

# Endocrine Emergencies

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Diabetic Ketoacidosis and Hyperosmolar non-  
ketotic hyperglycemia

3/10/2019

# 18 years old diabetic patient was found to be in coma

- What questions need to be asked ?

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- Differentiating hypo from hyperglycemia ?
- Symptoms suggestive of infection / is the patient taking insulin
- Other symptoms ( abdominal pain ) . Signs.
- Clinical and lab.
- Easiest way to make diagnosis .
- Check urine for ketones and GLUCOCHECK for blood glucose





# Lab. Results

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- Serum glucose
- ABG
- Urea and electrolytes
- CBC
- ECG
- CXR
- Cultures
- Urine

# DIABETIC KETOACIDOSIS

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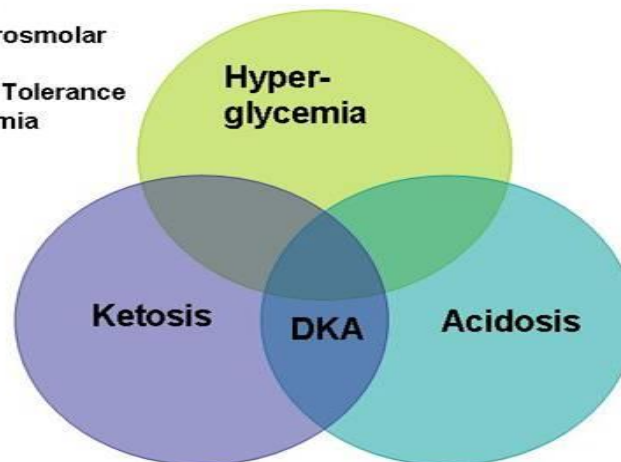
- **Criteria :**
- Blood sugar above 14 mmol/l
- Arterial Ph below 7.3
- Bicarbonate concentration below 15 mEq/l.
- Presence of ketonurea or ketonemia.



# Diabetic Ketoacidosis

## Other Hyperglycemic States

Diabetes Mellitus  
Non-Ketotic Hyperosmolar  
Coma  
Impaired Glucose Tolerance  
Stress Hypoglycemia



## Other Ketotic States:

Ketotic Hypoglycemia  
Alcoholic Ketosis  
Starvation Ketosis

## Other Metabolic Acidotic States

Lactic Acidosis  
Hyperchloremic Acidosis  
Salicysm  
Uremic Acidosis  
Drug-Induced Acidosis

# DKA ( precipitating factors )

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- 1. Infection
- 2. Stopping insulin
- 3. First presentation of type 1 DM
- 4. No obvious cause : psychological factors



# Pathogenesis

## 1. **Ketogenesis:**

Due to insulin deficiency & increased concentration of counter regulatory hormones esp. epinephrine

TG → **FFA** → LIVER → **KETONE BODIES** .

## 2. **Hyperglycemia :**

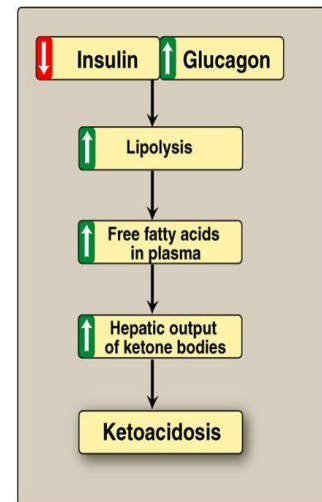
**A : gluconeogenesis**

**B: accelerated glycogenolysis**

**C : impaired glucose utilization**

### Mechanisms of DKA:

In uncontrolled DM there is ↑lipolysis in adipose tissue → ↑ [FFA] → ↑ mobilization of FFA to liver → ↑hepatic FA oxidation → ↑ hepatic acetyl CoA which will be utilized in KB synthesis (ketogenesis) → ketoacidosis



# Diabetic Ketoacidosis

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- Any type 1 diabetic patient with nausea , vomiting , abdominal pain , CNS depression , shortness of breath , fever , signs of infection is a candidate for DKA.
- Check urine for ketones. Check blood glucose by meter.
- Look for signs of dehydration : skin turgor , hypotension, tachycardia , Kussmaul breathing.
- Acetone smell.
- Send blood for : glucose , urea and electrolytes  
CBC,ABG , ECG , CXR .



# LAB.

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- Glucose :> 17 mmol/l
- PH < 7.3
- Bicarbonate : < 15 mEq / l
- Ketonemia and ketonurea
- High anion gap ( Na – Cl + bicarb ) > 14 m Eq / l

# TREATMENT

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- Admit patient to ICU.
- Monitor the following : blood (finger stick) or plasma glucose every 1-2 hours.
- Plasma K every 2-4 hours (important) .
- Other electrolytes every 4 hours.
- ABG as needed until PH is  $>7.1$
- Plasma phosphate , Mg , Ca , on admission : if low repeat every 4 hours.
- Urine for ketones every voiding.



# TREATMENT

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MONITORING

**USE A FLOW SHEET**

# ESSENTIAL ELEMENTS OF TREATMENT

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- 1. Insulin : 0.1 u /kg , followed by iv infusion of regular insulin

0.1u/kg/hr. Plasma glucose should fall by 4 – 5.5

mmol / l every hour. If no response by 4 hrs double

the dose.



# Fluids in Treatment Of DKA

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- Start with normal saline ( 15-20 ml /kg ) first 2 hours :
  - 1 litre in first hour
  - 1 litre in second hour

Then assess : if patient was initially hypotensive , give a third litre in the next 2 hours. **DON'T EXCEED MORE THAN 50 ML/KG IN THE FIRST 4 HOURS.**

When blood glucose reaches 14 mmol , give 0.45 % saline infusion + 5 % glucose to run at 150 – 300 ml / hour .

# Potassium

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- Always deficient ( UP TO 200 meq )
- Initial level could be high because of acidosis
- Replace as KCL & 1/3 as KPO<sub>4</sub>
- Usually 20 – 30 meq /hr is needed . Replace if K<sup>+</sup> if
- LESS THAN 5.3 Meq/l
- ECG monitoring



# BICARBONATE

- **Bicarbonate : only if PH IS  $\leq 6.9$  OR BICARBONATE IS  $< 5$  .**
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## WHY ?

1. WORSENING OF HYPOKALEMIA
2. PARADOXICAL CNS ACIDOSIS

Give one ampoule of 7.5 % sod bicarb. ( 50 mmol ) + 250 ML sterile water . Add 15 meq of K CL for each ampoule ( if K is  $\leq 5.5$  meq/l ) .

- 3 loss of drive for hyperventilation causing high PCO<sub>2</sub> AND CEREBRAL ACIDEMIA

# Criteria For Resolution

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- Blood glucose  $< 200$  mg /dl ( 11.1 mmol
- Serum bicarbonate  $> 18$  meq /l
- PH  $> 7.3$
- Calculated anion gap  $< 12$



# Starting Subcutaneous Insulin

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- When patient is able to eat
- Allow overlap between insulin infusion and subcutaneous insulin
- If patient is newly diagnosed , the initial total insulin dose should be 0.6 u/kg/day.

# Complications Of Therapy

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- 1.hypoglycemia
2. Hypokalemia
- 3.Cerebral edema : occurs in pediatric patients . May occur when blood sugar drops quickly to  $<14$  mmol/l
4. ARDS : rare



# PREVENTION

- 1. EDUCATION .
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- 2. SICK DAYS MANAGEMENT :

**HYDRATION**

**TREATMENT OF INFECTION**

**MONITORING FOR GLUCOSE & KETONES**

**USE OF SHORT ACTING INSULIN**

**NEVER STOP INSULIN**

# HYPERGLYCEMIC HYPEROSMOLAR STATE

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Different from DKA by absence of ketosis and presence of higher plasma glucose. Glucose is usually  $> 33$  mmol and osmolality  $> 320$  mosM.

Patient is typically a type 2 DM

**SERUM PH MORE THAN 7.3**

**SERUM BICARBONATE IS HIGHER THAN 18**



# Pathogenesis

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- Hyperglycemia
- **Ketogenesis : not operating ( some insulin is still available )**
- Dehydration is more severe
- Hyperosmolar state

## DKA vs HHS

### Diagnostic Criteria

- Hyperglycemia : Blood glucose  $\geq 14$  mmol/L
  - Acidosis : pH  $< 7.3$ ,  $\text{HCO}_3^-$   $< 15$  mmol/L
  - Ketonaemia or ketonuria
- Plasma glucose level of  $\geq 33$  mmol/L
  - Arterial pH  $> 7.3$ , serum bicarbonate  $> 15$  mmol/L
  - **Absence** of severe ketonaemia or ketonuria
  - Serum total osmolality  $> 330$  mmol/L



# Management

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- **Fluids : 0.9% saline in first hour and 2<sup>nd</sup> hour .  
Then give 0.45% saline at about 500 ml / hr or less .  
Watch cardiac status carefully esp. in cardiac patients.  
Add 5% glucose when blood glucose reaches 14 - 16 mmol /l .**

# Insulin

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- 5 – 10 units regular insulin bolus .
- 0.1 u/kg /hr infusion
- When blood glucose reaches 14 – 16 mmol/l give 1 - 2 u /hr + saline / glucose infusion .



CASE

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# 45 YEARS OLD Saudi lady

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- **Fatigue**
- **Tiredness**
- **Increased skin pigmentation**





proopiomelanocortin, a prohormone that is cleaved into the biologically active hormones ACTH, **MSH**, and others

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# Typical electrolytes

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- Na 126
- K 5.5
- Cl 89
- Bicarb 20

**HYPONATREMIA AND HYPERKALEMIA ARE  
NOT SEEN IN SECONDARY  
HYPOADRENALISM**



What about glucose ! ?

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# Causes of fasting hypoglycemia

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- EX
- P
- L
- A
- I
- N



# Fasting Hypoglycemia

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- Exogenous insulin or OHA
- Pituitary dis
- Liver dis
- Addison's dis
- Insulinoma
- Neoplasm

# Fasting Hypoglycemia

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# CBC

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- NEUTROPENIA
- RELATIVE LYMPHOCYTOSIS
- EOSINOPHILIA

# TREATMENT

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- IV SALINE +GLUCOSE
- IV STEROIDS



# PREVENTION

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- Extra steroids at times of stress
- Double dose for URTI
- Higher doses for more severe illnesses

# 35 YEARS OLD LADY ( post surgery)

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- Fever : 40c
- Agitation
- Tachycardia : 140 /min



# MANAGEMENT

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- IODIDE
- ANTI THYROID DRUGS
- BETA BLOCKERS
- STEROIDS
- ANTI PYRETICS
- SUPPORTIVE CARE

# CASE

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# 81 YEARS OLD LADY

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- FOUND IN COMA
- TEMPERATURE : VERY LOW
- PULSE : 45 /MIN

# OTHER CLINICAL FINDINGS THAT COULD BE FOUND

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- **Dry skin**
- **Loss of eyebrows**
- **Big tongue**
- **Look for a thyroidectomy scar**



# DO NOT FORGET BREATHING

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- HYPOVENTILATION IS A BIG PROBLEM
- TYPICAL ABG'S :

PCO<sub>2</sub> : HIGH

PO<sub>2</sub> : LOW

PATIENTS MAY NEED ASSISTED  
VENTILATION

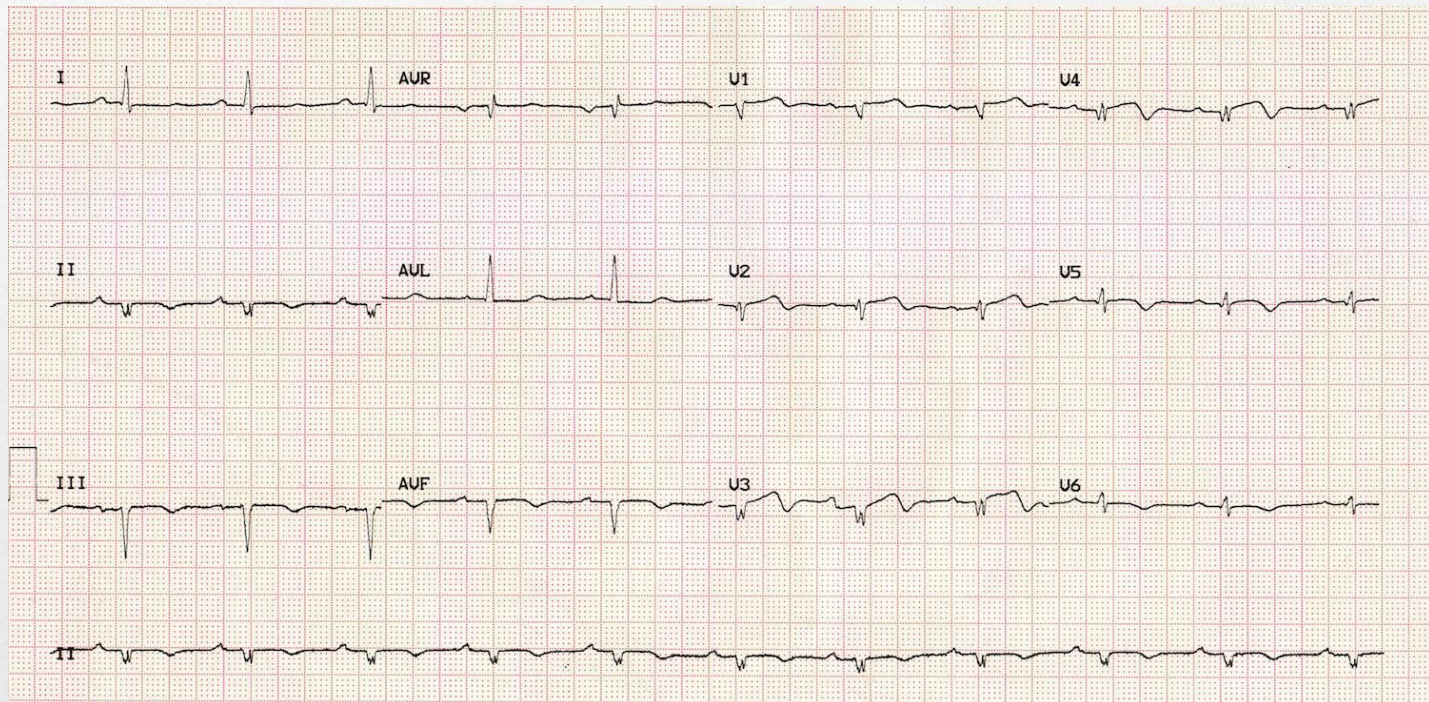
# sodium

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- Look for hyponatremia
- High cholesterol
- High CPK



# ECG : LOW VOLTAGE & BRADYCARDIA





# TREATMENT OF MYXEDEMA COMA

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- VENTILATION
- IV THYROXINE
- IV STEROIDS
- WARM PATIENT



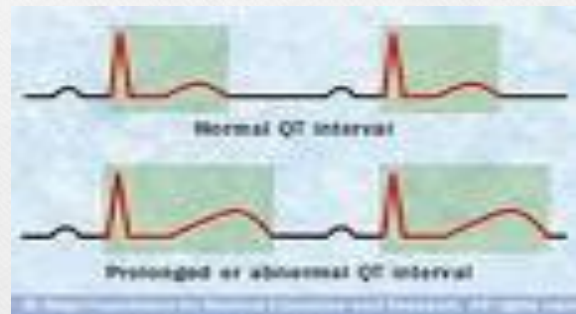
# SEVERE HYPOCALCEMIA

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- TETANY
- CONVULSIONS ESP. IN THE YOUNG
- ECG CHANGES ( QT INTERVAL)
- **Trousseau's sign**
- **Chvostek's sign**

# PROLONGED QT INTERVAL

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# TREATMENT OF SEVERE HYPOCALCEMIA

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- IV CALCIUM GLUCONATE SLOWLY AND UNDER ECG MONITORING

# SEVERE HYPERCALCEMIA

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- A 60 years old man presented with confusion. Serum calcium found to be 3.7 mmol/l (N 2.1-2.5)



What is the diagnosis ?

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# Causes of severe hypercalcemia

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- Primary hyperparathyroidism
- Malignancy induced hypercalcemia
- Iatrogenic ( high doses of calcium and vitamin D)



# Treatment of severe hypercalcemia

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- Saline hydration
- Calcitonin
- Bisphosphonates
- Steroids : only useful in sarcoidosis , multiple myeloma and lymphoma
- Dialysis : in renal failure or CHF