemia) + referral to dietician and follow up within 1 week with glucometer, SMBG x4 and hypoglycaemia advice.

#### HbA1C 9 or more or FPG 10 or more

- Lantus (as symptomatic hyperglycaemia) 0.1 units/Kg at bedtime aim FPG 5 - 7 and change dose weekly if needed by 10%, then Aspart 10% of Lantus dose with the meal with highest PPG level > 10 and
- Metformin + referral to dietician and follow up within 1 week with glucometer, SMBG x4 and hypoglycaemia advice. OR
- Ryzodeg BD + Metformin + referral to dietician and follow up within 1 week with glucometer, SMBG x7 and hypoglycaemia advice.
- 0.2 units/Kg if age over 60 or GFR below 60.
- 0.4 units/kg otherwise.
- 0.5 units/Kg if obese (BMI 30 or more).

#### NO symptoms of hyperglycaemia (polyuria, polydipsia, weight loss)

- HbA1C 6.5 - 7.5 Metformin + referral to dietician and follow up 3 months with HbA1C.
- HbA1C 8 - 8.5: Metformin + referral to dietician and follow up 3 months+.
- CKD/proteinuria/HF then SGLT2 inhibitor.
- Overweight or CVD then GLP-1 RA.
- Metformin + Sitagliptin if none of the above.
- HbA1C 9 or more or FPG 10 or more then Ryzodeg BD + Metformin + plus referral to dietician and follow up within 1 week with glucometer, SMBG x7 and hypoglycaemia advice.
- 0.2 units/Kg if age over 60 or GFR below 60.
- 0.4 units/kg otherwise.
- 0.5 units/Kg if obese (BMI 30 or more). OR
- Tresiba 0.1 units/Kg at bedtime aim FPG 5-7 and change dose weekly if required, then Aspart 10% of Tresiba dose with the meal with highest PPG level > 10.

### Basics of treatment:

- Repeat HbA1C 3 monthly until target is achieved.
- HbA1C < 8% (64) with No osmotic symptoms (polyuria, polydipsia, weight loss).

### Investigations:

#### Blood test:

- HbA1C, CBC, Haematinics (Iron/Ferritin/B12/Folate), Renal Profile, LFTs, Lipid Profile (Fasting if raised triglycerides), Uric acid, Urine test: albumin creatinine ratio (ACR) x3, ECG.
- Ophthalmology.
- Dentist.
- Duplex arterial USS if high risk.
- MRI foot if infection/deep ulcer.

### Treatment:

- Dietician (Essential).
- Exercise > 150 minutes/week? refer to exercise instructor.
- Weight loss? refer to bariatric surgery if BMI > 30 or more after treatment and advice, more than 10 - 15% weight loss can reverse diabetes in many patients.
- Patients with prediabetes (HbA1C 5.7-6.4%) have CVD risk and will benefit from Healthy lifestyle intervention.
- Stop smoking.
- Podiatrist if sensory loss or skin lesion on feet.
- Treat hypertension:
  - Ramipril if albuminuria.
  - Aim below 130/80 if established or high risk CVD (IHD, Stroke/TIA, PVD/AAA), CKD with albuminuria.
- Treat dyslipidaemia:
  - Statins aim reduction of LDL by 50% and less than 1.7 mmol/L.
  - Add Ezetimibe or PCSK9 inhibitor if target not achieved.

### Metformin modified release

- (Avoid if GFR < 30 and maximum dose 1g if GFR 30 - 45).
- (MR) 500 mg BD with meal then increase to 1G BD after 1 - 2 weeks.
- HbA1C after 3 months is 7 or more (53 or more) then add second agent.

**GLP-1 agonist:** If established or high risk CVD with raised BMI > 25.

**SGLT2 inhibitor:** If established or high risk CVD

- CKD < 60
- ACR > 3
- Heart failure.

HbA1C is between 8 - 9 (64 - 75) OR osmotic symptoms (polyuria, polydipsia, weight loss) consider two medications.

**Investigations:** Same.

**Treatment:**

- Healthy lifestyle interventions

**If:**

- No CKD (eGFR < 60), albuminuria.
- No CVD and not high risk for CVD.
- Not obese.
- Not in HF.
- No symptoms of hyperglycaemia, ketones not raised then.
- DPP4 inhibitor 50 mg and metformin.

**If:**

- CKD/proteinuria/CVD/HF.
- SGLT2 inhibitors + metformin.

**If:**

- Obese with CVD then GLP-1 RA with metformin.

**If:**

- Osmotic symptoms (polyuria, polydipsia, weight loss) or raised ketones.
- Gliclazide plus metformin.
- HbA1C >9 (more than 75), FPG >10 (>180), PPG > 16 (>288), OR
- After 3 medications and HbA1C > 8.5 (> 69), FPG > 8 (>145), PPG > 11.1 (>200).
- Blood test: Same.
- Healthy lifestyle intervention
- Metformin + Start insulin.

**Aim**

Aim FPG and premeal 5 - 7 (90 - 126), PPG < 10 (< 180) and before bed 5 - 8 (90 - 145).

**Dosing for T2DM:**

- TDD should not exceed (initially).
- GFR < 60 or AGE over 60 (0.2 units/Kg).
- Normal (0.4 units/Kg).
- Obese (0.6 units/Kg).

### Group 1:

Basal insulin (Glargine 100 (Lantus), Glargine 300 (Toujeo) or Degludec (Tresiba).

0.1 unit/Kg bed time (8 - 10 pm) if A1c < 8 or 0.2 unit/Kg if A1C > 8 - aim FPG 5 - 7.

If PPG > 10, then:

Basal-plus:

Add 10% of basal dose (aspart (Novorapid)/Lispro (Humalog)/Glulisine-(Apidra) as premeal bolus with the meal with highest PPG.

Fiasp® can be taken at the start of a meal or within 20 minutes after starting a meal, whereas NovoLog® (insulin aspart) injection 100 U/mL must be taken 0 to 15 minutes before a meal.

### Group 2:

Premix if A1C >9 (If more than one bolus required).

Biphasic insulin:

NovoMix 30 only BD (60/40).

Humalog Mix50 can be given TDS (30/30/40).

Ryzodeg only BD equal -6 units BD start (Degludec/Aspart 70/30 (Ryzodeg; 70% IDeg and 30% IAsp) 6 units BD with meals (0-15 minutes before meals), Increase dose weekly by 10% (2 units) and don't give more than 30 units at one dose.

If using NovoMix 30 (biphasic insulin, 30% soluble insulin aspart + crystalline phase (70%) consists of protamine-crystallised insulin aspart) give 60% of dose am and 40% of dose evening meal (0 - 15 minutes before meals) or Humalog Mix25 and Humulin M3.

### Insulin dosing for T1DM:

- 0.3 - 0.5 units/Kg.
- Basal-Bolus (50% basal and 50% bolus eg 20/10/20).
- 50% basal at night (Glargine 100 (Lantus), Glargine 300 (Toujeo) or Degludec (Tresiba).
- 50% with meals (aspart/Lispro/Glulisine) For example 4 units breakfast, 6 units lunch, 8 units dinner.
- Insulin carb ratio (how many units of rapid acting insulin required to cover the amount of carb in a meal) is decided after optimizing TDD,  $500/\text{TDD} = \text{amount of carb in grams which is covered by 1 unit of insulin}$ .
- Correction factor (how many units of rapid acting insulin required to burn extra glucose in blood) is  $100/\text{TDD}$  (when using mmol/L) and the outcome is amount of units of glucose which require 1 unit of insulin.

Example:

- Pre lunch CBG is 10, we advise 4-7, patient correction factor is 3 (1 unit of insulin for 3 units of glucose mmol/L).
- Amount of carb in his/her lunch is 100 g, insulin carb ration 1:10, therefore 10 units of insulin is required.
- Total amount of bolus rapid acting insulin for this meal is  $10 + 1 = 11$  units of insulin.

### Target CBG

Aim FPG and premeal 5 - 7 (90 - 126), PPG < 10 (< 180) and before bed 5 - 8 (90 - 145).

**Duration of rapid acting insulin:**

	<b>Onset</b>	<b>Peak</b>	<b>Duration</b>
Fiasp (aspart)	16 - 20 minutes	90 - 130 minutes	5 - 7 hours
Novolog (aspart)	21 - 25 minutes	60 - 90 minutes	3 to 5 hours
Humalog (lispro)	10 - 20 minutes	30 - 90 minutes	3 to 5 hours
Apidra (glulisine)	10 - 20 minutes	30 - 90 minutes	2 to 4 hours

**Sick day rule:**

- CBG >15 and Ketones > 0.6 (give 10% - 20% of TDD) Rapid acting analogue extra.
- All rapid acting insulin injections not more frequent than 4 hourly and never after 8 pm.
- In insulin naïve patients:
  - CBG 11-17= 2 units.
  - CBG 17-22 = 4 units.
  - CBG > 22 = 6 units [1-15].

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