Management of Diabetic Ketoacidosis and Hypoglycemia

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(Slides are adopted and modified from Prof. Hanan Hagar)

Diabetic ketoacidosis

- **Is a serious acute emergency situation that requires admission to hospital with a risk of death.**
- **It develops as a result of insulin deficiency**
- **It is a characteristic feature of type I diabetes but may occur with type II especially during stress.**

Diabetic ketoacidosis

In absence of insulin, many metabolic changes can occur:

Carbohydrates

- ↑ **Glycogenolysis**
- ↑ **Gluconeogenesis**

Diabetic ketoacidosis

In absence of insulin,

Protein

↑ proteolysis thus providing amino acid as precursors for gluconeogenesis.

Diabetic ketoacidosis

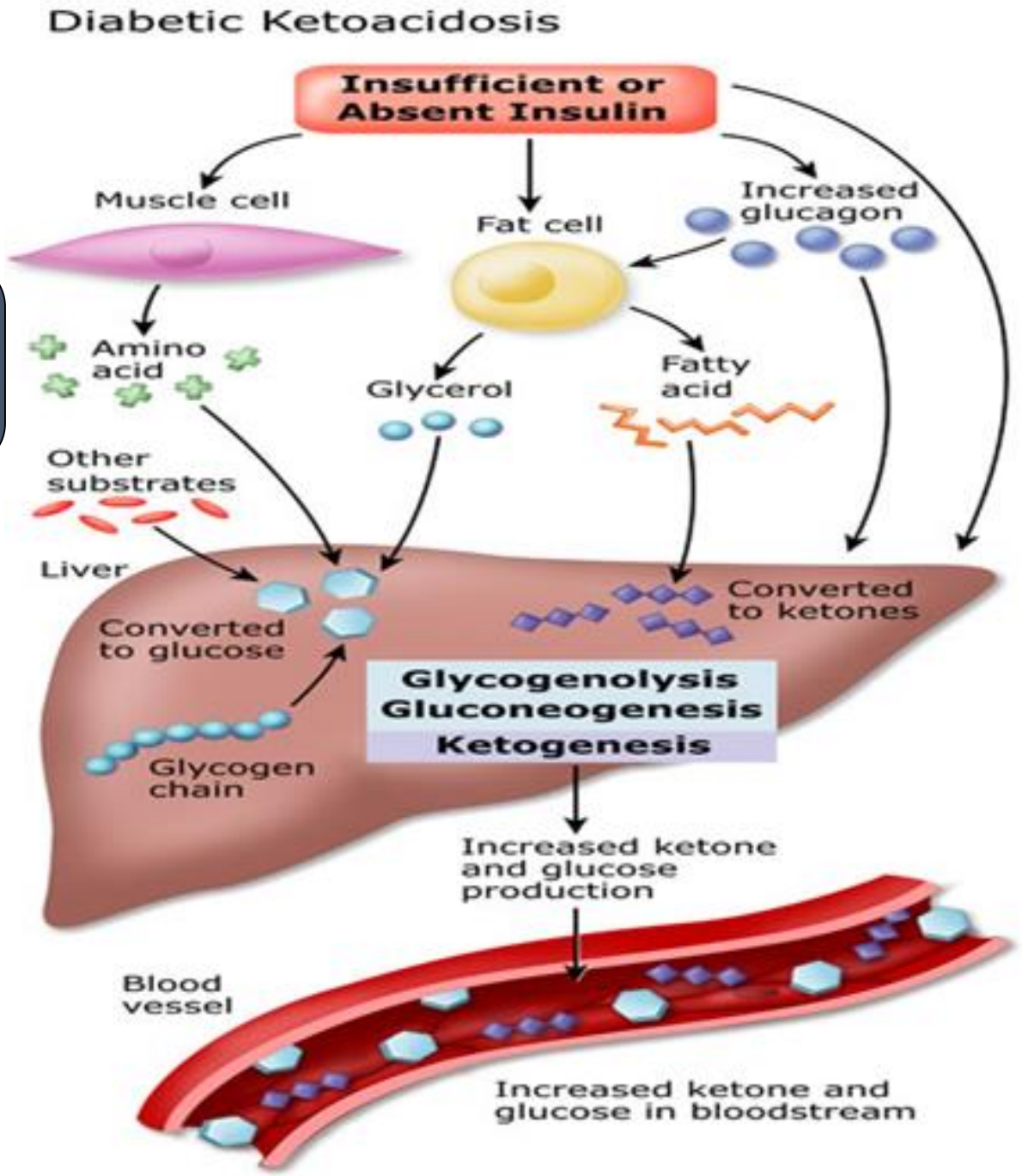
In absence of insulin,

Fats: ↑ Lipolysis & ketogenesis

Fat breakdown to free fatty acids then to acetyl-CoA that is converted to ketone bodies

- **Acetoacetic acid, β-hydroxybutyric acid and acetone (↑ ketogenesis).**

Insulin deficiency



Diabetic ketoacidosis

Insulin deficiency

↑ Glycogenolysis
↑ Gluconeogenesis,
↑ Protein catabolism
↑ Lipolysis

↓

↑ Hyperglycemia

↓

Glycosuria

↓

Osmotic diuresis

↓

Dehydration

↑ Lipolysis

↓

↑ Free fatty acids

↓

↑ Ketone bodies

(ACAC, β-OHB, Acetone)

↓

Ketonemia

↓

Ketonuria & Acidosis

Diabetic ketoacidosis

- **Hyperglycemia-induced glucosuria, osmotic diuresis & severe fluid loss.**
- **Fluid loss induces dehydration & electrolyte imbalance**
- **Metabolic acidosis induces hyperventilation**

Characters of diabetic ketoacidosis

- **Hyperglycemia**
- **Glucosuria**
- **Osmotic diuresis**
- **Polyuria**
- **Thirst**
- **Polydipsia (increased drinking)**
- **Dehydration**
- **Electrolyte imbalance**
- **Ketogenesis (ketonemia, ketonuria)**
- **Metabolic acidosis**

Clinical symptoms for diabetic ketoacidosis

- **Classic features of hyperglycemia (thirst, polyuria)**
- **Nausea, vomiting, abdominal pain**
- **Tachycardia**
- **Kussmaul–Kien respiration (rapid & deep).**
- **Ketotic breath (fruity, with acetone smell)**
- **Mental status changes (confusion, coma)**

Diagnostic Criteria in Diabetic Ketoacidosis

- **Blood glucose level > 250 mg/dl**
- **Arterial pH < 7.35**
- **Serum bicarbonate level < 15 mmol/L**
- **Ketonemia**
- **Ketonuria**

Lines of treatment of diabetic ketoacidosis

Adequate correction of :

- **Dehydration (Fluid therapy)**
- **Hyperglycemia (Insulin)**
- **Electrolyte deficits (Potassium therapy)**
- **Ketoacidosis (Bicarbonate therapy)**

Treatment of diabetic ketoacidosis

- **Fluid therapy (Rehydration)**
  - **Restore blood volume and perfusion of tissues.**
  - **Infusion of isotonic saline (0.9% sodium chloride) at a rate of 15–20 ml/kg/hour or lactated Ringer solution..**

Treatment of diabetic ketoacidosis

- **Insulin therapy (Short acting insulin)**
  - **Regular insulin, should be administered by means of continuous intravenous infusion in small doses through an infusion pump (0.1 U/kg/h).**

Treatment of diabetic ketoacidosis

- **Insulin therapy (Short acting insulin)**
  - **Subcutaneous absorption of insulin is reduced in DKA because of dehydration; therefore, using intravenous routes is preferable.**
  - **Insulin stops lipolysis and promotes degradation of ketone bodies.**

Treatment of diabetic ketoacidosis

- **Potassium therapy**
  - **Potassium replacement must be initiated.**
  - **Potassium is added to infusion fluid to correct the serum potassium concentration.**

Treatment of diabetic ketoacidosis

- **Bicarbonate therapy**
  - **Correct for metabolic acidosis**
  - **Bicarbonate therapy should be used only if the arterial pH < 7.0 after 1 hour of hydration, (sodium bicarbonate should be administered every 2 hours until the pH is at least 7.0).**

Hypoglycemia

- Blood sugar of less than 70 mg/dl is considered hypoglycemia.
- Is a life threatening disorder that occurs when blood glucose level becomes < 50 mg/dl
- One of the common side effects of insulin in treating type I diabetes.

Causes of Hypoglycemia

- **Overdose of insulin or oral hypoglycemic drugs (sulfonylureas - meglitinides).**
- **Excessive physical exercise**
- **Missed or delayed meal.**

Causes of Hypoglycemia

- **Hypoglycemia can be an early manifestation of other serious disorders (sepsis, congenital heart disease, brain hemorrhage).**

Characters of Hypoglycemia

Autonomic features

- ↑ **sympathetic: tachycardia, palpitation, sweating, anxiety, tremor.**
- ↑ **parasympathetic: nausea, vomiting.**

Characters of Hypoglycemia

Neurological defects:

- **Headache, visual disturbance, slurred speech, dizziness.**
- **Tremors, mental confusion, convulsions.**
- **Coma due to ↓ blood glucose to the brain.**

Precautions

Hypoglycemia can be prevented by:

- **Monitoring of blood glucose level** (blood sugar level should be checked routinely).

- **Patients should carry glucose tablets or hard candy to eat if blood sugar gets too low.**

Precautions

- Diabetic patient should wear a medical ID bracelet or carry a card.
- Patient should not skip meals or eat partial meals.
- Patient should eat extra carbohydrates if he will be active than usual.

Treatment of Hypoglycemia

Conscious patient:

- **Sugar containing beverage or food (30 g orally).**

Unconscious patient:

- **Glucagon (1 mg S.C. or I.M.)**
- **20-50 ml of 50% glucose solution I.V. infusion (risk of possible phlebitis).**

	Hypoglycemic coma (Excess insulin)	Diabetic ketoacidosis Hyperglycemic coma (Too little insulin)
Onset	Rapid	Slow - Over several days
Acidosis & dehydration	No	Ketoacidosis
B.P.	Normal	Subnormal or in shock
Respiration	Normal or shallow	Air hunger
Skin	Pale & Sweating	Hot & dry
CNS	Tremors, mental confusion, sometimes convulsions	General depression
Blood sugar	Lower than 70 mg/100cc	Elevated above 200 mg/100cc
Ketones	Normal	Elevated

SUMMARY

- **Hyperglycemic ketoacidosis: treated by insulin, fluid therapy, potassium supplement and bicarbonate.**

- **Hypoglycemia: treated by oral glucose tablets, juice or honey (if the patient is conscious) and by 20-50 ml of 50% glucose solution I.V. infusion or glucagon (1 mg, S.C. or I.M.) (if the patient is unconscious).**