OSH STATE UNIVERSITY

INTERNATIONAL MEDICAL FACULTY

DEPARTMENT OF CLINICAL DISCIPLINES 1

Complications of Diabetes Mellitus

Educational-methodical manual

for students and teachers

Osh - 2025

Recomended by decision of the Academic Council International Medical Faculty

Osh State University

Reviewer:

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Complicaitons of Diabetes Mellitus

DIAGNOSIS AND TREATMENT

Educational-methodical manual provides a summary of the etiology, pathogenesis, classification, clinical manifestations, diagnosis of complications of **Diabetes mellitus.** Modern approaches to the treatment of complications of Diabetes mellitus are considered.

The educational-methodical manual is intended for students and teachers of medical universities for the study of the "Faculty therapy" and “Endocrinology”.

Content

1. List of abbreviations

DM	Diabetes Mellitus
FFAs	Free fatty acids
GDM	Gestational diabetes mellitus
MODY	maturity-onset diabetes of the young
LADA	late-onset type 1 autoimmune diabetes in adults
HbA1c	Glycated haemoglobin
FBS	Fasting blood sugar
RBS	Random blood sugar
GTT	Glucose tolerance test
DSME	diabetes self-management education
DSMS	diabetes self-management support
MNT	Medical nutrition therapy
NPH	neutral protamine Hagedorn
CSII	continuous subcutaneous insulin infusion
DKA	Diabetic Ketoacidosis

2.The objectives of the lesson

Clearly define what diabetes mellitus is, its types (Type 1, Type 2, gestational diabetes, etc.), and its prevalence in the population.

Describe the underlying biological mechanisms and processes that lead to diabetes, including insulin production, insulin resistance, and glucose metabolism.

Discuss the various risk factors that contribute to the development of diabetes, such as genetic predisposition, lifestyle choices (diet and physical activity), obesity, and family history.

Explain how diabetes is diagnosed using criteria such as fasting blood glucose levels, oral glucose tolerance tests, and HbA1c levels.

Provide strategies for managing diabetes through lifestyle modifications, including adopting a balanced diet, engaging in regular physical activity, monitoring blood glucose levels, and managing stress.

Discuss various medical treatments for diabetes, including insulin therapy, oral medications, and other emerging treatment options.

3. Professional competencies (PC) and Learning outcomes

Code of the results of the general education curriculum and its formulation	**Code and formulation of competencies** **(ГОС 2015)**	**Learning outcome of course and its code**
LO -5 - Able to implement fundamental knowledge in assessing the morphofunctional and physiological states of the body for the early diagnosis of diseases and the identification of pathological processes.	**PC -2** - able to collect patient anamnesis; do physical examination, interpret results of laboratory and instrumental studies, write a medical card of adult and child patients.	**LOc- 1:** able and ready to analyze the data of history, physical examination, the results of laboratory-instrumental examination, and fill out a medical card of an ambulatory and stationary patient
LO-7 Able to implement basic knowledge in the diagnostic activities to solve professional cases.	**PC-11** - able and ready to make a diagnosis based on the results of biochemical and clinical studies, taking according to of the pathology in organs, systems and the whole body.	**LOc- 2** able to analyze the regularity of functioning of individual organs and systems, use knowledge of anatomical and physiological features, and know how to implement fundamental knowledge

	PC-13 **-** able to identify the main pathological symptoms and disease syndromes in patients, using knowledge of the basics of biomedical and clinical disciplines, in assessing the course of pathology in organs, body systems in general, analyze patterns of functioning of organs and systems in various diseases and pathological processes, use an algorithm diagnosis (main, concomitant, complications), ICD-10, to carry out the main diagnostic measures to identify urgent and life-threatening	in assessing morphofunctional and physiological states of the body for the early diagnosis and the identification of pathological processes.
LO 8 – Able to apply basic knowledge in the medical pra to solve professional cases	**PC-15** - able to assign patients adequately treated in accordance with the diagnosis**;** **PC-16** able to first aid the adult population and children in case of emergency and life-threatening conditions, hospitalize patients in a routine and emergency basis	**LOc-3: be** able to perform basic therapeutic measures in the rare diseases and conditions in the adult population and be able to implement fundamental knowledge (anatomical, topographical and histophysiological rationale) and the basics of physical examination.

4. Information block relating to: Complication of Diabetes mellitus

Complications of diabetes :

Acute complications	Chronic complications
• Hypoglycaemia • Diabetic ketoacidosis • Non-ketotic hyperosmolar coma • Lactic acidosis	• Diabetic retinopathy • Diabetic nephropathy • Diabetic neuropathy • Diabetic foot

DEFINITION, ETIOLOGY AND PATHOGENESIS	
TERM	DEFINITION
Hypoglycemia	Hypoglycaemia is a condition in which your blood sugar (glucose) level is lower than the standard range.
Etiology	• Imbalance between injected insulin and patients normal diet, activity & basal insulin requirement. • Irregular eating habits, unusual exertion and alcohol excess may precipitate episodes. • Impaired ability to counter - regulate glucose levels after hypoglycaemia in diabetic patient is also responsible for episode. Glucagon response is lost. Adrenaline response may also fail in patients with a long duration of diabetes.

SYMPTOMS AND SING	
Symptoms of hypoglycaemia begin at plasma glucose 60mg/dl: brain impairment develops at approximately 50 mg/d. Brain damage after prolonged severe hypoglycaemia is not reversible.	
Autonomic	• Sweating • Trembling • Pounding heart • Hunger • Anxiety
Non-specific	• Nausea • Tiredness • Headache

Neurologic	• Confusion • Drowsiness • Speech difficulty • Inability to concentrate • Incoordination
Treatment :	• Patient conscious: oral glucose drink • Patient unconscious: 50 ml of 50% dextrose water I/V or Inj glucagon 1 Mg I/M • Precaution: patient should carry some tablets of glucose for use in emergency. • If severe hypoglycaemia causes unconsciousness or stupor, the treatment is 50ml of 50% glucose solution by rapid IVV infusion. If intravenous therapy is not available, 1 mg of glucagon's injection IM will usually restore the patient to consciousness within 15 min. Rectal administration of honey or syrup (30ml/500ml of warm water) has been effective. • NOTE: Injection glucagon is not effective for hypoglycemia caused by oral hypoglycemic drugs, it is effective for insulin induced hypoglycemia: • Patients with hypoglycemia caused by oral hypoglycemic agent or long acting insulin should be admitted and observed because hypoglycemia may be recurrent due to the prolonged duration of these drugs.

DEFINITION, ETIOLOGY AND PATHOGENESIS	
TERM	DEFINITION
DIABETIC KETOACIDOSIS	Diabetic ketoacidosis is a medical emergency with mortality rate about 5%. It may be the initial manifestation of type 1 diabetes or may result from increased insulin requirement in type 1 diabetes patients during the course of stress such as infection, trauma, surgery or myocardial infarction. Type 2 diabetics may develop ketoacidosis under severe stress such as infection or trauma.
PRECIPITATING FACTORS	I. Acute infection: bacterial or viral 2. Omission or drastically reduction the dose of insulin 3. New onset of type 1 diabetes (about 25% patients of type 1 are first time diagnosed when they present with ketoacidosis).
Pathophysiology	• Hyperglycaemia • Without effective circulating insulin levels, blood glucose concentrations rise, eventually producing an osmotic diuresis with the loss of fluid and electrolytes. This results in dehydration (usually 4-6 litre), depletion of total body potassium (about 300 mmol and lesser degree of sodium (about 500 mmol), chloride, phosphate and magnesium. These electrolytes are lost due to osmotic diuresis. • Metabolic acidosis

	• Lack of insulin absolute or relative, causes increased release of fatty acids from adipose tissue and increased ketone bodies production from these acids. Ketone bodies are produced more rapidly than can be metabolized and therefore accumulate. Accumulation of acid in the form of ketone bodies causes fall in blood pH with characteristic hyperventilation, negative inotropic effect on heart and peripheral vasodilatation with consequent hypotension. Therefore due to metabolic acidosis patient develops hypotension and hyperventilation. Hydrogen ions also displace intracellular potassium which is then lost in the urine.

SYMPTOMS AND SING	
	Symptoms • Intense thirst • Polyuria • Nausea, vomiting • Abdominal pain more common in children **Signs** • Dry tongue, inelastic skin, sunken eyes • Kussmaul's respiration (rapid and deep breathing) • Abdominal tenderness (may be) • Hypotension • Rapid weak pulse • Hypothermia • Level of consciousness is variable, patient with severe ketoacidosis may be conscious and alert, drowsiness is usual but coma is uncommon. Level of consciousness depends on serum osmolality, not on level of acidosis. When serum osmolality exceeds 320-330 mosm/L. CNS depression or coma develops (normal value is 280-300 mosm/L) Formulate for calculation of serum osmolality is: Serum osmolality=2 [Na] + K+ glucose mg/dl/18

DIAGNOSIS
1. Hyperglycaemia (usually: >250 mg/dl) The magnitude of hyperglycaemia does not correlate with the severity of metabolic acidosis: moderate elevation of blood glucose may be associated with life-threatening ketoacidosis. In some cases hyperglycaemia predominates with minimal acidosis. There is +++glycosuria.

2. Metabolic acidosis

- Blood pH 7.3
- Serum bicarbonate < 15 meq/L

3.Hyperketonaemia and ketonuria

- Urinary ketones strongly positive +++

COMPLICATIONS

1. Hypotension can lead to renal failure. Plasma expanders (such as Hemaccel) or whole blood may be given if systolic blood pressure is below 80 mmHg and not responding to normal saline.
2. Cerebral edema It may be caused by rapid reduction of blood glucose or use of hypotonic fluids. Mortality is high; treat with mannitol and oxygen,
3. Acute respiratory distress syndrome (ARDS) It manifests as hypoxemia on ABG or pulse oximetry and as pulmonary infiltrates on chest x-ray. Thromboembolism T prevent DVT and other forms of thromboembolism give heparin in unconscious, elderly or obese patient.
4. Disseminated intravascular coagulation (DIC) It rare.
5. Hypothermia Severe hypothermia may occur in ketoacidosis.
6. Complications of therapy Hypoglycaemia, hypokalaemia, pulmonary edema.

INVESTIGATIONS

1	Blood glucose and electrolytes hourly for 3 hours and then every 2-4 hour thereafter.
2	Elevated anion gap: it is the difference between cations and anions and is measured by the following formula: Anion gap = [sodium + potassium] - [chloride + bicarb] Normal anion gap is 12 plus minus 2 mmol/lit. The normal anion gap is because of anionic plasma protein (albumin) while the elevated anion gap signifies overproduction of an organic acid.
3	Urinary ketones: Urine is strongly positive for ketone bodies (check urinary ketones every 4 hourly). Ketonuria can persist after correction of acidosis.
4	ABGs show low pH, low bicarb. ABG is usually performed once and only repeated if serum bicarbonate is not elevated 4-6 hours of insulin therapy.
5	Blood CP:- high WBC counts (leucocytosis). TLC may be as high as 25000 with a left shift With or without infection.
6	X-ray chest: to look for infection.
7	ECG: to exclude myocardial infarction and to monitor K+ level.
8	Urea and creatinine: to measure renal status.
9	Plasma osmolality: level exceeding 320-330 mosm/L can lead to CNS depression and coma.

Treatment of HSP

GENERAL MEASURES

Diabetic ketoacidosis is a medical emergency and should be treated in hospital. The principles of treatment are:

I. Fluid replacement

2. Regular or plain insulin by I/V or UM

3. Potassium (K+) replacement

4. Antibiotics if infections are present

Fluid replacement

Average fluid deficit is about 6 litres.

- 3 litres from extracellular compartment, replaced by normal saline (.9% NaCl)
- 3 litres from Intracellular compartment, replaced by dextrose water (0.5% glucose).
- However 6 litres fluid is not required by every patients, it depends on degree of dehydration. Therefore check JVP, basal crept and urine output during fluid replacement, fluid overloading causing pulmonary edema is not an uncommon complication especially if management is performed by junior doctors.

Scheme

First we correct extracellular and then intracellular deficit.

Normal saline 0.9% NaCI

- 1 litre in % hour, then
- 1 litre in 1 hour, then
- 500 ml per hour

Insulin

- First give loading dose of regular insulin 0.1 unit IV bolus then 0.I units/kg/hr in a continuous infusion.
- If infusion is not possible then 10 units IM stat then 4-6 units in IM hourly.
- Blood glucose level should decrease by 100 mg/dl/hour.
- If blood glucose levels do not fall at least 10% in the first hour, a repeat loading dose is recommended. Double the infusion

Potassium replacement

- All patients in diabetic ketoacidosis are potassium depleted and nearly all will require 1V potassium to prevent dangerous hypokalaemia. Therefore add 20 mmol of KCl to each litre except in first litre because plasma K+ level is often high at presentation due to reduced entrance of K+ in the cell in the deficiency of insulin.
- Potassium should be replaced even the report 1s awaited if ECG shows no hyperkalaemia and patient is passing urine. Otherwise wait for the Deport of

<table>
<tr>
<td>rate every 2-hours until blood glucose level begins to fall by at least 10%.
• When the blood glucose conc. has fallen to 250 mg/dl, the dose of insulin should be reduced to 1-4 units hourly.
• The subcutaneous route is avoided because subcutaneous blood flow is reduced in shocked patients.
• Very rapid fall in blood sugar should be avoided because it can lead to cerebral edema.</td>
<td>electrolytes because patient might have renal failure in which potassium would be already raised.
• If ECG shows flat T wave or formation of U wave that indicate hypokalaemia, potassium management with fluid and insulin will cause further hypokalaemia. Fluid replacement dilutes plasma causing life-threatening hypokalaemia. Insulin also shifts potassium inside the cell that can also lead to hypokalaemia.</td>
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<tr>
<td colspan="2">Antibiotics

These are given after detection of infection and according to the type of infection. Meanwhile broad-spectrum antibiotics should be given.</td>
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Diabetic ketoacidosis and hyperglycemic hyperosmolar state

Knowing the difference between the two is essential to ensure patients receive prompt, proper treatment.

	Diabetic ketoacidosis	Hyperglycemic hyperosmolar state
Diabetes type	• Type 1 • Ketosis-prone Type 2	• Type 2
Onset	• Rapid (typically 24 hours)	• Gradual
Blood glucose levels	• 350-500 mg/dL	• >800 mg/dL
Serum ketones/anion gap	• Present/elevated	• Usually absent or low/usually normal
Serum osmolality	• 300-320 mOsm/kg	• 330-440 mOsm/kg
Other findings	• Acetone breath • Kussmaul breathing	• Altered mental status • Significant dehydration
Diagnostic criteria	• Elevated blood glucose • Anion-gap acidosis • Serum ketones	• Elevated blood glucose • Elevated serum osmolality • Mental status changes
Treatment	• I.V. insulin and I.V. fluids	• I.V. fluids and I.V. insulin
Resolution	• Anion gap normalized • Ketones improved	• Alert • Serum osmolality <315 mOsm/kg

20.16 Emergency management of diabetic ketoacidosis

Time: 0–60 mins

- Establish IV access, assess patient and perform initial investigations
- Commence 0.9% sodium chloride:
  - If systolic BP >90 mmHg, give 1 L over 60 mins
  - If systolic BP <90 mmHg, give 500 mL over 10–15 mins, then re-assess; if BP remains <90 mmHg, repeat and seek senior review
- Commence insulin treatment:
  - 50 U human soluble insulin in 50 mL 0.9% sodium chloride infused intravenously at 0.1 U/kg body weight/hr
  - Continue with SC basal insulin analogue if usually taken by patient
- Perform further investigations: see text
- Establish monitoring schedule:
  - Hourly capillary blood glucose and ketone testing
  - Venous bicarbonate and potassium after 1 and 2 hrs, then every 2 hrs for first 6 hrs
  - Plasma electrolytes every 4 hrs
  - Clinical monitoring of O_2 saturation, pulse, BP, respiratory rate and urine output every hour
- Treat any precipitating cause

Time: 60 mins to 6 hrs

- IV infusion of 0.9% sodium chloride with potassium chloride added as indicated below:
  - 1 L over 2 hrs
  - 1 L over 2 hrs
  - 1 L over 4 hrs
  - 1 L over 4 hrs
  - 1 L over 6 hrs
- Add 10% glucose 125 mL/hr IV when glucose <14 mmol/L (252 mg/dL)
- Be more cautious with fluid replacement in older or young people, pregnant patients and those with renal or heart failure; if plasma sodium is >155 mmol/L, 0.45% sodium chloride may be used
- Adjust potassium chloride infusion:

Plasma potassium (mmol/L)	Potassium replacement (mmol/L of infusion)
>5.5	Nil
3.5–5.5	40
<3.5	Senior review – additional potassium required

Time: 6–12 hrs

- Clinical status, glucose, ketonaemia and acidosis should be improving; request senior review if not
- Continue IV fluid replacement
- Continue insulin administration
- Assess for complications of treatment (fluid overload, cerebral oedema)
- Avoid hypoglycaemia

Time: 12–24 hrs

- By 24 hrs, ketonaemia and acidosis should have resolved (blood ketones <0.3 mmol/L, venous bicarbonate >18 mmol/L)
- If patient is not eating and drinking:
  - Continue IV insulin infusion at lower rate of 2–3 U/hr
  - Continue IV fluid replacement and biochemical monitoring
- If ketoacidosis has resolved and patient is able to eat and drink:
  - Re-initiate SC insulin with advice from diabetes team; do not discontinue IV insulin until 30 mins after SC short-acting insulin injection

Additional procedures

- Consider urinary catheterisation if anuric after 3 hrs or incontinent
- Insert nasogastric tube if obtunded or there is persistent vomiting
- Insert central venous line if cardiovascular system is compromised, to allow fluid replacement to be adjusted accurately; also consider in older patients, pregnant women, renal or cardiac failure, other serious comorbidities and severe DKA
- Measure arterial blood gases; repeat chest X-ray if O_2 saturation <92%
- Institute ECG monitoring in severe cases
- Give thromboprophylaxis with low-molecular-weight heparin

(BP = blood pressure; ECG = electrocardiogram; IV = intravenous; SC = subcutaneous)

Adapted from Joint British Diabetes Societies Inpatient Care Group. The Management of Diabetic Ketoacidosis in Adults, 2nd edn; September 2013; abcd.care.

DEFINITION, ETIOLOGY AND PATHOGENESIS

TERM	DEFINITION
HYPEROSMOLAR NON-KETOTIC COMA	This condition, in which severe hyperglycaemia develops without significant ketosis, is the metabolic emergency characteristic of uncontrolled type 2 diabetes. Patients present in middle or later life, often with mild or previously undiagnosed diabetes. Infection, myocardial infarction, stroke, or recent surgery is the precipitating factors.

SYMPTOMS AND SING

Clinical features are dehydration and stupor or coma due to hyper osmolality. Nausea, vomiting and abdominal pain are much less common because there is no acidosis. There is no hyperventilation as seen in DKA.

DIAGNOSIS

1. Hyperglycaemia (usually: >250 mg/dl) The magnitude of hyperglycaemia does not correlate with the severity of metabolic acidosis: moderate elevation of blood glucose may be associated with life-threatening ketoacidosis. In some cases hyperglycaemia predominates with minimal acidosis. There is +++glycosuria.

2. Metabolic acidosis

- Blood pH 7.3
- Serum bicarbonate < 15 meq/L

3.Hyperketonaemia and ketonuria

- Urinary ketones strongly positive +++

INVESTIGATIONS

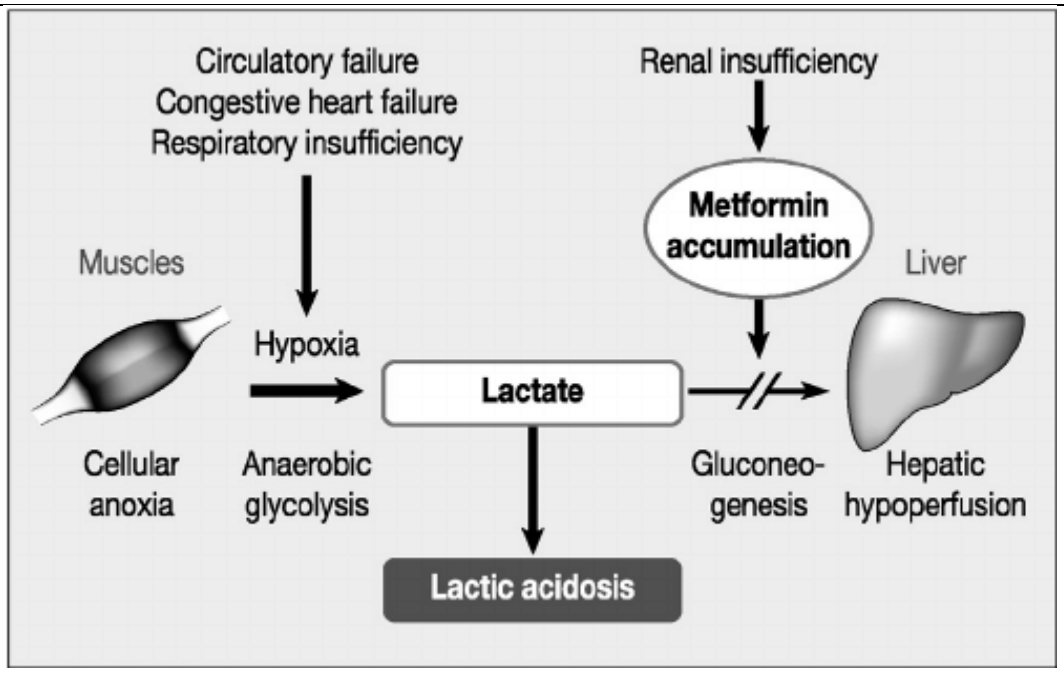
1	Severe hyperglycaemia, blood sugar 600-2400 mg/dl but ketone bodies in urine are absent.
2	Plasma osmolality >310 mosm/L
3	Serum bicarbonate> 15meq/L
4	Normal anion gap (< 14 meq/L)
5	ABGs show normal ph.

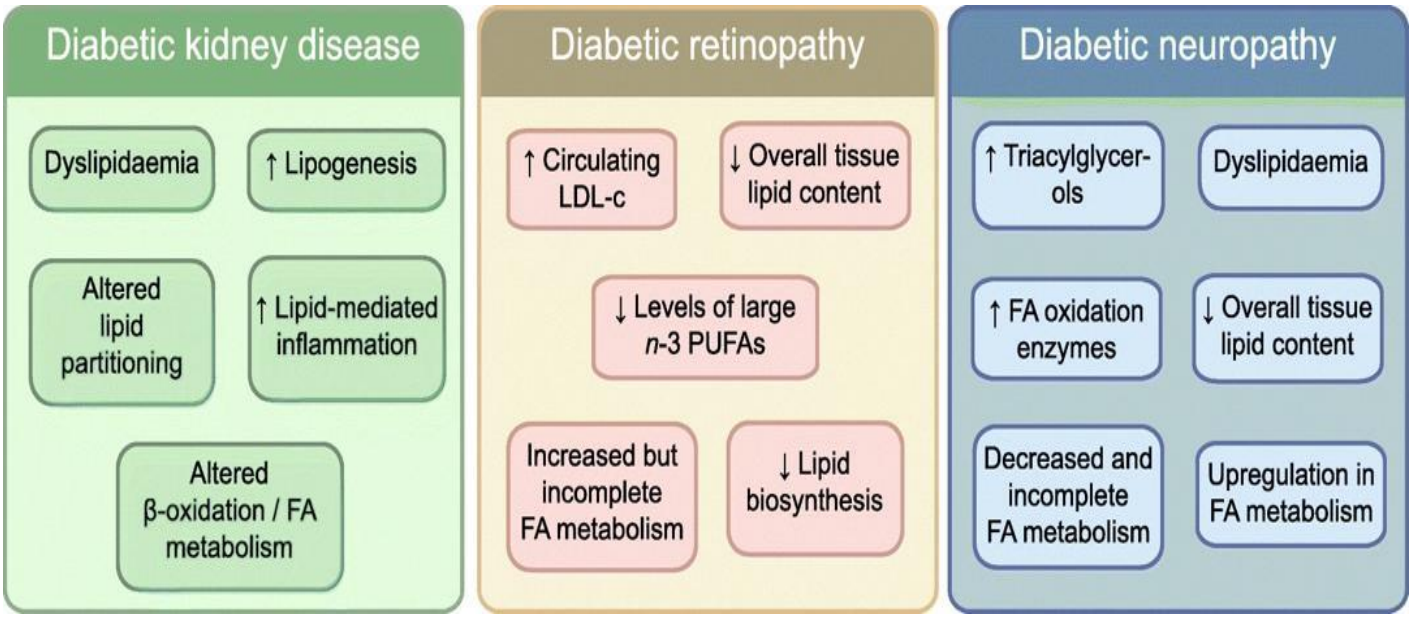
Treatment of HSP

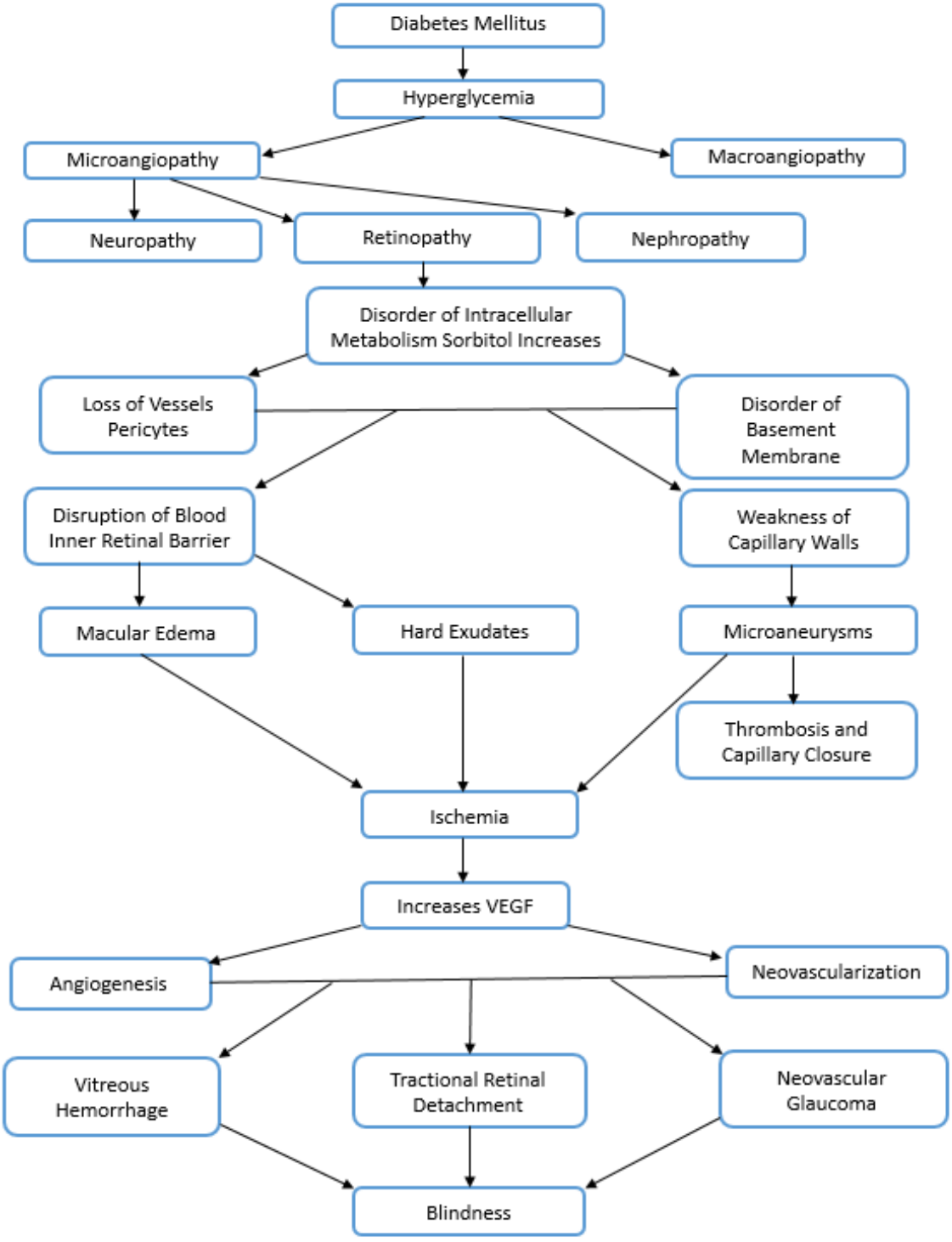
Treatment of hyperosmolar non- ketotic coma is similar to ketoacidosis with some differences:

Fluid replacement- Fluid replacement is the mainstay of treatment in hyperosmolar coma. It can reduce hyperglycaemia by correcting hypovolemia, which then increases both glomerular filtration and renal excretion of glucose. Saline should be of 0.45% NaCI (not 0.9% normal saline). As much as 4-6 litres fluid may be required in the first 8-10 hours. Once blood glucose reaches to 250mg/dl fluid replacement should include 5% dextrose water in either 0.45% or 0.9% saline.
Insulin therapy- insulin may be required to reduce hyperglycaemia but lesser in amount than required in ketoacidosis. Initial dose of 15 units IV and 15 units S/C of regular insulin is usually effective, with subsequent dose of 10-20 units SIC every 4- hours.
Potassium replacement- Less potassium replacement is required in hyperosmolar coma because there is no acidosis. However serum potassium may decline rapidly after giving insulin , its advised to add potassium chloride (10 meq/L) to initial bottle of saline if serum potassium is not elevated.
Heparin- Heparin As the thromboembolic complications are common in hyperosmolar coma; prophylactic S/C heparin is recommended.

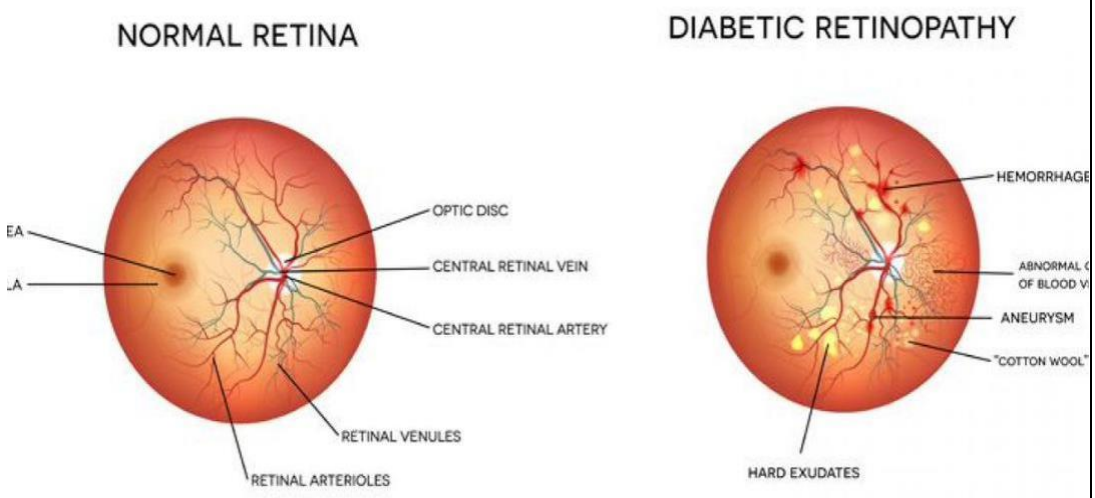
TERM	**DEFINITION**
LACTIC ACIDOSIS:	Lactic acidosis is a condition caused by the buildup of lactic acid in the body. It leads to acidification of the blood (acidosis), and is considered a distinct form of metabolic acidosis.
	The cells produce lactic acid when they use glucose for energy in the absence of adequate oxygen. If too much lactic acid stays in the body, the balance tips and the person begins to feel ill. The signs of lactic acidosis are deep and rapid breathing, vomiting, and abdominal pain. Lactic acidosis may be caused by diabetic ketoacidosis or liver or kidney disease, as well as some forms of medication (most notably the anti-diabetic drug metformin). Some anti-HIV drugs (antiretrovirals) warn doctors in their prescribing information to regularly watch for symptoms of lactic acidosis caused by mitochondrial toxicity.


Circulatory failure
Congestive heart failure
Respiratory insufficiency
Renal insufficiency
Metformin accumulation
Muscles
Liver
Hypoxia
Lactate
Cellular anoxia
Anaerobic glycolysis
Gluconeo-genesis
Hepatic hypoperfusion
Lactic acidosis


Diabetic kidney disease
Dyslipidaemia
↑ Lipogenesis
Altered lipid partitioning
↑ Lipid-mediated inflammation
Altered β-oxidation / FA metabolism
Diabetic retinopathy
↑ Circulating LDL-c
↓ Overall tissue lipid content
↓ Levels of large n-3 PUFAs
Increased but incomplete FA metabolism
↓ Lipid biosynthesis
Diabetic neuropathy
↑ Triacylglycer-ols
Dyslipidaemia
↑ FA oxidation enzymes
↓ Overall tissue lipid content
Decreased and incomplete FA metabolism
Upregulation in FA metabolism



TERM	DEFINITION
DIABETIC RETINOPATHY:	Diabetic retinopathy occurs with the duration of diabetes 10-20 years. Diabetes causes increased thickness of the basement membrane and increased permeability of the retinal capillaries. Aneurysmal dilation may occur in some vessels. Following are the changes occurring in retinopathy. Up to 20% patients with type 2 diabetes have retinopathy at the time of diagnosis of diabetes. Other ocular

	lesions frequently occur in diabetics are early development of cataract due to non-enzymatic glycosylation of lens protein, and development of glaucoma.
Background retinopathy characterized by:	• Dot haemorrhage: due to capillary micro aneurysms • Blot haemorrhage: due to leakage of blood into deeper layers of retina • Hard exudates: exudate rich in lipids and protein having bright yellow white colour Background retinopathy does not itself constitute a threat to vision but may progress to two other forms of retinopathy: • Maculopathy • Proliferative retinopathy
Diabetic maculopathy characterized by:	Hard exudates arranged in horse shoe or circular fashion around the central and lateral part of macula. This may cause loss of visual acuity by occluding central part of retina. Edema and ischemia of macula may also occur.
Proliferative retinopathy characterized by	• Cotton-wool spots (soft exudates): representing patches of retinal edema. • Neovascularization: New vessel formation lying superficially and growing forward into the vitreous. These vessels are fragile and rupture easily causing vitreous haemorrhage Ophthalmoscopy gives appearance of featureless grey haze. **Figure 1** 

Treatment

General measures
1.Control hypertension and avoid smoking. 2. Good glycaemic control. 3.Annual consultation with ophthalmologist should be arranged. Patients with macular edema, severe non- proliferative proliferative retinopathy require the care of ophthalmologist. 4. Ophthalmoscopy is essential in the following conditions: Long duration of DM Poor control Pregnancy Use of oral contraceptive. heavy smoking Neuropathy and nephropathy

TERM	DEFINITION
DIABETIC NEPHROPATHY :	Diabetic nephropathy is the most common cause of chronic renal failure. Patients with type 1 diabetes have a 30-40% chance of developing nephropathy after 20 years - in contrast to much less frequency in type 2 patients in whom 15-20% patients develop neuropathy. However, since there are many more individuals affected with type 2 diabetes, end-stage renal disease is much more prevalent in type 2 than in type 1.
RISK FACTORS FOR DEVELOPING DIABETIC NEPHROPATHY	• Poor control of blood glucose • Long duration of diabetes • Presence of other microvascular complications • Racial group (e.g. incidence high in Asian races, Pima Indians) • Pre-existing hypertension • Family history of diabetic nephropathy • Family history of hypertension
STAGES OF NEPHROPATHY	• Initially there is microalbuminura • Microalbuminura leads to progressive diabetic nephropathy manifesting as heavy presidia nephrotic syndrome) and renal failure with raised urea and creatinine.

Progressive diabetic nephropathy	• It manifests as nephrotic syndrome (heavy proteinuria, hyperalbuminemia, hyperlipidaemia, edema) and progressive renal insufficiency. In contrast to other renal disorders, the proteinuria associated with diabetic nephropathy does not diminish with progressive renal failure. Hypertension develops with progressive renal involvement, coronary and cerebrovascular atherosclerosis is accelerated.
Diabetic glomerulosclerosis	1. Primarily a result of rheumatic fever. 2. Infective endocarditis. 3. Systemic lupus erythematosus, rheumatoid arthritis. 4. Severe calcification of the mitral annulus. 5. The association of atrial septal defect with rheumatic mitral stenosis is called Lutembacher syndrome.
Diabetic glomerulosclerosis	Clinically nephropathy secondary to glomerular disease manifests 10-20 years after diagnosis. Structural abnormalities are the thickening of the glomerular basement membrane and disruption of protein cross-linkages that make the membrane as ineffective filter. As a result, a progressive loss of protein into the urine occurs starting from micro albuminuria and leading to frank proteinuria.
Infective lesions	**Infective lesions** in kidneys occur as an ascending infection due to bladder stasis that results from autonomic neuropathy.
Ischemic lesions	Characterized by hypertrophy and hyalinization of the afferent and efferent arterioles Infective lesions

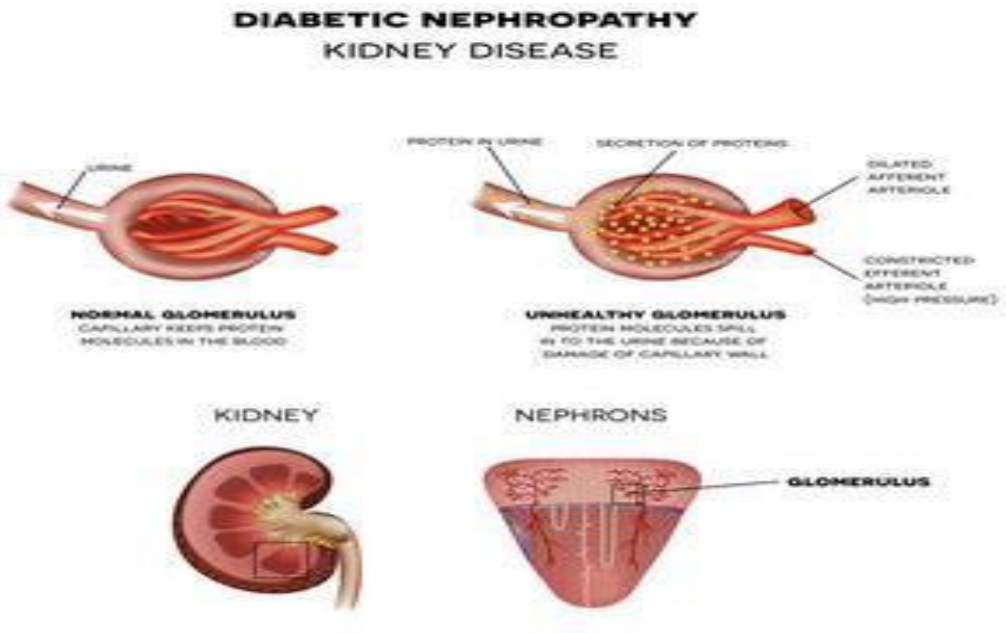


Figure 1

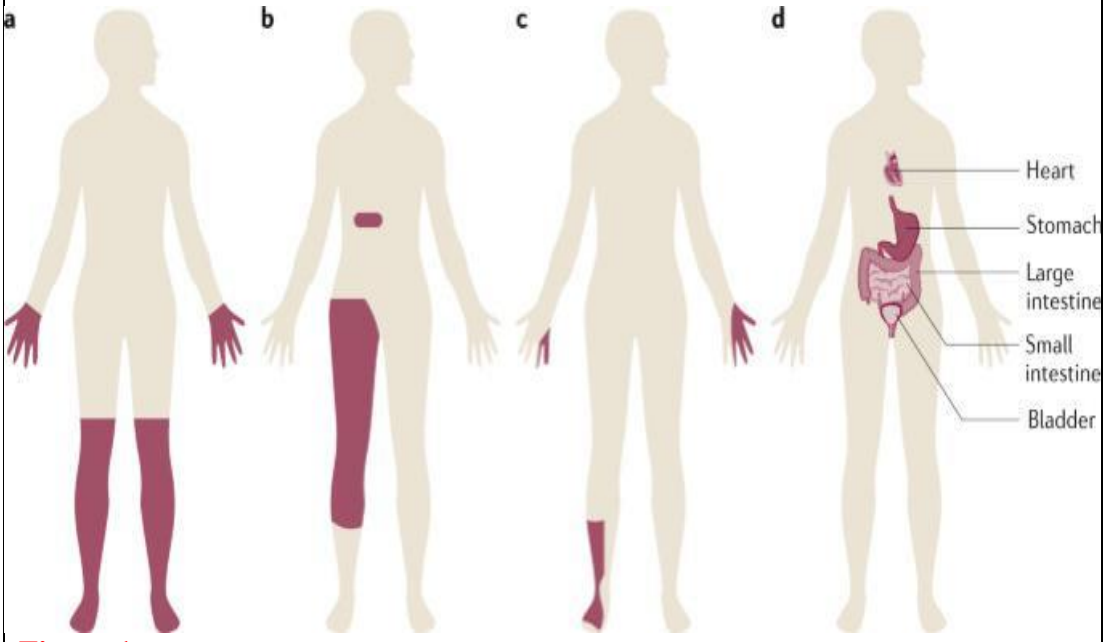
INVESTIGATIONS
• Urine D/R detects albumin • 24 hours urinary proteins and creatinine clearance. • Albumin - creatinine ratio in early morning spot urine. • Urine culture • Ultrasound kidney

Treatment

MEDICAL:
1. Low protein diet (0.8 g/kg/d): low protein diet causes decreased protein filtration and less nephrosclerosis.
2. Salt restriction if edema is present.

3. Energetic treatment of hypertension reduces the rate of disease progression. Target blood pressure is 140/90. ACE inhibitors are the drugs of first choice, because they control blood pressure as well as reduce proteinuria by reducing efferent arteriolar pressure of glomeruli.
4. Loop diuretics e.g. Furosemide in case of edema. The drugs which should be avoided: • Thiazide diuretics: They inhibit insulin secretion, therefore raise the blood glucose level in NIDDM. • Beta-blockers: They aggravate peripheral vascular disease and impotence.
5. Insulin sensitivity increases in renal failure (because insulin is inactivated by kidney; in case of renal failure insulin is not inactivated completely and continues glucose lowering effect. Therefore dosage of insulin should be reduced.
6. Oral hypoglycemic drugs should be avoided if renal impairment develops; especially metformin should not be used since the risk of lactic acidosis increases with impaired renal function. If oral hypoglycemic are used then select the drug that is excreted through or metabolized by the liver such as glipizide (Minitab) or gliclazide (Diamicron).
7. Dialysis required for end-stage renal disease, renal transplantation may improve the life., A segmental pancreatic graft transplantation performed at the same time as a renal transplantation may give the patient a year or so of freedom from insulin injection.

TERM	**DEFINITION**
DIABETIC NEUROPATHY:	Mechanism The hypothesis for mechanism of neuropathy are as follows: • Occlusion of the vasa nervosum OR

	• Hyperglycaemia leads to increase formation of sorbitol and fructose in Schwann cells, accumulation of these sugars may disrupt the nerve function (causing delayed nerve conduction velocity) and nerve structure (causing segmental demyelination).
TYPES OF NEUROPATHY	• Symmetrical sensory polyneuropathy • Asymmetrical motor neuropathy • Mononeuropathy • Autoimmune neuropathy
	 **Figure 1**

SYMMETRIC SENSORY POLYNEUROPATHY

SYMPTOMS AND SING	
• Paraesthesia in the feet hands • Dull pain in the lower limbs worse at night • Burning sensation in the sole • Sense of numbness in the feet	• Loss of tendon reflexes in the lower limbs • Diminished perception of vibration sensation in distal parts • Glove and stocking type impairment of other sensations • Loss of deep pain and temperature sensation in the feet • Cutaneous hyperesthesia , increased sensitiveness to pain) • Painless ulcers on the feet, painless distal arthroplasty characterized by disorganization of the joints (Charcot joints) (Sharkot joints)

ASYMMETRICAL MOTOR NEUROPATHY

SYMPTOMS AND SING

This is sometimes called diabetic amyotrophic.

- Presentation is severe and progressive weakness and wasting of proximal muscles of lower (and occasionally upper) limbs.
- It is commonly associated with severe pain, mainly felt on the anterior aspect of the leg
- Sometimes there is marked loss of weight (called neuropathic cachexia).
- Painful wasting is usually asymmetrical with extreme tenderness of the affected area.
- This condition is thought to involve acute infarction of lumbosacral plexus.
- There is loss of tendon reflexes on affected side.
- Sometimes there is extensor plantar response and CSF protein is raised.

MONONEUROPATHY

SYMPTOMS AND SING

Involvement of distribution of one nerve is called Mononeuropathy

- It may be motor (predominantly) or sensory involving peripheral or cranial nerve. Femoral and cranial nerves are commonly involved.
- Iinvolvement of 3rd and 6th nerve resulting in diplopia due to impaired ocular movements is Common.
- Carpal tunnel syndrome due to involvement of median nerve.
- Foot drop due to femoral, sciatic and lateral popliteal nerves involvement.
- Mononeuritis multiplex: When single nerve of different areas is involved at the same time, this is called Mononeuritis multiplex.

AUTONOMIC NEUROPATHY

SYMPTOMS AND SING

Cardiovascular

- Postural hypotension
- Resting tachycardia
- Fixed heart rate

Gastrointestinal

- Dysphagia, due to oesophageal atony
- Abdominal fullness, nausea and vomiting, unstable diabetes due to delayed gastric emptying (gastro paresis)
- Nocturnal diarrhoea and faecal incontinence
- Constipation due to colonic atony

Genitourinary

- Difficulty in micturition, urinary incontinence, recurrent infection, due to atonic bladder
- Impotence and retrograde ejaculation

Sudomotor

- Gustatory sweating
- Nocturnal sweats without hypoglycaemia

- Anhidrotic fissures in the feet

Vasomotor

- Feet feel cold, due to loss of skin vasomotor responses.

Pupillary

- Decreased pupil size
- Resistance to mydriatrics
- Delayed or absent response to light

TYPES OF DIABETIC NEUROPATHY		
Polyneuropathy	**Mononeuropathy**	**Autonomic neuropathy**
Symmetrical, mainly sensory and distal Asymmetrical, mainly motor and proximal.	Involvement of distribution of one nerve is called Mononeuropathy. When single nerve of different areas is involved at the same time, this is called Mononeuritis multiplex.	Cardiovascular Gastrointestinal Genitourinary Vasomotor pupillary

Treatment

Neuropathy Management

Painful neuropathy(pain and paraesthesia)

- Strict glycaemic control
- Tricyclic antidepressants e.g. imipramine, amitriptyline
- Anticonvulsants (gabapentin, carbamazepine
- Antiarrhythmic (mexiletine)

Postural hypotension

- Support stockings
- Fludrocortisone
- NSAIDs

Gastro paresis

- Metoclopramide, domperidone Erythromycinn

Diarrhoea

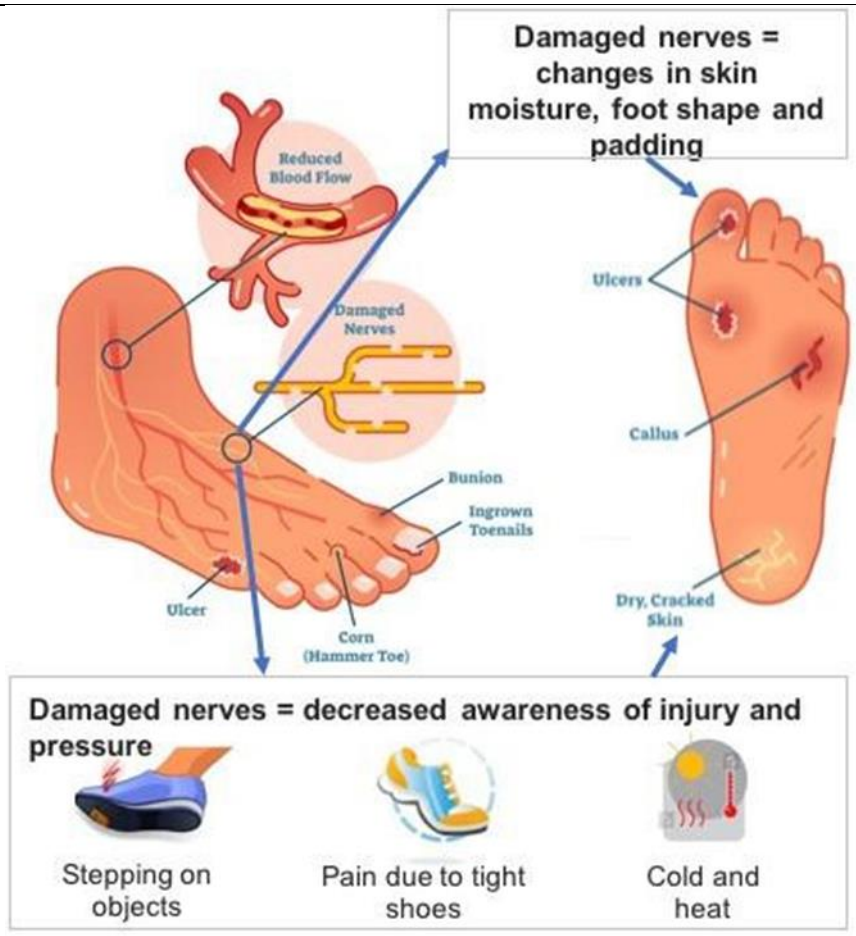
- Loperamide
- Octreotide

Constipation

- Laxatives

Atonic bladder • Intermittent self catheterization.

TERM	DEFINITION
DIABETIC FOOT:	There are three factors responsible for tissue necrosis in the feet of diabetic patients:
RISK FACTORS	1. Neuropathy: Necrosis occurs due to prolonged pressure. Patient does not feel pain due to sensory neuropathy, therefore if he/she gets injury, there is no feeling of pain resulting in negligence of wound care. This leads to tissue necrosis. 2. Ischemia: Ischemia occurs due to shunting of blood via peripheral arterio-venous anastomosis occurring in neuropathic feet, thereby reducing blood flow in the smallest vessels. Therefore there is reduced blood supply to the most peripheral tissues even when the circulation is apparently good. 3. Infection: Diabetic patient is more prone to have skin infection and there is decreased ability of wound healing which leads to necrosis,



Treatment

Management
• Patient education to keep feet as clean as face. Avoid smoking and should not cut their own toe nails. • Once the ulceration or gangrene has occurred, the aim is preservation of viable tissue. There are two main threats; infection and ischemia.
Infection: • Early effective antibiotics. • Drain if there is collection of pus • Regular foot X-rays to see bone involvemen

Ischemia:

- Assess the blood flow to the feet clinically or with Doppler ultrasound.
- Cholesterol-lowering drugs are useful as adjunctive therapy when Carly signs of ischemia are detected.
- When chronic foot ulcers are refractory to standard debridement and antibiotics, platelet-derived growth factor should be considered for local application.
- Non-selective beta-blockers are relatively contraindicated in patients with ischemic foot ulcers; these drugs may reduce peripheral blood flow.

Indications of amputation

- Uncontrolled infection
- Osteomyelitis
- Extensive tissue destruction

MANAGEMENT OF DIABETIC FOOT ULCERS

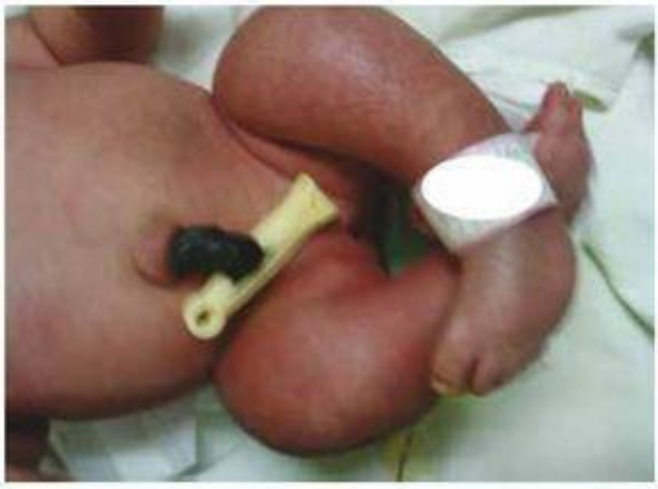
- Remove callous skin
- Treat infection
- Avoid weight-bearing
- Ensure good diabetic control
- Control oedema
- Undertake angiogram to assess feasibility of vascular reconstruction in some cases

Diabetic foot: practice points

- Prevention is the most effective way of dealing with the problem of tissue necrosis in the diabetic foot
- A specialist chiropodist (podiatrist) is an integral part of the diabetes team to ensure regular and effective chiropody and to educate patients in care of the feet.

DEFINITION, ETIOLOGY AND PATHOGENESIS	
TERM	DEFINITION
DIEBETES MELLITUS COMPLICATION IN PREGNANT WOMEN	Diabetes mellitus is the most common medical complication of pregnancy. Gestational diabetes mellitus (GDM) represents approximately 90% of these cases and affects 2–5% of all pregnancies and varies in direct proportion to type 2 diabetes mellitus in the background population.[1] Pre-existing diabetes mellitus complicates 0.2% to 0.3% of pregnancies.[2] The importance of diabetes in pregnancy stems from the fact that it carries a significant risk to both the foetus and the mother. Despite major advances in clinical management, we are still facing a higher incidence of malformations and perinatal morbidity compared to the non-diabetic population.
Normal Glucose Regulation	Metabolic changes occur in normal pregnancy in response to the increase in nutrient needs of the foetus and the mother. There are two main changes which are seen during pregnancy, progressive insulin resistance that begins near mid-

during Pregnancy*:*	pregnancy and progresses through the third trimester to the level that approximates the insulin resistance seen in individuals with type 2 diabetes mellitus. The insulin resistance appears to result from a combination of increased maternal adiposity and the placental secretion of hormones (progesterone, cortisol, placental lactogen, prolactin and growth hormone). The fact that insulin resistance rapidly abates following delivery suggests that the major contributors to this state of resistance are placental hormones. The second change is the compensatory increase in insulin secretion by the pancreatic beta-cells to overcome the insulin resistance of pregnancy. As a result, circulating glucose levels are kept within normal. If there is maternal defect in insulin secretion and in glucose utilisation, then GDM will occur as the diabetogenic hormones rise to their peak levels.
Risks to the Fetus & the Neonate	If the mother has hyperglycaemia, the fetus will be exposed to either sustained hyperglycaemia or intermittent pulses of hyperglycaemia; both situations prematurely stimulate foetal insulin secretion.

Fetal complications in diabetic pregnancy	
• **Congenital anomalies: cardio-vascular central nervous system, skeletal (sacral agenesis), and genito-urinary**	
• **Excessive fetal growth (macrosomia)**	

	
• **Fetal growth retardation (in diabetic pregnancy complicated by nephropathy)**	

Neonatal complications in diabetic pregnancy	
• **Traumatic delivery**	Fetal hyperinsulinaemia may cause increased foetal body fat (macrosomia) resulting in difficult delivery. It may also cause inhibition of pulmonary maturation of surfactant resulting in respiratory distress of the neonate. The fetus may also have decreased potassium level caused by elevated insulin and glucose levels, and may therefore have cardiac arrhythmia. Foetal organogenesis is completed by seven weeks post-conception and there is an increased prevalence of congenital anomalies and spontaneous abortions in diabetic women with poor glycaemic control during this period. Because a woman may not even know she is pregnant at this time, it is imperative that pre-pregnancy counselling and planning occur in women of child-bearing age who have diabetes. It seems that post-prandial glucose levels are the most important determining factor on the subsequent risk of neonatal macrosomia. Pregnancy in patients with diabetes is associated with a six-fold increase in perinatal mortality and a twofold increase in the rate of major congenital malformations and an eight fold increase in preterm delivery compared to the general population. There is also an increase in neonatal hypoglycaemia which may cause permanent neurologic damage, hyperbilirubinaemia, respiratory distress and stillbirth. The associated increase of congenital anomalies for the foetus and spontaneous abortion in women with poor glycaemic control appears to be related to maternal glycaemic control rather than to the mode of anti-diabetic therapy during early pregnancy.
• **Pulmonary surfactant deficiency**	
• **Hypoglycaemia**	
• **Polycythaemia**	
• **Hypocalcaemia**	
• **Hypomagnesaemia**	

• **Hyperbilirubinaemia**	The normalisation of maternal glucose before and throughout pregnancy can decrease pregnancy-related complications to those seen in non-diabetic pregnancies. Studies from many centres have shown that the higher the levels of glycosylated haemoglobin [HbA1c] in early pregnancy, the greater the incidence of anomalies and the higher the perinatal mortality.

RISK TO MOTHER	
Maternal complications in diabetic pregnancy	
Diabetic keto-acidosis	Maternal diabetes complications are frequent in women with both type 1 and type 2 diabetes. Diabetic retinopathy and diabetic nephropathy may progress or start de novo during the pregnancy. Pre-eclampsia occurs in both type 1 and type 2 diabetes mellitus and is high as it affects approximately 20% of cases. Other complications including polyhydramnios and worsening of chronic hypertension are not uncommon.
Hypoglycaemia	
Visual deterioration/retinopathy	
Deterioration of nephropathy	
Vomiting (gastric neuropathy)	
Miscarriages	
Pre-eclampsia	
Polyhydramnios	
Premature delivery	

Contraception for diabetic women	All forms of contraception carry some risk and every woman must be considered individually. The combined oral contraceptive pill is effective if taken reliably, however, the first generation, high dose oestrogen pills should be avoided as they may increase insulin requirement and increase the risk of vascular disease. The second and third generation pills have a much lower dose of oestrogen and can probably be used safely in the majority of women with diabetes. The progesterone-only pill is reliable if taken regularly but omission may be more likely to result in pregnancy than with the combined pill. Injectable progestogens/implants are suitable for some patients. Intra-uterine contraceptive devices have the advantage of the lack of detrimental metabolic effect and

	the need for compliance; however, its failure rate is high. Other methods of contraception such as mechanical contraception can also be used in diabetic patients. Emergency contraception is safe for diabetic women and should be prescribed if needed.
Optimise glycaemic control	In preparation for pregnancy, oral hypoglycaemic agents should be discontinued and insulin started if needed, statins and ACE-inhibitors should also be discontinued. Hypertension should be controlled with safer drugs like Methyldopa, Nifedipine or Labetalol. Diabetic complications should be assessed and treated. Regular self-monitoring should be encouraged to optimise control. Folic Acid should be started at least four weeks pre-conception. Glycaemic control should be optimised with the aim of pre-prandial blood glucose < 5.5 mmol/l (<95mg/dl) and HbA1c < 7%.
Diabetes ante-natal care	this should be provided in a special clinic and the team caring for pregnant women should ideally include a Diabetes Nurse Specialist, Dietician, Diabetologist and an Obstetrician. The aim of ante-natal care is to maintain tight glycaemic control and to monitor the mother for diabetes complications. Tighter glycaemic control has an impact on maternal and foetal complications, therefore, excellent glycaemic control should be continued throughout pregnancy, fasting blood glucose should be kept < 5.5 mmol/l (<95mg/dl), post-prandial glucose < 7.8 mmol/l (<140 mg/dl) and HbA1c < 7%. Tighter glycaemic control may lead to an increase in episodes of severe hypoglycaemia and worsening of hypoglycaemia unawareness. The patient should be aware of subtle signs of hypoglycaemia, and the patient's family should be taught the proper treatment of severe hypoglycaemia (i.e. Glucagon).
Glucose monitoring	Home blood glucose monitoring is an essential part of maintaining euglycaemic state and its goal is to detect glucose concentration to allow fine-tuning of insulin adjustment. Pre-prandial glucose level < 5.5 mmol/l (<95mg/dl), and postprandial level glucose <7.8 mmol/ l (<140mg/dl). Post-prandial glucose levels have been shown to correlate more with macrosomia than do fasting levels. Diabetes in early pregnancy studies found that third trimester post-

	prandial glucose levels were the strongest predictors of percentile birth weight.
Dietary advice	The goal of diet in pregnancy is to provide adequate nutrition for the mother and the foetus, provide sufficient calories for appropriate maternal weight gain, maintain normal glycaemia and avoid ketosis. Eating three small to moderate size meals and three snacks per day is appropriate. Monitoring with a pre-breakfast ketone measurement is recommended for patients who are on a hypo-caloric or carbohydrate restricted diet.
Insulin Therapy	Insulin regimes should be individualised but in type 1 patients multiple injection/basal bolus regime of human insulin is preferable and in type 2, twice-daily injections may be appropriate. The aim is to achieve blood glucose as near normal as possible without excessive risk of hypoglycaemia.
Hypoglycemia	hypoglycaemia is common in pregnancy, particularly in the first trimester. Education of patients and their families in the recognition and management of hypoglycaemia is vital. A Glucagon kit should be provided early in pregnancy.
Ketoacidosis	Ketoacidosis is a preventable condition but potentially lethal to the foetus at any stage of pregnancy. Women should be instructed to test their urine for ketones if their blood glucose readings are high or if they feel unwell.
Retinopathy	Diabetic retinopathy may accelerate during pregnancy.[13] Fundoscopy is necessary before conception and once in each trimester of pregnancy for all women with diabetes.
Nephropathy:	Baseline assessment of renal function by serum creatinine and some measure of urinary protein excretion (urine albumin/creatinine ratio or 24-hour albumin excretion) should be undertaken before conception. Women with microalbuminuria may experience transient worsening during pregnancy; however, those with established nephropathy with overt proteinuria are at increased risk of pre-eclampsia and intra-uterine growth retardation and premature delivery. Pregnancy may lead to permanent worsening of renal function in more than 40% of those with serum creatinine of 250 umol/l or greater

	or creatinine clearance <50ml/minute and therefore it should serve as a contraindication to pregnancy. However, at that level of impaired renal function fertility is reduced and pregnancy is rare. ACE-inhibitors for treatment of microalbuminuria should be discontinued in women who are attempting to become pregnant.
Hypertension:	Hypertension is a frequent concomitant of diabetes. Patients with type 1 diabetes frequently develop hypertension in association with diabetic nephropathy, as manifested by the presence of overt proteinuria. Patients with type 2 diabetes more commonly have hypertension as a concomitant disease. In addition, pregnancy induced hypertension is a potential problem for women with diabetes. Hypertension contributes to worsening of diabetic nephropathy and retinopathy in pregnancy. ACE-inhibitors, beta-blockers and diuretics should be avoided in women contemplating pregnancy if they are being used for hypertension. Methyl-Dopa or Labetalol may be substituted.
Neuropathy:	Compartment syndromes such as carpal tunnel syndrome may be exacerbated by pregnancy and should be treated symptomatically with splints. Autonomic neuropathy particularly manifested by gastroparesis, hypoglycaemia unawareness, or orthostatic hypertension may complicate the management of diabetes in pregnancy. These complications should be identified, appropriately evaluated and treated before conception.
Cardiovascular disease:	Untreated coronary artery disease is associated with a high mortality rate during pregnancy and women with significant coronary artery disease should be advised against pregnancy.
Timing of delivery:	Uncomplicated case with no evidence of foetal compromise, spontaneous delivery at term is standard practice. When there are maternal complications of diabetes, complications of pregnancy, previous stillbirth or evidence of abnormal foetal growth, each case must be considered in its own merit with timely delivery in hospital. Delivery by elective Caesarean section should

	be considered if the ultrasound estimated foetal weight is > 4kg. A previous Caesarean section in a diabetic woman will usually be managed by a repeat Caesarean section. In the absence of these or other obstetric contra-indications a spontaneous vaginal delivery should be possible, with induction of labour as required. If delivery is indicated before 36 weeks then administration of a steroid to the mother for 48 hours prior to delivery should be undertaken. Steroids will upset glycaemic control and should only be given on an inpatient basis with careful monitoring of the glucose level and appropriate alteration of the insulin regime.

Management of labour and delivery:	
Glucose control during labour	It is necessary to administer IV insulin and Dextrose to prevent ketoacidosis and to maintain the blood glucose as near normal as possible. The insulin requirements after delivery should return to about the pre-pregnancy level. Labour and delivery of women with diabetes should be undertaken in units where there is neonatal care.
Neonatal problems	This would include hypoglycaemia, polycythaemia, respiratory distress syndrome, jaundice, hypocalcaemia and hypomagnesemia. Routine blood glucose monitoring of the baby should be performed for the first 12 hours.
Post-natal care	Insulin requirements fall dramatically at the time of delivery and insulin dose should be reduced to around the pre-pregnancy level. Breastfeeding also reduces insulin requirements and appropriate reduction should therefore be made once feeding is established. It is usually possible to stop insulin in women with GDM and in women with type 2 diabetes mellitus who do not intend to breastfeed. Contraception should be discussed whil the patient is in hospital.

GESTATIONAL DIABETES MELLITUS
GDM is defined as a glucose intolerance that begins or is first detected during pregnancy. Differences in screening programmes and diagnostic criteria make it difficult to compare frequencies of GDM among various populations. Nevertheless, ethnicity has been proven to be an independent risk factor for GDM, which varies in prevalence in direct proportion to the prevalence of Type 2 diabetes in a given population or ethnic group. The prevalence may range from 1–14% of all pregnancies, depending on the population sample, with 2–5% being the most common rate. GDM develops when a woman is unable to secrete sufficient insulin to compensate for the increased insulin resistance during pregnancy. The foetus responds to hyperglycaemia by secreting large quantities of insulin. The result is increasing adiposity and the accrual of visceral fat. Women who develop GDM are at increased risk for type 2 diabetes mellitus. The screening and diagnostic methods for GDM remain controversial, especially the threshold values for the diagnosis.

MATERNAL RISK FACTORS FOR GESTATIONAL DIABETES	Obesity
	Diabetes in first-degree relative
	Previous infant with macrosomia
	Previous diagnosis of GDM
	Age more than 35 years
	Polycystic ovary syndrome
	Multiparity
	Member of high risk population (e.g. Asian or African descent)

Reclassification of glucose tolerance status post-partum 75-g oral glucose tolerance test

	Fasting Plasma Glucose	**2-hour OGTT**
Normal	6.1 mmol/1 [<110mg/dl]	< 7.8mmol/l [140mg/dl]
Impaired	5.6-6.9mmol/1 [100-125mg/dl] Impaired fasting glucose	7.8-11mmol/l [140-199mg/dl] Impaired glucose tolerance
Diabetes	>7mmol/l [126mg/dl]	> 11.1mmol/l [200mg/dl]

TESTS FOR CHECKING THE FINAL LEVEL OF KNOWLEDGE

1.Which of the following is an example of high anion gap acidosis?
a. Renal tubular acidosis
b. Diarrhea
c. Ureterosigmoidostomy
d. Diabetic Ketoacidosis
2. An obese patient presented in casualty with random blood sugar 400 mg%, urine sugar +++ and ketones j 1+.Druguseful in management will be:
a. Glibenclamide
b. Troglitazsone
c. Insulin
d. Metformin
3. Retinopathy is most likely to be seen with:
a. IDDM of 5 years duration
b. NIDDM of 8 years duration
c. Gestational diabetes
d. Juvenile diabetes started before puberty
4. Hypoglycemic unawareness is because of:
a. Shifting of oral hypoglycemics to insulin
b. Insulin resistance
c. Autonomic neuropathy
d. Necrobiosis lipoidica
5.What is correct indiabetic ketoacidosis?
a. Low serum potassium
b. Increased anion gap
c. Metabolic alkalosis
d. Respiratory acidosis
6.Dose of insulinindiabetic nephropathy:
a. Insulin dose should be increased in patient with ESRD
b. Insulin dose should be decreased in patients with ESRD
c. Insulin does not need change in ESRD
d. Add inhaled insulin to conventional administration
7.The most effective correction of acidosis in diabetic ketoacidosis is by:
a. l.V.bicarbonate
b. I.V. saline
c. I.V. insulin
d. Oral bicarbonate
8.Diabetes mellitus patient presents with HbAlC of 9.6%.All improve with tight glycemic control except:
a. Neuropathy
b. Nephropathy
c. Retinopathy
d. Peripheral vascular disease
9.The characteristic and common presentation of I diabetic neuropathy is:
a. Amyotrophy

b. Mononeuropathy
c. Symmetrical sensory neuropathy
d. Autonomic neuropathy
10. Hypoglycemia is seen in
a. Acromegaly
b. Cushing'ssyndrome
c. Hyperthyroidism
d. Hypopituotarism

Answers for TESTS:

№	Answers for TESTS
1	d)
2	c)
3	a)
4	c)
5	b)
6	b)
7	c)
8	c)
9	d)
10	d)

1. **A 30-year-old man with type 1 diabetes presents to the emergency department (ED). His blood pressure (BP) is 100/70 mm Hg and heart rate (HR) is 140 beats per minute. His blood glucose is 750 mg/dL, potassium level is 5.9 mEq/L, bicarbonate is 5 mEq/L, and arterial pH 7.1. His urine is positive for ketones. Which of the following is the best initial therapy for this patient?**

a. Give normal saline as a 2-L bolus; then administer 20 units of regular insulin subcutaneously.

b. Bolus 2 ampules of bicarbonate and administer 10 units of insulin intravenously.

c. Give him 5 mg of metoprolol to slow down his heart, start intravenous (IV) hydration, and then give 10 units of regular insulin intravenously.

d. Give normal saline in 2 L bolus and then administer 10 units of insulin intravenously followed by an insulin drip and continued hydration.

e. Give normal saline in 2 L bolus with 20 mEq/L potassium chloride (KCl) in each bag.

2. **A 74-year-old woman who is a known diabetic is brought to the ED by emergency medical service (EMS) with altered mental status. The home health aide states that the patient ran out of her medications 4 days ago. Her BP is 130/85 mm Hg, HR is 110 beats per minute, temperature is 99.8°F, and RR is 18 breaths per minute. On examination, she cannot fol low commands but responds to stimuli. Laboratory results reveal white blood cell (WBC) count of**

14,000/L, hematocrit 49%, platelets 325/L, sodium 128 mEq/L, potassium 3.0 mEq/L, chloride 95 mEq/L, bicarbon ate 22 mEq/L, blood urea nitrogen (BUN) 40 mg/dL, creatinine 1.8 mg/dL, and glucose 850 mg/dL. Urinalysis shows 3+ glucose, 1+ protein, and no blood or ketones. After addressing the ABCs, which of the following is the most appropriate next step in management?

a. Begin fluid resuscitation with a 2- to 3-L bolus of normal saline; then administer 10 units of regular insulin intravenously.

b. Begin fluid resuscitation with a 2- to 3-L bolus of normal saline; then administer 10 units of regular insulin intravenously and begin phenytoin for seizure pro phylaxis.

c. Administer 10 units of regular insulin intravenously; then begin fluid resuscita tion with a 2- to 3-L bolus of normal saline.

d. Order a computed tomographic (CT) scan of the brain; if negative for acute stroke, begin fluid resuscitation with a 2- to 3-L bolus of normal saline. e. Arrange for urgent hemodialysis.

3. **A 21-year-old man presents to the ED. He has a known history of type 1 diabetes. He is hypotensive with BP of 95/65 mm Hg, tachycardic at 120 beats per minute, and tachypneic at 30 breaths per minute. Laboratory results reveal a WBC 20,000/µL, hematocrit 45%, platelets 225/µL, sodium 131 mEq/L, potassium 5.3 mEq/L, chloride 95 mEq/L, bicarbonate 5 mEq/L, BUN 20 mg/dL, creatinine 0.9 mg/dL, and glucose 425 mg/dL. Arterial blood gas reveals a pH of 7.2. Urinalysis reveals glucosuria and ketosis. There is a fruity odor to his breath. Which of the following provides the strongest evidence for the diagnosis?**

a. Hypotension, tachycardia, and tachypnea b. Glucose of 425 mg/dL, ketosis, and leukocytosis

c. Glucose of 425 mg/dL, ketosis, pH 7.2, and bicarbonate of 5 mEq/L

d. Glucose of 425 mg/dL, hypotension, and fruity odor to breath

e. Glucosuria, hypotension, and leukocytosis

4. **A 16-year-old boy is brought to the emergency department because of confusion, fatigue and abdominal pain. He has also experienced excessive thirst and polyuria during the last 3 weeks. His past medical history is insignificant. Famil history is unremarkable. Urine dipstick is positive for glucose and ketones. Which of the following factors most likely contributed to the development of this patients condition?**
    a. Abdominal fat distribution
    b. Excessive body weight
    c. Islet amyloid deposition
    d. Islet leukocytic infiltration

5. **A 20-year-old woman comes to the emergency department with lethargy, abdominal pain and nausea. She has had polyuria and excessive thirst for one day. She also complains of dysuria and chills over the last few days but did not seek medical care**

until today. Physical examination shows tachycardia and dry mucous membranes. Laboratory results are as follows:

Serum chemistry panel

Sodium	130 mEq/l
Chloride	93 mEq/l
Bicarbonate	12 mEq/l
Blood urea nitrogen	30 mEq/l
Creatinine	1.3 mg/dL
Calcium	10.0 mg/dL
Glucose	698 mg/dL

Which of the following electrolyte findings would mostly likely be seen in this patient?

	Extracellular K+ concentration	Intracellular K+ stores
A.	Decreased	Decreased
B.	Decreased	Increased
C.	Increased	Decreased
D.	Increased	Increased

№	Answers for TESTS
1	d)
2	a)
3	c)
4	d)
5	c)

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