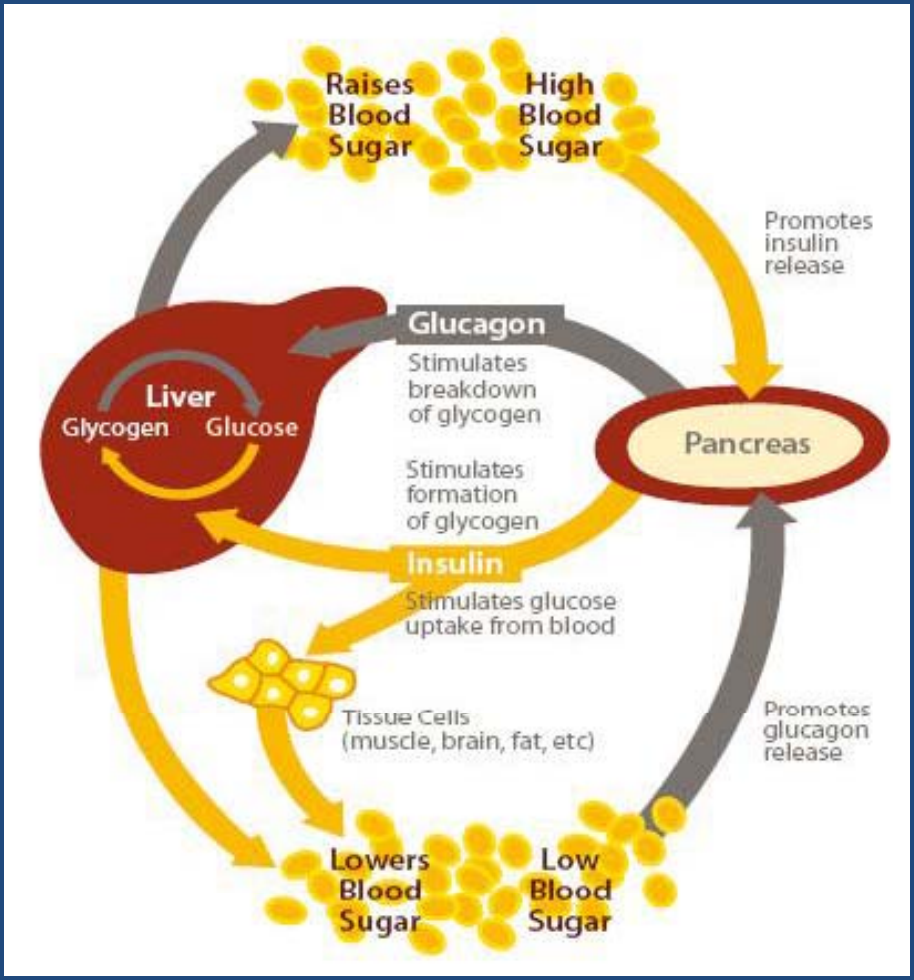
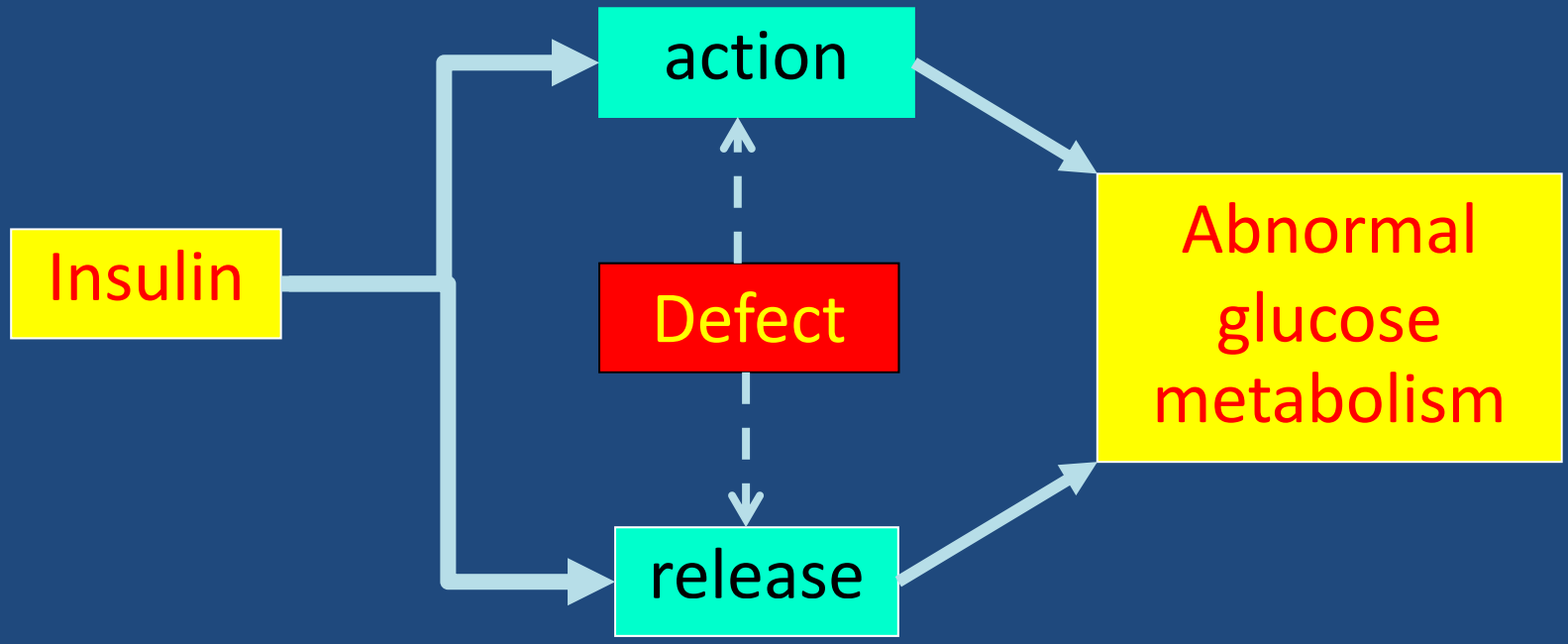
Exercise in Diabetes Mellitus

By

Pranisa Luengratsameerung,MD


Raises Blood Sugar
High Blood Sugar
Promotes insulin release
Glucagon
Stimulates breakdown of glycogen
Liver
Glycogen
Glucose
Pancreas
Stimulates formation of glycogen
Insulin
Stimulates glucose uptake from blood
Tissue Cells (muscle, brain, fat, etc)
Promotes glucagon release
Lowers Blood Sugar
Low Blood Sugar

What is the Diabetes Mellitus ?



Symptoms

- Polyuria (frequent urination)
- Polyphasia (constant hunger)
- Polydipsia (excessive thirst)
- Unexplained weight loss

Diagnostic Criteria of Diabetes Mellitus

1. Glycosylated Hemoglobin (HbA_{1c}) **≥ 6.5 %**
2. FBS **≥ 126 mg/dl** (7.0 mmol/L)
3. 2 hour plasma glucose **≥ 200 mg/dl** (11.1mmol/L) during an oral glucose tolerance test (using 75 g of glucose)
4. Classic symptoms of hyperglycemia (polyuria, polydipsia, unexplained weight loss)

   or hyperglycemic crisis with random plasma glucose **≥ 200 mg/dl** (11.1mmol/L)

Prediabetes (Impaired fasting glucose)

- Blood glucose = 100 – 125 mg/dl (5.6 – 6.9 mmol/L)
- Hb_{A1c} = 5.7 – 6.4 %

Type 1 Diabetes Mellitus

- Age < 30 years
- Immune-mediated disease : selectively destroyed the pancreatic β cells
- Absolute lack of insulin production

Treatment

- Need exogenous insulin to maintain normal glucose level

Complication

Diabetic ketoacedosis

- Lack of insulin, dehydration, infection
- Failure to manage glucose level
- Ketone ↑
- Coma and death

Type 2 Diabetes Mellitus

- Age > 30 years
- Lack of insulin action in insulin – sensitive tissue → insulin resistance
- Normal or elevated insulin production

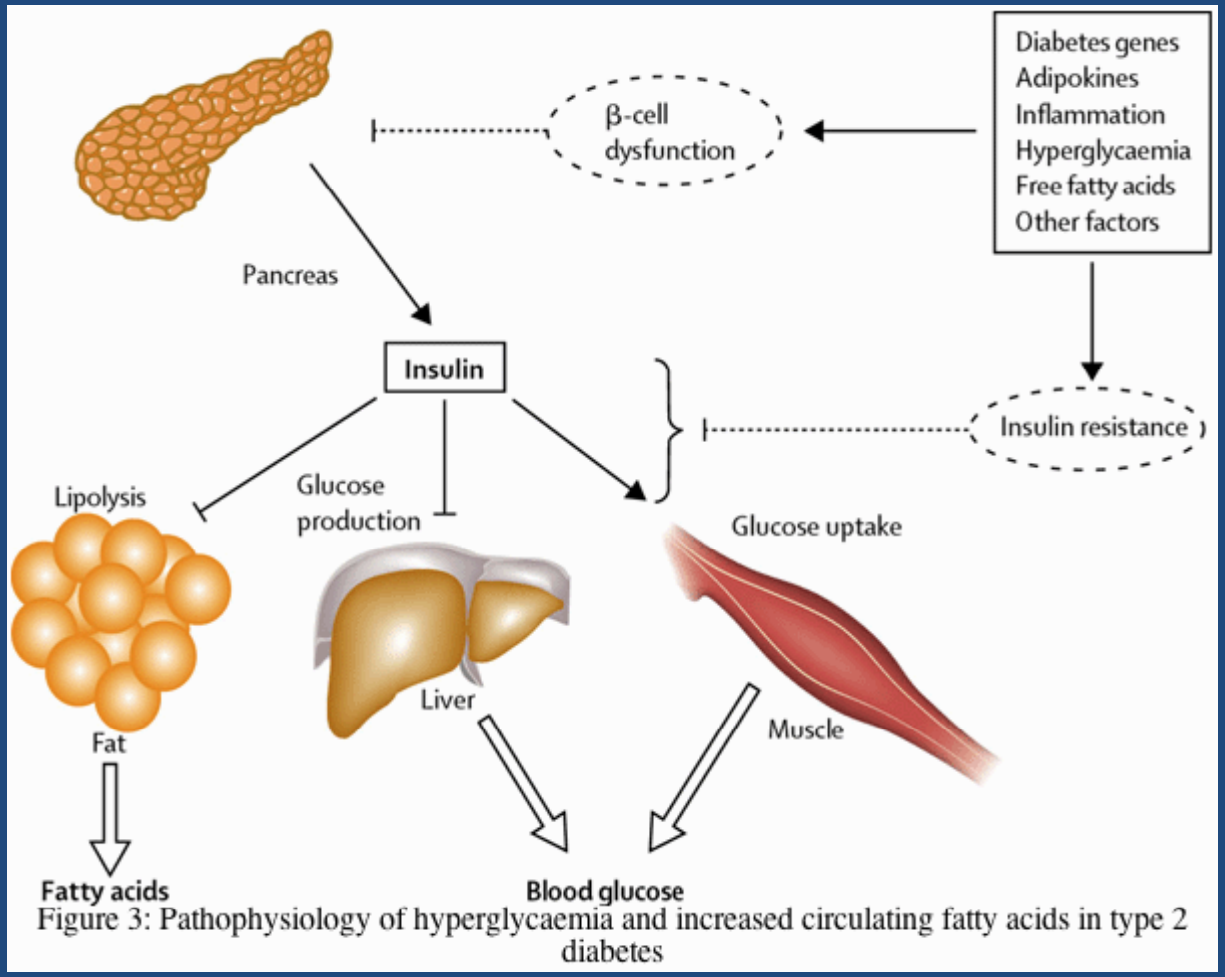


Figure 3: Pathophysiology of hyperglycaemia and increased circulating fatty acids in type 2 diabetes

Complication

Hyperosmolar hyperglycemic nonketotic syndrome

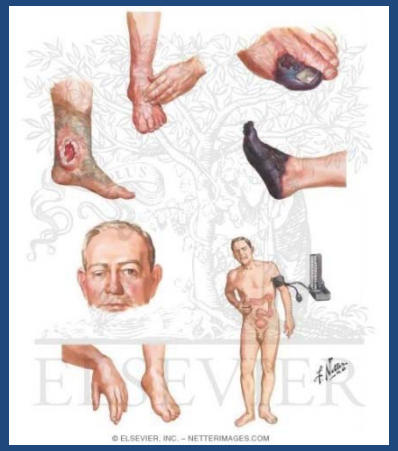
- Very high blood glucose, dehydration
- No ketone in urine
- Coma and death

Gestational DM

- 40 – 60% develop type 2 DM in next 5-10 years
- Higher levels of PA may reduce risk of developing GDM (C)
- Moderate exercise may lower maternal BG level in GDM (B)

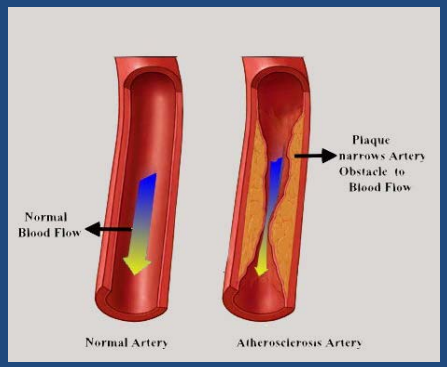
Diabetic related complication

Microvascular



- Retinopathy
- Nephropathy
- Neuropathy

Macrovascular



Cardiovascular disease

Goal of treatment

- Hb_{A1c} ≤ 6.5 %
- FBS < 110 mg/dl
- Inpatient : glucose ≈ 140-180 mg/dl
- LDL ≤ 70 mg/dl (highest risk)
  ≤ 100 mg/dl (high risk)
- HDL > 40 mg/dl (male)
  > 50 mg/dl (female)
- Triglyceride < 150 mg/dl
- BP SBP ≤ 130 mmHg
  DBP ≤ 80 mmHg
- Weight loss ≈ 5-10 %

Treatment

1. Antihyperglycemic pharmarcotherapy
2. Therapeutic lifestyle change

- Nutritional therapy
- Regular physical therapy : aerobic exercise, flexibility & strength training

Recommendation : moderate-intensity exercise at least **150 minutes** per week

Effects of exercise in DM

Acute effects of exercise

Glucose lowering effect

- **Mild to moderate** exercise in type 2 DM

: ↓ glucose level in during and post-exercise period

: Glucose control lasts within **24-72 hours** after exercise session

- **Moderate** or short- term **high intensity** exercise

: ↑ glucose level in during and 1 hour post exercise period

Glucose lowering effect → frequent mild to moderate intensity exercise

BG uptake into skeletal muscle mechanisms

Insulin stimulated

: action at rest

: impaired in type 2 DM

Muscular contraction stimulate

: action during exercise

: not impaired in type 2 DM

(Evidence A)

Normal people

: peripheral glucose uptake = hepatic glucose production

Type 2 DM

: peripheral glucose uptake > hepatic glucose production

- Physical activity → acute improvements in systemic insulin action lasing 2 -72 hours. (A)
- A combination of aerobic and resistance exercise training may be more effective in improving BG control than either .(B)
- Milder forms of exercise (tai chi,yoga) have shown mixed result. (C)

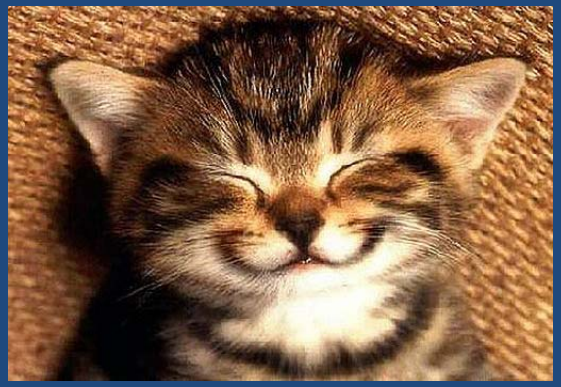
Long term effects of exercise

Cardiovascular

	Type 1	Type2
• Aerobic capacity	↑	↑/↔
• Resting HR	↓	↓
• Resting BP in mild to moderate HT	↓	↓
• HR at submaximal load	↓	↓

Lipid & lipoprotein alteration	Type 1	Type 2
• HDL	↑	↑/ ↔
• LDL	↓/ ↔	↓/ ↔
Anthropometric measures		
• Body mass	↓	↓
• Fat mass	↓	↓
• Fat-free mass	↑	↑/↔

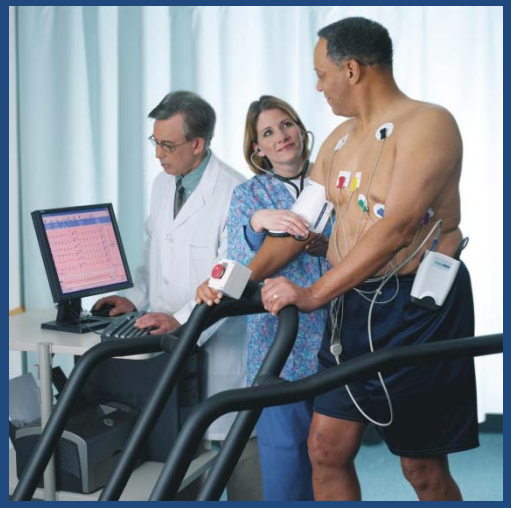
Metabolic parameter	**Type 1**	**Type 2**
• Insulin sensitivity	↑	↑
• Hb_{A1c}	↔	↓
Psychological aspect		
• Depression & anxiety	↓	↓



Exercise prescription

Evaluation

- Medical history
- Physical examination



Indication for Stress Testing with diabetes

- **Age > 40 years**
- **Age > 30 years :**
- ✓ **DM type 1 or DM type 2 > 10 years**
- ✓ **Other risk factors for CAD**
- **Known or suspected cardiovascular disease (CAD,PAD)**
- **Microvascular disease**
- **Autonomic neuropathy**

Recommendation

Aerobic exercise

- **Frequency :** at least 3 days per week, no more than two consecutive days between bout of activity
- **Intensity :** at least moderate intensity
- **Duration :** at least 150 minutes / week,
  bout at least 10 minutes

" Moderate intensity 150 minutes/week,
vigorous activity 75 minutes/week"

Resistance training

- Frequency : at least twice a week on non consecutive days, 2-3 times per week
- Intensity :

➢ Moderate : 50% of 1 RM

➢ Vigorous : 75% of 1RM

- 8-10 muscles, 8-10 repetitions/muscle

Practical Recommendations

Type 1 DM

- Do **SBGM** : before and after exercise

> 250 mg/dl : postpone exercise

≤ 100 mg/dl : eat easily absorbed carbohydrate(10 – 20 g)

100 – 240 mg/dl : exercise is recommended

- Keep a daily log : SBGM values, medication, exercise sessions
- Plan of exercise sessions : how much exercise?, adjust caloric intake and medication (↓ insulin), carry extra carbohydrate, hydration

Type 2 DM

- **> 300 mg/dl + feeling well + adequately hydrated :** continue exercise
- **≤ 100 mg/dl :**

➢ **Insulin and sulfonylureas users :** eat easily absorbed carbohydrate(10 – 20 g **)**

➢ **Others + exercise low to moderate intensity :** not need carbohydrate supplement

➢ **Insulin and sulfonylureas users + exercise high intensity:** eat easily absorbed carbohydrate(5 – 30g**)** during and within 30 minutes after exercise

- Exercise with partner
- Wear a diabetes identification card tag
- Wears good socks and shoes
- Practice feet care

Risks of exercise in DM

- Silent myocardial infarction
- Hypoglycemia :

➢ Sulfonylurea and meglitinide drugs :

Diabenese, Glucotrol, Amaryl

➢ Rapid or short acting insulin : Humalog, Novolog, Humulin R, Novolin R :↓ dose

- Hyperglycemia

Exercise Recommendation for Specific Diabetes-related complication

Autonomic neuropathy

- Frequent dehydration, hypoglycemia, hypothermia
- Abnormal resting HR and BP, Abnormal response to exercise
- Need closed monitoring, use RPE
- Need EST

Peripheral neuropathy

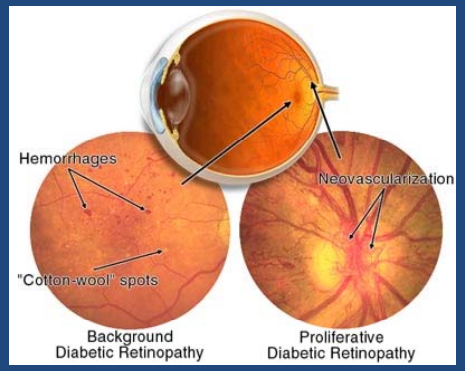
- **Non weight bearing** exercise : cycling, chair exercise, swimming
- Active foot ulcer : aquatic exercise is not recommended
- Regular assessment of the feet

Nephropathy

- Avoid exercise that increase BP : high intensity aerobic or strength exercise, Valsava maneuver
- **Lower intensity** is recommended

Retinopathy

- Avoid strenuous **high intensity** activities (weight lifting, isometrics, overhead lifting,
  Valsava maneuver)
- Avoid activities that **lower the head** ;
  yoga, gymnastics
- Limit SBP < 170 mmHg



Hypertension

- Avoid heavy weight lifting or breathing holding
- Dynamic exercise using large muscle groups at low to moderate intensity
- Follow BP guidelines
- Use RPE