CASE STUDY OF DKA (DIABETIC KITOACIDOSIS)

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Presenting the case of 5 year old female patient admitted in our civil hospital in pediatric ward H-4 dated at 27/09/2016 with following chief complain:

- **Pain in right ear since 15 days**
- **Pain in neck since 15 days**
- **Vomiting and fever since 15 days**

ODP(ORIGIN , DURATION & PROGRESS)

- Initially patient has complain of pain in the right ear which got radiated towards the neck region ,and thus they went to nirmal hospital with the same chief complain .This was accompanied by fever and vomiting as what she ate, was vomited out. The medication was taken for vomiting and it was subsided. For 3 days she was conscious and then she became unconscious and was brought to civil hospital for further medication.

Biochemistry section

Sample type:Blood(serum,plasma) Date:27/09/2016

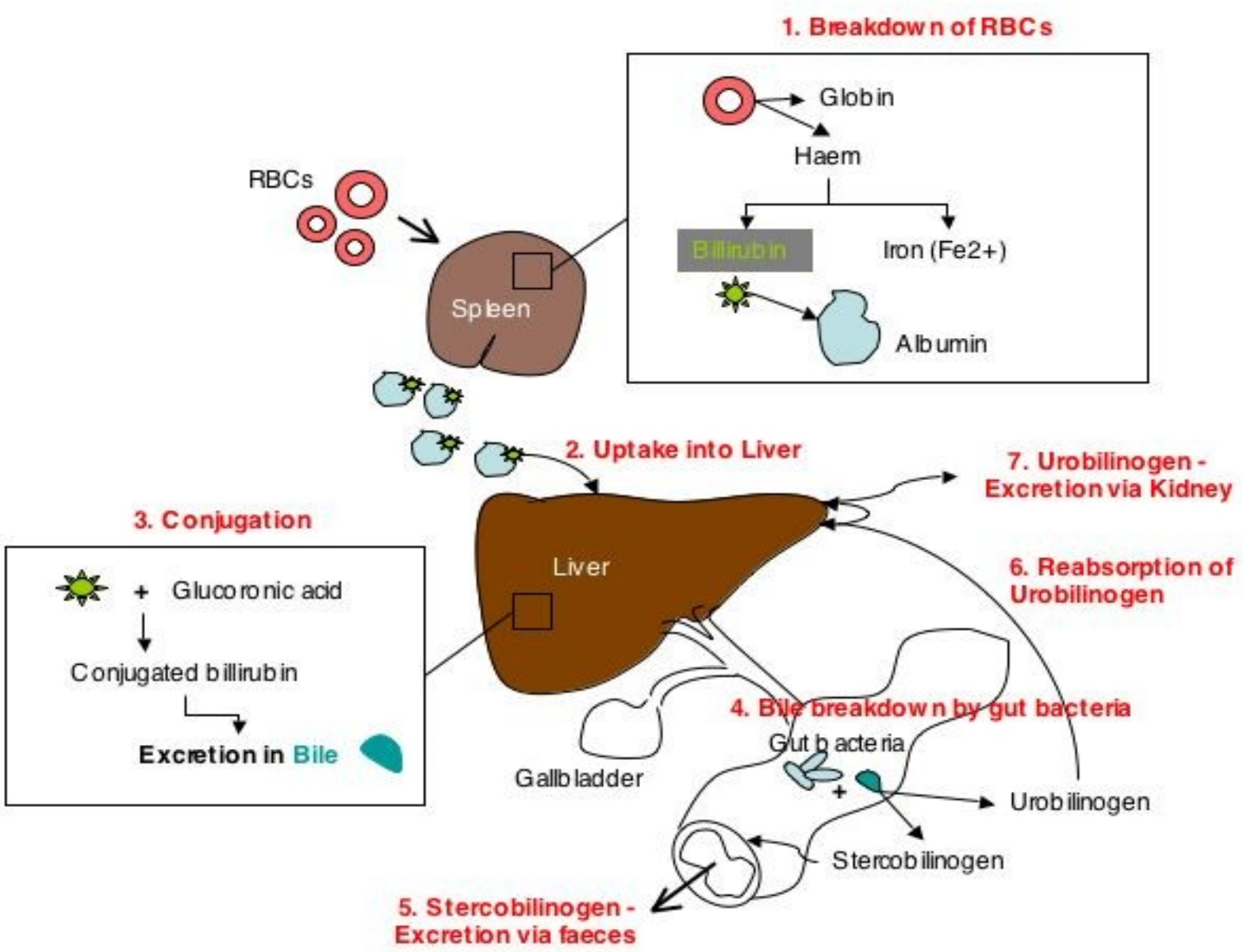
Examination(Test)	Result	Reference Range
Albumin	2.9 gm/dL	3.5-5.2 gm/dL
ALT	12 U/L	<45 U/L
Bilirubin Direct	0.1 mg/dL	<0.4 mg/gL
Bilirubin Total	0.4 mg/dL	<1.3 mg/dL
Bilirubin Indirect	0.3 mg/dL	<1.3 mg/dL
Calcium	7.8 mg/dL	8.6-10.2 mg/dL
Corrected Calcium	8.6 mg/dL	8.6-10.2 mg/dL
Creatinine	1.2 mg/dL	0.8-1.2 mg/dL
K+	5.65 mmol/L	3.5-5.1 mmol/L
Ketones	Positive	N/A
Na+	122.90 mmol/L	136-145 mmol/L

- **Albumin**:One type of plasma protein.It is water soluble. It is synthesized in liver,it decreases in liver and kidney diseases.

- **Alanine transaminase(ALT):**It is found in plasma and in various body tissues but it’s more common in liver.

- **Bilirubin Total**: Bilirubin Direct + Bilirubin Indirect

BILIRUBIN METABOLISM



- **Calcium in plasma are of two types:**
- **Calcium : Free form of Calcium.**
- **Corrected Calcium: Calcium which attached to Albumin.**
- Free calcium is biologically very important.
- When albumin is low , albumin bound calcium also decrease,But free calcium remains normal.

- **Total calcium**= free calcium (around 50%)+bound calcium (around 50%)

- **Bound calcium**= calcium mostly bound with albumin and also with some other protein.

- **Free Calcium**= ionised form in body fluid.It is functional part

Formula:

- **Corrected calcium(mg/dl)=**

  measured total calcium(mg/dl) +0.8 (4.0- Serum albumin(gm/dl))

Where 4 = average albumin level

0.8= Correction factor

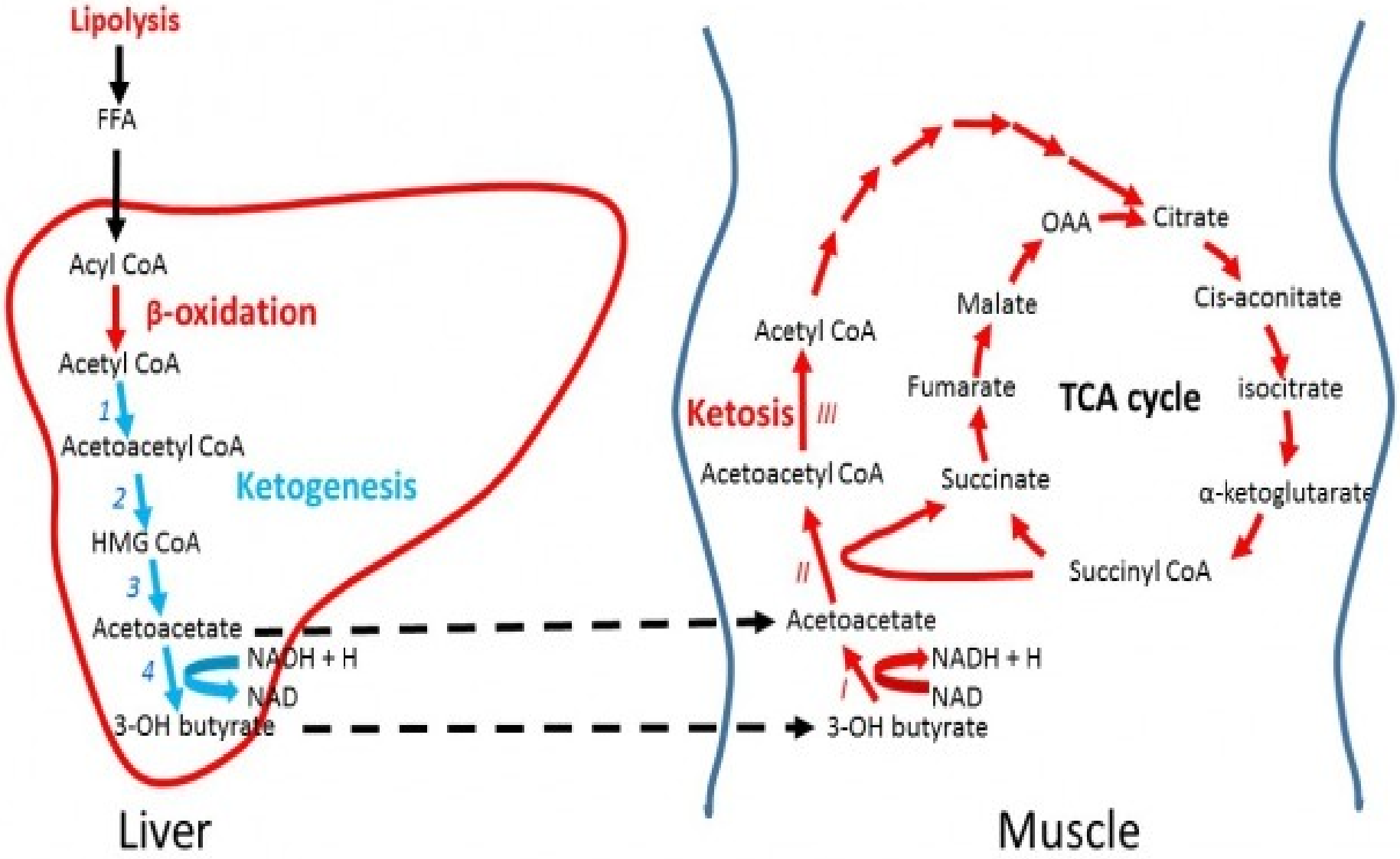
- For every 1 gm/dl drop in serum albumin below 4gm/dl, measured serum total calcium decrease by 0.8mg/dl.

- **Creatinine:** Its breakdown product of Creatine Phosphate and it is excretery product removed by Kidney.The level of Creatinine determines the functioning of Kidney.

- **Na+ & K+:** They are free ionic minerels which are present in body fluid.

- **Ketones:** Its obtained from catabolism of fat stored in cell when the glucose is not available to cell for energy production.

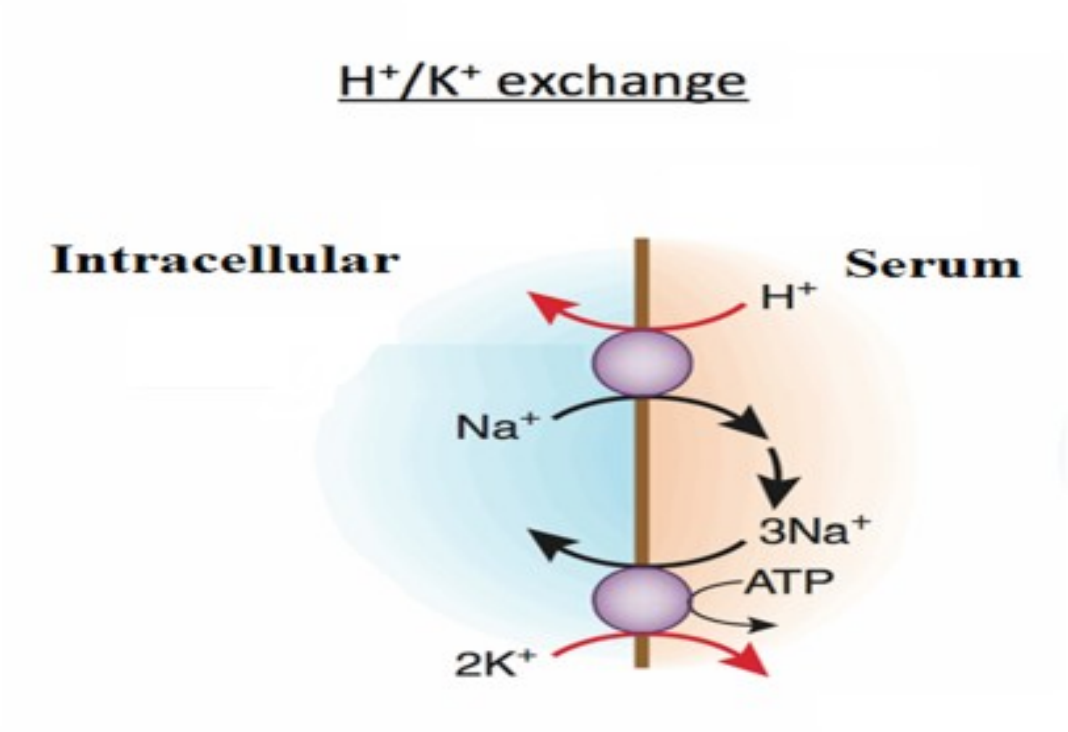
Formation of ketone bodies in cell for ATP



*Hyperkalemia and potassium deficit in diabetic ketoacidosis:

- H+-K+ exchange across cell -> hyperkalemia -> Excess loss in urine (deficit with hyperkalemia)

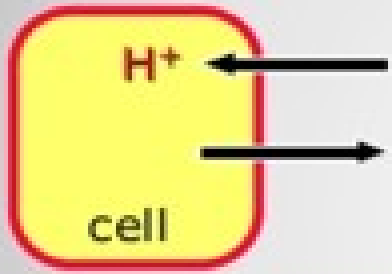
NORMAL MECHANISM FOR EXCHANGE OF IONS



ELECTROLYTE SHIFTS

Acidosis

Compensatory Response

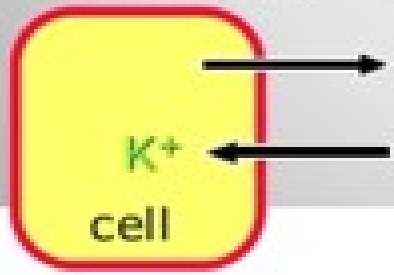


Result

- H^+ buffered intracellularly
- Hyperkalemia

Alkalosis

Compensatory Response

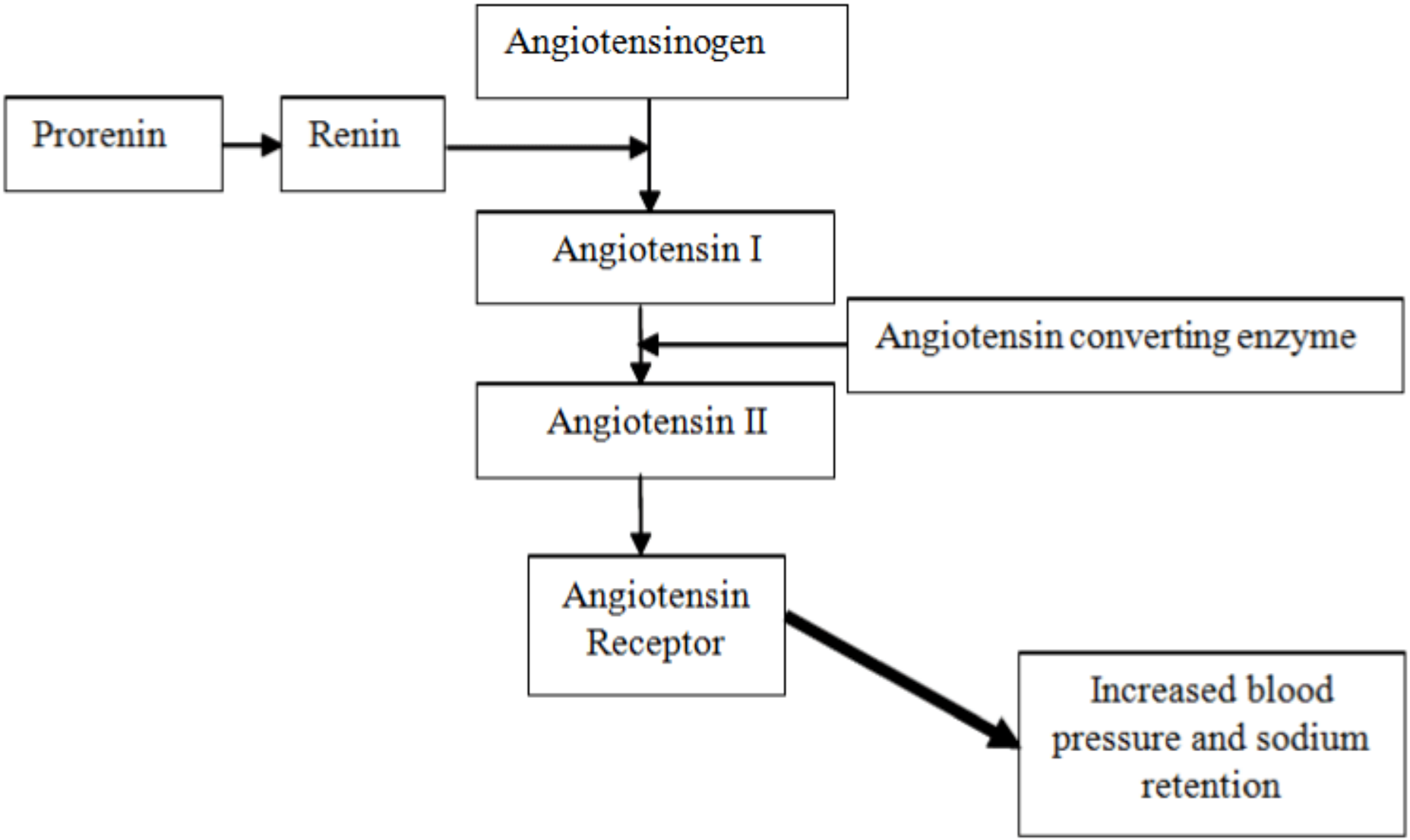


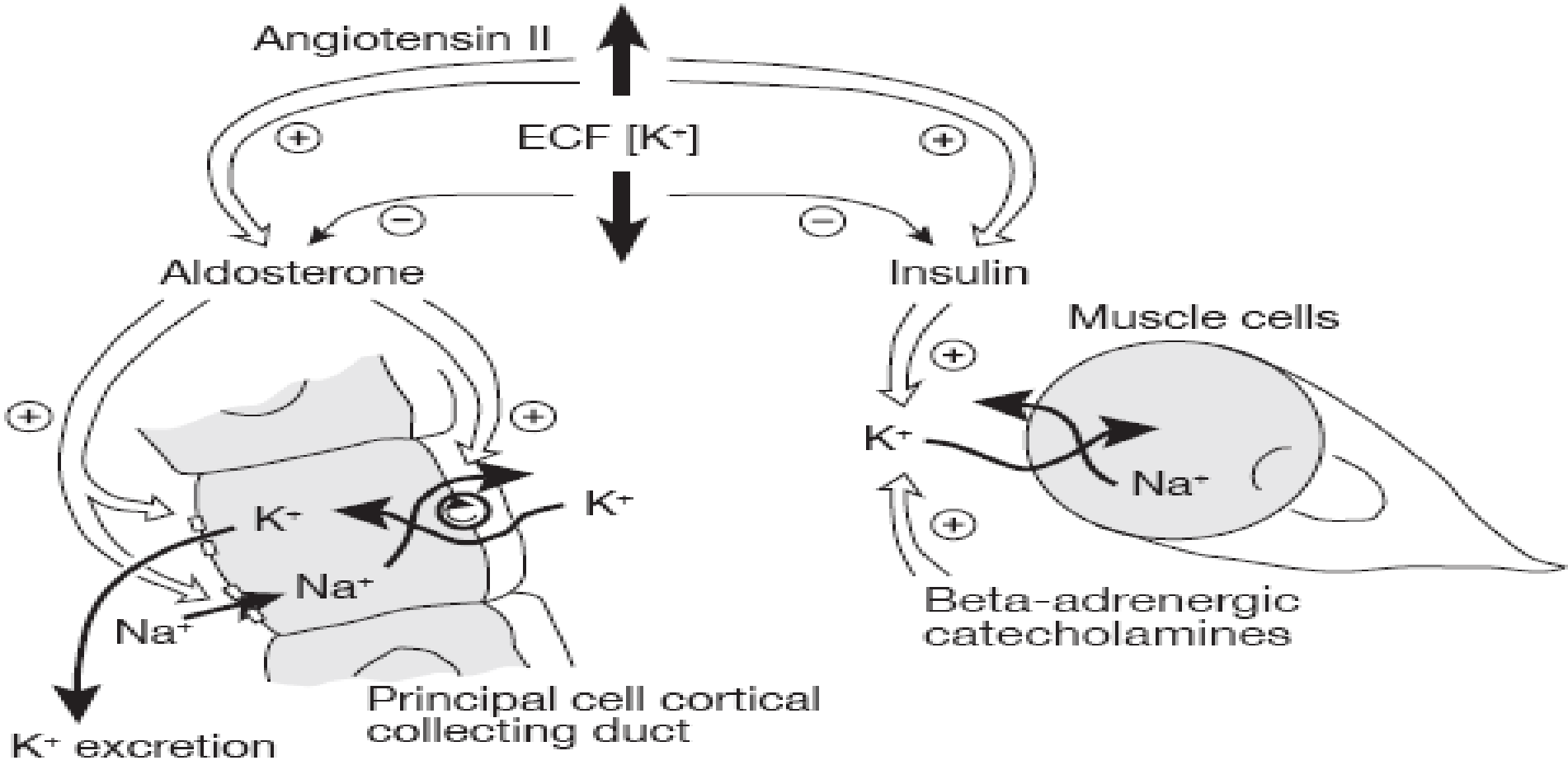
Result

- Tendency to correct alkalosis
- Hypokalemia

- polyuria -> loss of ECF water --> loss of ICF water -> Loss of ICF K+ to maintain ICF K+ -> Hyperkalemia --> Excess loss in urine (deficit with hyperkalemia)
- polyuria ->low BP --> increased renin --> Aldosterone --> Na+ saved, K+ lost in urine (deficit and pull towards hypokalemia)
- Insulin promote entry of K+ and Glucose in muscle cell and deficiency cause loss of K+ from ICF

REGULATIOIN OF EXTRACELLULAR POTASSIUM FLUID MECHANISM





An increase in extracellular fluid potassium concentration (ECF [K^+]) stimulates both aldosterone and insulin secretion. Insulin stimulates K^+ entry into cells, and aldosterone secretion stimulates K^+ secretion into the collecting duct urine, promoting its excretion by the kidney.

Gennari FJ. Disorders of potassium metabolism. In: Suki WN, Massry SG, eds. *Therapy of Renal Diseases.* 3rd ed. Figure 1.

BIOCHEMISTRY SECTION

SAMPLE TYPE:BLOOD(SERUM,PLASMA)

DATE:27/09/2106

Examination(Test)	Result	Refrence Range
Glucose	898	F: 74-100 mg/dL PP: <140 mg/dL R: <200 mg/dL

Fasting		Post Glucose(75 gm, 2 hours)	
Diabetes Mellitus	>126	Diabetes Mellitus	>200
Impaired Fasting Glucose	100-125	Impaired Glucose Tollerence	140-199

- **Impaired Fasting Glucose**: Impaired fasting glucose (IFG) is a type of prediabetes, in which the blood sugar level during fasting is consistently higher than what are considered normal levels however, the level is not high enough to be diagnosed as diabetes mellitus.

- **Impaired Glucose Tollerence:** Impaired glucose tolerance (IGT) is a pre-diabetic state. IGT may precede type 2 diabetes mellitus by many years.

COAGULATION PROFILE

SAMPLE TYPE:BLOOD(SERUM,PLASMA) DATE:27/09/2016

Test	Result	Refrence Range
Prothombine Time		
Patient	16.00 SEC	11-16 SEC
Control	15 SEC	

- **Prothrombin**: Prothrombin (coagulation factor II) is proteolytically cleaved to form thrombin in the coagulation cascade, the clotting process. Thrombin in turn acts as a serine protease that converts soluble fibrinogen into insoluble strands of fibrin, as well as catalyzing many other coagulation-related reactions.

- **Prothrombin Time**:It indicates the time taken for cloting of blood.(blood plasma)

HAEMOGRAM PROFILE

SAMPLE TYPE:BLOOD(SERUM,PLASMA) DATE:27/09/2016

Test	Result	Refrence Range
Blood Counts & Indices		
Hemoglobin	7.70 gm%	12-16 gm%
Total RBC	3.52 mil/cmm	4.2-5.4 mil/cmm
Total WBC	17800 /cmm	4000-11000 /cmm
Platelet Count	310000 /cmm	1.5-4 lakh /cmm
WBC Morphology		
WBC	-	
Platelate on smear	Adequate	
Parasites	Malarial parasite not detcted	

ARTERIAL BLOOD GAS ANALYSIS

SAMPLE TYPE: BLOOD(SERUM,PLASMA)

DATE:28/09/2016

UNCOMPASATED METABOLIC ACIDOSIS

Test	Result	Refrence range
pH	6.886	7.38-7.42
pCO2	15.8 mmHg	35-45 mmHg
pO2	33.6 mmHg	75-100 mmHg

(NIRMAL HOSPITAL)
CEREBROSPINAL FLUID(CSF)REPORT
SAMPLE:CSF DATE:28/9/2016

❖ PHYSICAL EXAMINATION

PROFILE	RESULT
Quantity	0.5 cc
Colour	Colourless
Odour	-
Clarity	Clear
Specific Gravity	-
Clot Formation	-

BIOCHEMISTRY SECTION

SAMPLE TYPE:CSF DATE:28/09/2016

EXAMINATION (TEST)	RESULT	REFERENCE
Glucose	669 mg/dL	40-70 mg/dL
Total Protein	453 mg/dL	15-40 mg/dL

- In CSF fluid- Glucose level is around 60% of serum level.
  - It is higher in this patient due to higher serum glucose level.

- CSF protein-The main protein in spinal fluid is albumin, a large protein important in the body's fluid balance. During bacterial infection, the level of protein in the spinal fluid goes up, due to an increase in the presence of the replicating bacteria, which have a high composition of protein, and an increase in the number of cells that fight infection and inflammation, which are also composed of protein.

URINE TEST

SAMPLE TYPE:URINE DATE:28/09/2016

PROFILE	RESULT	VALUES
Urea	66 mg%	10-45 mg%
Creatinine(s)	1.7 mg%	0.5-1.5 mg%
Sodium(s)	118 mmol/lit	133-145 mmol/lit
Chloride(s)	87 mmol/lit	95-107 mmol/lit
Albumin(s)	3 gm%	3.5-5.5 gm%
Globulin	2.6 gm%	2.3-4.4 gm%
Potassium(s)	2.7 mmol/lit	3.8-5.4 mmol/lit
Total Proteins(s)	5.60 gm%	2.3-4.4 gm%
A/G Ratio	1.15	0.8-2.0

PERSONAL HISTORY

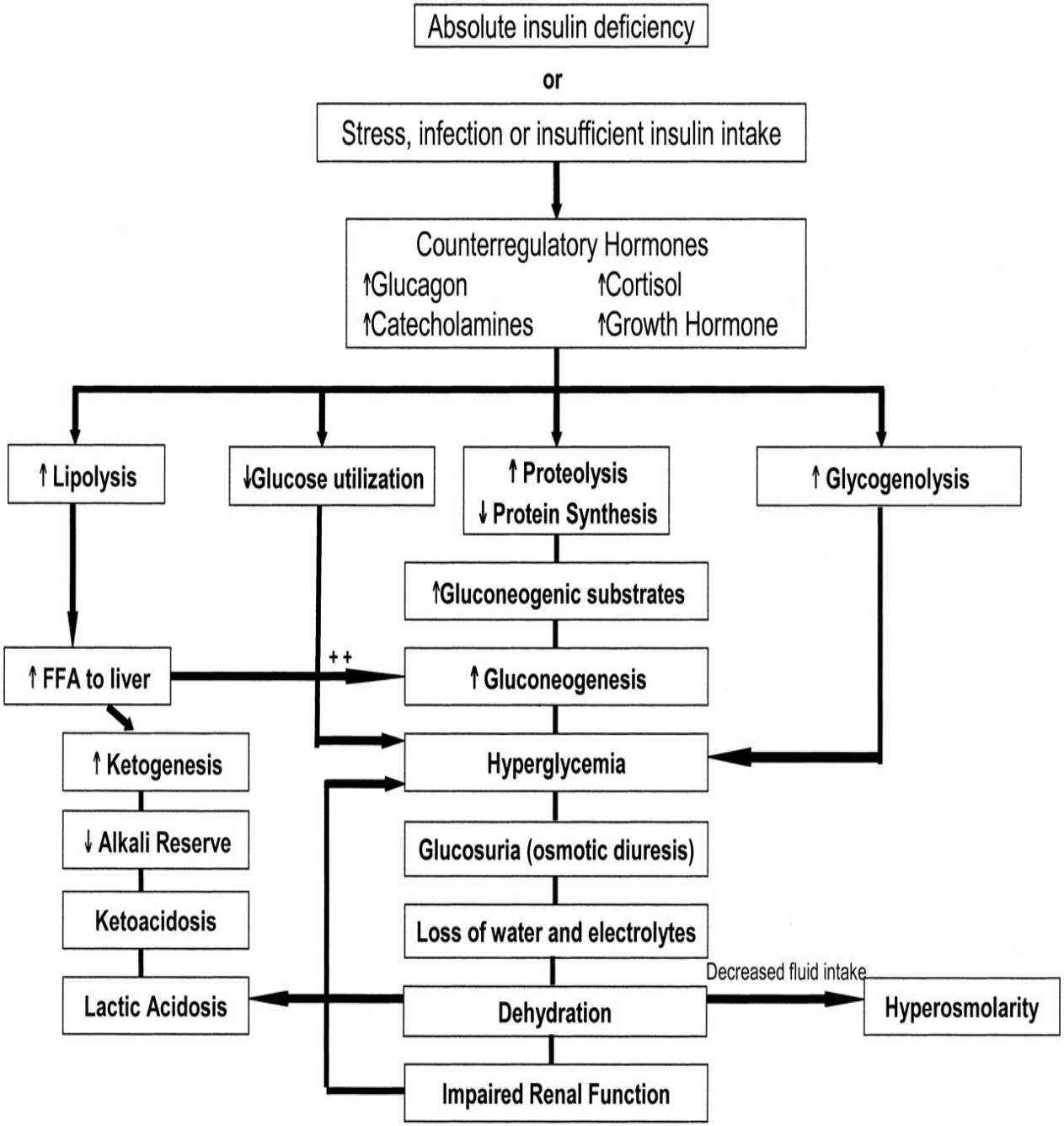
- **Bladder:** patient was passing urine at night since month.
- **Bowl:** normal
- **Past History:**- No significant history
- **Family History:** No significant history

DRUG HISTORY:

CURRENT MEDICATIONS

Drug Allergies	No
Recent prescription medication	Injection ceftriaxome-antibiotic Injection Amikacine Injection Rantac-antacid Injection Vitamin-k Injection Mannitol- diuretics Injection Phenytoin-anticonvulsant

- **General examination:** It was not done
- **Probable Diagnosis**: DKA with meningitis.
- **Pateint was expire after the three days of admission in civil hospital.**


Absolute insulin deficiency
or
Stress, infection or insufficient insulin intake
Counterregulatory Hormones
↑Glucagon
↑Cortisol
↑Catecholamines
↑Growth Hormone
↑ Lipolysis
↓Glucose utilization
↑ Proteolysis
↓ Protein Synthesis
↑ Glycogenolysis
↑Gluconeogenic substrates
↑ FFA to liver
++
↑ Gluconeogenesis
↑ Ketogenesis
Hyperglycemia
↓ Alkali Reserve
Glucosuria (osmotic diuresis)
Ketoacidosis
Loss of water and electrolytes
Decreased fluid intake
Lactic Acidosis
Dehydration
Hyperosmolarity
Impaired Renal Function

MENINGITIS WITH DKA:

- The patient is suffering from meningitis along with DKA.
- Meningitis is inflammation of the thin tissue that surrounds the brain and spinal cord, called the meninges. There are several types of meningitis. The most common is viral meningitis. The patient can get it when a virus enters the body through the nose or mouth and travels to the brain. Bacterial meningitis is rare, but can be deadly.

*DIABETES MELLITUS(DM):

- **This patient may have DM for many months, but undetected.**
- **DM decrease body capacity to fight infection**
- **Then she may have developed ear infection -> spread to meninges (Covering of brain) --> Meningitis**
- **Infection --> release of cortisol by body --> further increase in blood glucose --> worsening of DM**

- 1. **Cause of infection**

  DM leads to micro-angiopathy of blood vessels

  Decrease blood supply

  Decrease chemotexisis

  Lead to infection

Microangiopathy Pathogenesis:

- Chronic Hyperglycemia.
- Glycosylation of basement membrane proteins → Leaky blood vessels.
- Deposition of proteins, matrix, LDL.
- Narrow, thick, fragile, Leaky BV.
  - Ischemia, defective inflammation.
  - Leakage – edema, Proteinuria (kidney)
  - Micro Aneurysms (retina)
  - Atherosclerosis.

- 2. Increase glucose level in Blood which provide good nutritional media for growth of bacteria
- 3.DM cause Neuropathy which decrease the pain sensation in peripheral parts of the body -> more prone for injury-> poor healing due to less blood supply-> leads to infection

- Cause of fever- due to infection
- Cause of vomitting-
  - meningitis which may lead to increase intracranial pressure - lead to vomiting.
  - Acidosis

QUESTIONS:-

- What Can be the reason of pain in right ear and neck?
- What can be the reason of vomitting and fever?
- What can be the reason of convulsion?
- What is corrected calcium?
- What is Glucose tolerance test?
- What can be the reason of nocturnal urination?
- What can be the reason of low PH, co2 and low 02?
- What is the reason of ketone positive report? Example of ketone.
- What is the reason of high K+ and low sodium in blood?

THANK YOU