

7: Management of diabetic ketoacidosis and hypoglycemia

objectives

- Identify the different characters of diabetic ketoacidosis.
- Know the different lines of treatment for hyperglycemia, dehydration, electrolyte deficits and ketoacidosis.
- Recognize the characters of hypoglycemia and how it can be prevented.
- Describe the different treatment of hypoglycemia
- Be able to differentiate between hypoglycemia and hyperglycemia coma.

Color index

- extra information and further explanation
- **important**
- **doctors notes**
- **Drugs names**
- **Mnemonics**

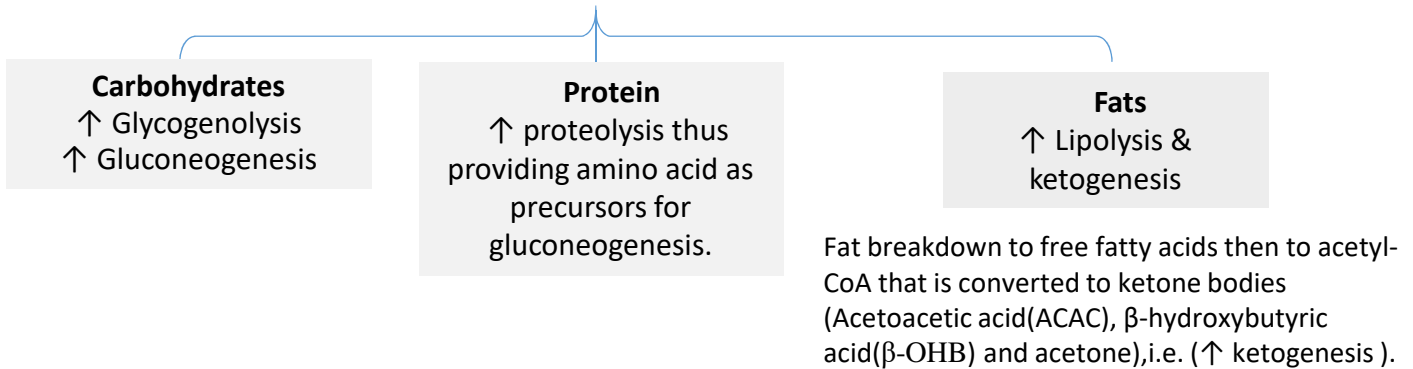


Diabetic ketoacidosis

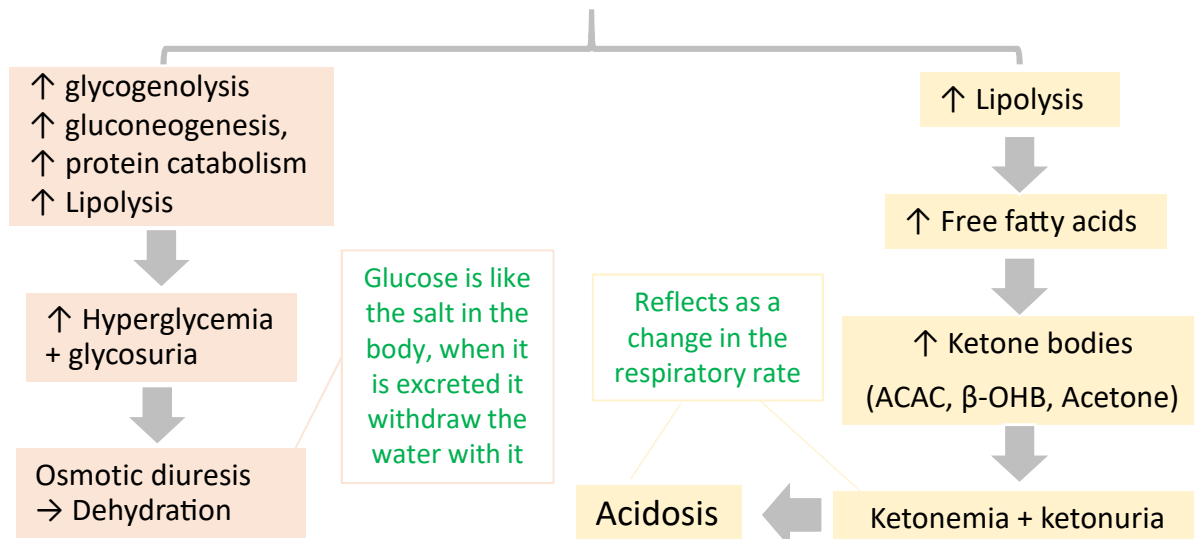
Definition

- It 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.

In absence of insulin, many metabolic changes can occur:



Insulin deficiency lead to :



- Hyperglycemia-induced glycosuria, osmotic diuresis & severe fluid loss.
- Fluid loss induces dehydration & electrolyte imbalance
- Metabolic acidosis induces hyperventilation with fruity odor

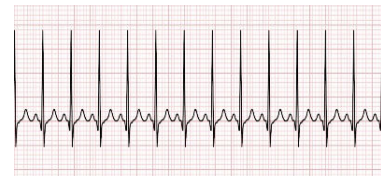
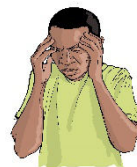
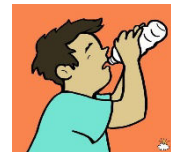
Diabetic ketoacidosis

Characters of diabetic ketoacidosis

1. Hyperglycemia
2. Glucosuria
3. Osmotic diuresis
4. Polyuria
5. Thirst
6. Polydipsia (increased drinking).
7. Dehydration
8. Electrolytes imbalance
9. Metabolic acidosis
10. Ketogenesis (ketonemia, ketonuria)

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)
characteristic sign
- Mental status changes (confusion, coma) **but the patient may still conscious, or the patient may be in coma.**



Diagnostic Criteria in diabetic ketoacidosis

- ✓ Blood glucose level > 250 mg/dl
- ✓ Serum bicarbonate level < 15 mmol/L
- ✓ Ketonemia (accumulation of ketone bodies in the blood)
- ✓ Ketonuria (accumulation of ketone bodies in the urine)
- ✓ Arterial pH < 7.35

Treatment of diabetic ketoacidosis

Lines of treatment of diabetic ketoacidosis

Adequate correction of :

- ❖ Dehydration (**Fluid therapy**) ❖ Electrolyte deficits (**Potassium therapy**)
- ❖ Hyperglycemia (**Insulin**)
- ❖ Ketoacidosis (**Bicarbonate therapy**) *Sometimes it is used and sometimes not, depending on its concentration in the blood.*

Step-wise treatment	M.O.A	Indication
Fluid therapy (Rehydration) 1st line treatment	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	Dehydration
Insulin therapy (Short acting insulin, the regular insulin) <i>Some times we use the fast acting insulin especially in children</i>	Regular insulin, should be administered by means of continuous intravenous infusion in small doses through an infusion pump low rate of infusion (0.1 U/kg/h). 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.	Hyperglycemia
Potassium therapy	<i>The patient is already in hypokalemia, and administration of insulin increases the risk for hypokalemia, that's why we have to give the patient insulin and then Potassium.</i> Potassium replacement must be initiated. Potassium is added to infusion fluid to correct the serum potassium concentration that results from dehydration and insulin administration.	Electrolyte deficits
Bicarbonate therapy	<i>I have to measure bicarbonate level before the initiation of the treatment.</i> 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).	Ketoacidosis

Hypoglycemia

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.
 - ✓ If we are not sure weather the patient has hyperglycemia or hypoglycemia we treat the patient as hypoglycemic, because hypoglycemia is a life threatening condition, while hyperglycemia is less dangerous.

Causes of Hypoglycemia

Overdose of insulin or oral hypoglycemic drugs (sulfonylureas - meglitinides).

Excessive physical exercise **Physical stress or exercise increases glucose utilization therefore the patient has to decrease insulin dose.**

Missed or delayed meal.

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

Characters of Hypoglycemia

Neurological defects:

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

Autonomic features:

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

If a diabetic patient uses b-blocker and had hypoglycemic shock, he wont be able to feel these autonomic features and suddenly he will go into coma. So be careful when describing b-blockers !

Hypoglycemia

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.

- 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.

Diabetic patient must not take the medication without food especially the sulfonyl group, so it is better to start with the sensitizers to decrease the risk of hypoglycemia.

Treatment of Hypoglycemia

	Glucagon	Sugar containing beverage or food
information	<ul style="list-style-type: none"> ○ Unconscious patient: <p>Glucagon (1 mg S.C. or I.M.) (if not in hospital) 20-50 ml of 50% glucose solution I.V. infusion. (if in the hospital)</p>	<ul style="list-style-type: none"> ○ Conscious patient: <p>Sugar containing beverage or food (30 g orally). Or honey</p>
ADRS	Risk of possible phlebitis.	

Comparison between Hypoglycemic and Hyperglycemic Coma

	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

	Treatment of Hyperglycemia				Treatment of Hypoglycemia		
Subclass	Fluid therapy	Insulin	Potassium	Bicarbonate therapy	Sugar containing beverage or food	Glucagon	Glucose solution
Drug	Isotonic saline	Regular Insulin	-	-			
MOA	Restore blood volume and perfusion of tissues.	Insulin stops lipolysis and promotes degradation of ketone bodies	-	-	-		
Indication	Dehydration secondary to DKA	Hyperglycemia	Electrolyte deficits	Ketoacidosis. Metabolic acidosis.	Hypoglycemic conscious patient	Hypoglycemic unconscious patient	
Notes	IV infusion		Added to infusion fluid	Should be used only if the arterial pH < 7.0 after 1h of hydration. Administered every 2 hours until the pH is at least 7.0	-	S.C. or I.M.	I.V. infusion Risk of possible phlebitis

MCQs

Q1: Which one of the following is considered as initial step in treatment of ketoacidosis ?

- A. 0.9% sodium chloride. B. Regular insulin. C. Potassium replacement. D. sodium bicarbonate

Q2: Which one of the following steps can be skipped sometimes in case of ketoacidosis management ?

- A. 0.9% sodium chloride. B. Regular insulin. C. Potassium replacement. D. sodium bicarbonate

Q3 : Which one of the following preparation is commonly use to treat ketoacidosis in clinical practice ?

- A. I.V Insulin lispro. B. S.C Insulin glargine. C. I.V Regular insulin. D. I.V NPH insulin.

Q4: In which dose the regular insulin is given intravenous infusion ?

- A. 0.01 U/kg/h. B. 0.05 U/kg/h. C. 0.1 U/kg/h. D. 0.2 U/kg/h.

Q5:10 years old child came to ER with fruity breath, he was with hot and dry skin, his mother said that his child tend to be thirsty all the time. The biochemical investigation shows (Blood glucose level : 267 mg/dl, Arterial PH : 7.37, dehydration with ketonuria) . How can we manage his case ? **

- A. Isotonic saline + Humulin regular + Potassium replacement + Sodium bicarbonate.
B. 0.9 % sodium chloride + Humulin Lente + Potassium replacement + Sodium bicarbonate.
C. Isotonic saline + Humulin regular + Potassium replacement.
D. 0.9 % sodium chloride + Humulin regular + Sodium bicarbonate.

Q6: 58 years old male who fall down due to hypoglycemic coma. How can be treated in this situation?

- A. By giving him orange juice.
B. By giving him I.V regular Insulin.
C. By giving him I.M Glucagon.
D. All of them.

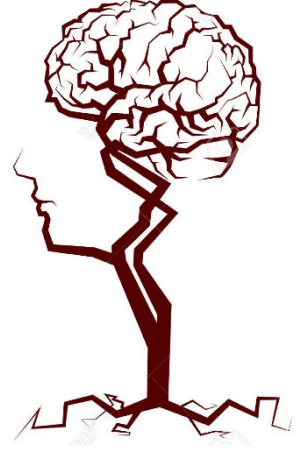
Q7: Which one of the following insulin preparations should be avoided in diabetic ketoacidosis?

- A) A. Glulisine. B. Humulin regular. C. Novolin regular. D. Glargine Insulin.

*This step can be skipped sometimes depending on bicarbonate concentration, so if the PH more than 7 we do not need.

** Bicarbonate therapy should be used only if the arterial PH < 7.0 and there is metabolic acidosis to correct that.





إِنَّ فِي ذَلِكَ لَآيَاتٍ لِّقَوْمٍ يَتَفَكَّرُونَ ﴿٣﴾

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References :

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