



*Management of diabetic
ketoacidosis and hypoglycemia*

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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,

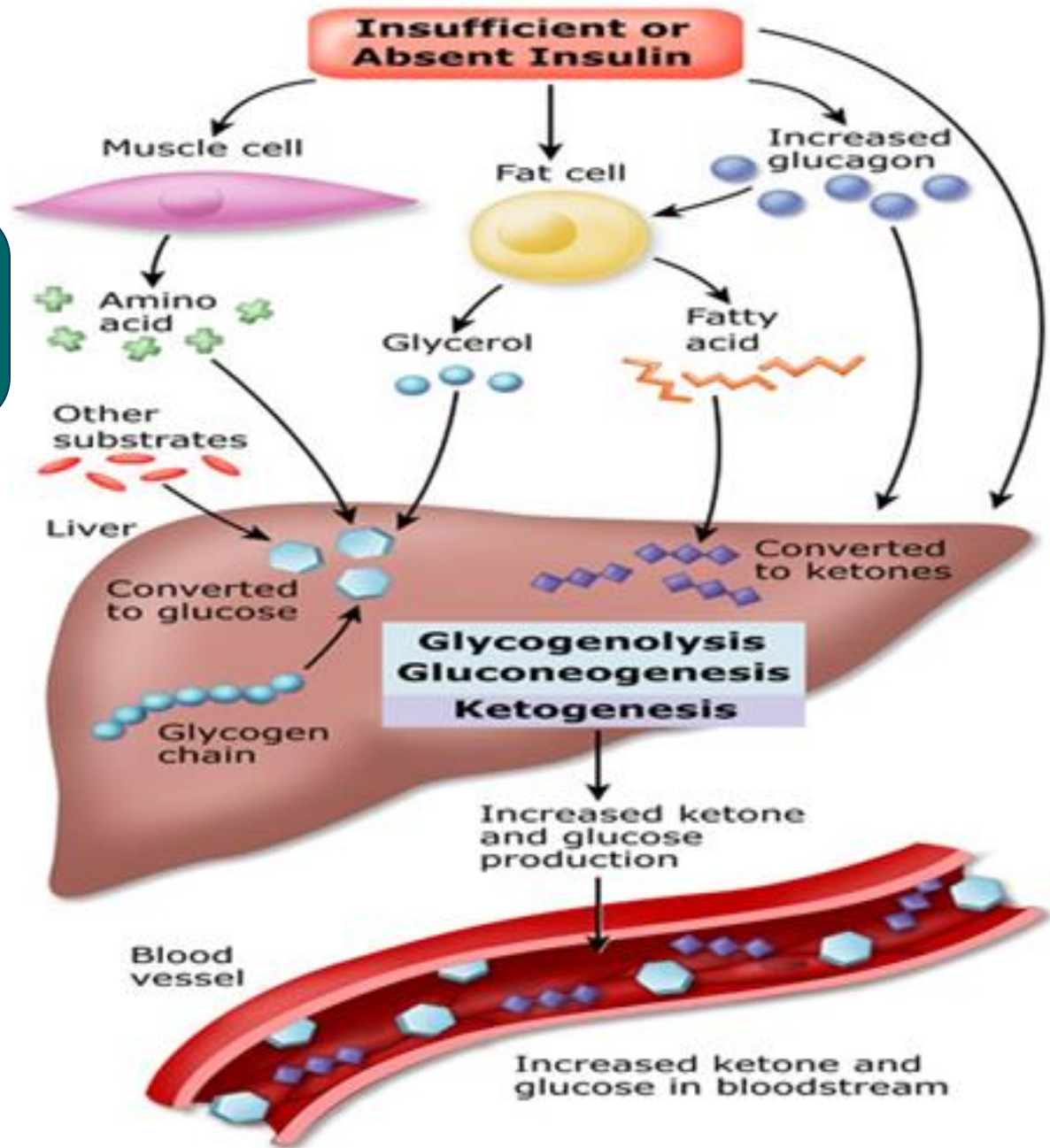
Fats: ↑ **Lipolysis & ketogenesis**

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

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

Diabetic Ketoacidosis

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.**

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).
 - **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) | Hyperglycemic coma Diabetic ketoacidosis (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).