

Essentials of Diagnosis, Treatment and Prevention of Major Endocrine Diseases: Diabetes Mellitus – 1/2017

LECTURE IN INTERNAL MEDICINE FOR IV COURSE STUDENTS

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Preamble

Internal Medicine Department on Internet: University WEB-portal

The screenshot shows a web browser window with the URL im.medicine.karazin.ua. The browser's address bar and tabs are visible at the top. The website's navigation menu includes: Home, Educational work, Scientific work, Clinical work, Our journal, and About the Department.

Welcome!

Dear visitor, present and future partner, we welcome you!

On our website you will find our recent publications, scientific, educational and clinical presentations. Here we also provide information about other forms of activity of our friendly and ambitious team. We hope that this information will be useful for your everyday creative work. We thank you for visiting our website, and if you have any questions and/or suggestions please do not hesitate to contact us via email immedi@karazin.ua

*The Department of Internal Medicine
V. N. Karazin Kharkiv National University*

Our journal

Issue 32

News / Новини / Новости

- Наш журнал
- Наш журнал
- Our journal
- Статті
- Статьи
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- Тези
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- Abstracts

Medical Education

- Ministry of Health of Ukraine
- Ministry of Education and Science of Ukraine
- School of Medicine of V. N. Karazin KhNU
- Kharkiv Medical Academy of Postgraduate Education

Usefull resources

- Department of Internal Medicine in Facebook
- Non-stop HRV, biofeedback and chronotherapy congress
- Meteosensitivity and Meteopathy Website
- Website about health and disease
- Medical Tube

Follow & like us

At the bottom of the page, there are social media icons for Facebook, Twitter, and YouTube. The Windows taskbar is visible at the very bottom, showing the time as 20:20 on 29.08.2017.

Internal Medicine Department on Internet: Facebook

The image shows a screenshot of a Facebook group page titled "HRV & BFB & CHRONOTHERAPY". The browser's address bar shows the URL "https://www.facebook.com/groups/BiofeedbackKhNU/". The page features a blue header with the group name and a search bar. Below the header is a large banner image with a blue brain and a red heart, overlaid with the text "NON-STOP HRV & BIOFEEDBACK & CHRONOTHERAPY CONGRESS". The left sidebar contains navigation options like "Дискусія", "Учасники", and "Події". The main content area shows a post by "Mykola Iabluchanskyi" with a sun icon and the text "Доспехи метеолата". The right sidebar lists "РЕКОМЕНДОВАНІ ІГРИ" and "РЕКОМЕНДОВАНІ УЧАСНИКИ". The bottom of the image shows the Windows taskbar with various application icons and the system tray displaying the date "29.08.2017" and time "20:19".

Internal Medicine Department on Internet: Facebook

The screenshot displays the Facebook profile of the Internal Medicine Department of V.N. Karazin KhNU. The page is viewed in a browser window with multiple tabs open, including 'Internal Medicine D...'. The main header shows the department's name and a search bar. Below the header is a large group photo of the department members, with a caption indicating '77 словічень від Андрій Кудря та Хамада Амран'. The page is divided into several sections: a left sidebar with navigation options like 'УЛЮБЛЕНІ' and 'ГРУПИ'; a main content area with tabs for 'Дискусія', 'Учасники', 'Події', and 'Світлини'; and a right sidebar with 'ВАШІ ІГРИ' and 'РЕКОМЕНДОВАНІ ІГРИ'. The 'Учасники' section shows a list of members, including Boris Tsarbaev, Alexandr Koliada, and others. The 'ОПИС' section contains a welcome message: 'Dear visitor, present and possible future partner, we are welcome...'. The bottom of the page shows the Windows taskbar with various application icons and the system clock displaying 16:05 on 04.09.2016.

Supportive module 1: “Essentials of diagnosis, treatment and prevention of major endocrine diseases”

1.	Diabetes. The current classification, etiology, symptoms, diagnosis. Current question of angio-and neuropathy	2	06/09
2.	New methods of treatment for patients with diabetes. Oral hypoglycemic agents, modern insulin and its analogues.	2	13/09
3.	Diseases of the thyroid gland. Goiter: diagnosis, differential diagnosis, prevention and treatment.	2	20/09
4.	Diseases of the adrenal glands. Chronic adrenal insufficiency. Hormonally active tumors.	2	27/09
5.	Diseases of the hypothalamic-pituitary system. Its part in correction of the functional activity of the endocrine glands.	2	04/10

TEST - 1

A 62-year-old female with a history of type II diabetes presents to her primary care physician for an annual check-up. Her long-term medications include glyburide, metoprolol, and sertraline. She is afebrile. Blood pressure is 140/90 mmHg, pulse is 82/min, and respiratory rate is 16/min. Fasting glucose is recorded as 160 mg/dL. Serum cholesterol is 150 mg/dL and serum creatinine is 0.9 mg/dL. BMI is 31 kg/m². On physical exam, erythema is present at the fifth metatarsal-phalangeal joint of the right foot and the patient has decreased sensation over the affected area.

TEST - 2

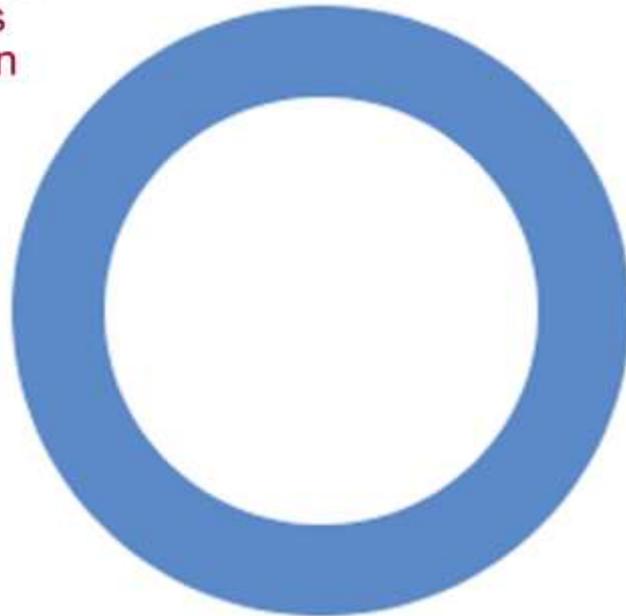
Which of the following would most likely decrease the incidence of future neuropathy in this patient?

1. Add atorvastatin
2. Add hydrochlorothiazide
3. Right-sided femoral-popliteal bypass
4. Tight glycemic control
5. Discontinue sertraline

TEST - 3

- 1. Add atorvastatin 2% (3/146)
- 2. Add hydrochlorothiazide 0% (0/146)
- 3. Right-sided femoral-popliteal bypass 1% (1/146)
- 4. Tight glycemic control 96% (140/146)
- 5. Discontinue sertraline 1% (1/146)

Plan of the Lecture



- Definition
- Epidemiology
- Mechanisms
- Classification
- Clinical presentation
- Diagnosis
- Treatment
- Prognosis
- Prophylaxis
- Abbreviations
- Diagnostic guidelines

Definition 1

Diabetes mellitus (DM) or diabetes is a group of a chronic, often debilitating and sometimes fatal, incurable, costly, and increasing but largely preventable non-communicable metabolic diseases that causes high blood sugar (glucose) levels when the body is unable to produce or/and effectively use insulin with unique multisystem complications of microvascular endpoints, including retinopathy, nephropathy, neuropathy, and macrovascular endpoints in forms of ischaemic heart disease, stroke and peripheral vascular disease).

Definition 2

There are 3 main types of DM:

- Type 1 (insulin-dependent DM or juvenile DM) results from the pancreas's failure to produce enough insulin,
- Type 2 (non insulin-dependent DM or adult-onset DM) begins with insulin resistance, when body cells fail to respond to insulin properly,
- Gestational occurs when pregnant women without a previous history of DM develop high blood-sugar levels.

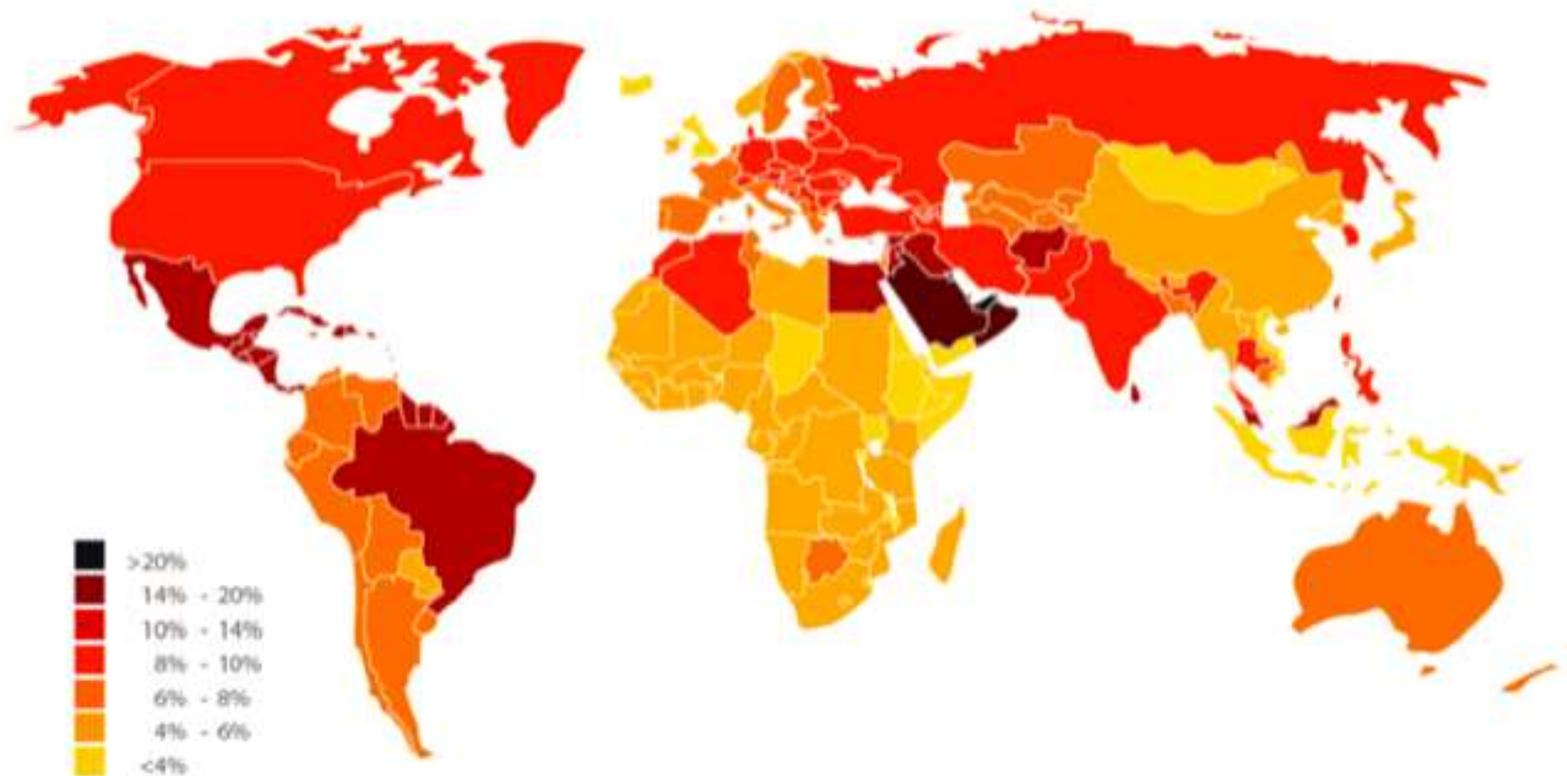
Epidemiology 1

- DM is one of the most common endocrine disorders affecting almost 6% of the world's population.
- The number of patients will reach 300 million in 2025 (International Diabetes Federation, 2001).
- More than 97% of these patients will have type II DM.

Epidemiology 2

Prevalence estimates of diabetes, 2025

>300 million diabetics worldwide



Risk Factors 1

Type 1 DM

- Family history
- Environmental factors (exposure to a viral illness)
- The presence of damaging immune system cells (autoantibodies)
- Dietary factors (low vitamin D consumption, early exposure to cow's milk formula, and exposure to cereals before 4 months of age)
- Geography (Finland, Sweden, etc.).

Risk Factors 2

Type 2 DM

- Family history
- Race (Blacks, Hispanics, American Indians, Asian-Americans)
- Age (risk increases with age)
- Gestational diabetes
- Polycystic ovary syndrome (women)
- High blood pressure
- Abnormal cholesterol and triglyceride levels.

Risk Factors 3

Gestational DM

- Family or personal history
- Race (Black, Hispanic, American Indian or Asian are more likely to develop gestational diabetes)
- Age (women older 25 are at increased risk)
- Weight (being overweight before pregnancy increases risk).

Etiology

Type 1 DM: 1

- Type 1 DM is characterized by loss of the insulin-producing beta cells of the islets of Langerhans in the pancreas, leading to insulin deficiency
- The majority of type 1 DM is of the immune-mediated nature, in which a T-cell-mediated autoimmune attack leads to the loss of beta cells and thus insulin

Etiology

Type 1 DM: 2

- Sensitivity and responsiveness to insulin are usually normal, especially in the early stages
- Type 1 DM can affect children or adults, but was traditionally termed "juvenile diabetes" because a majority of these diabetes cases were in children

Etiology

Type 1 DM: 3

- Type 1 DM can be accompanied by irregular and unpredictable high blood sugar levels, frequently with ketosis, and sometimes with serious low blood sugar levels
- Type 1 DM is partly inherited, with multiple genes, including certain HLA genotypes, and can be triggered by one or more environmental factors, such as a viral infection or diet (gliadin (a protein present in gluten)).

Etiology

Type 2 DM: 1

- Type 2 DM is characterized by insulin resistance, which may be combined with relatively reduced insulin secretion.
- The defective responsiveness of body tissues to insulin is believed to involve the insulin receptor.

Etiology

Type 2 DM: 2

- In the early stage of type 2, the predominant abnormality is reduced insulin sensitivity.
- Type 2 DM is due primarily to lifestyle factors and genetics (obesity, lack of physical activity, poor diet, stress, urbanization)
- Dietary factors also influence the risk of developing type 2 DM (sugar-sweetened drinks, saturated fats, trans fatty acids, white rice).

Etiology

Gestational DM: 1

- Gestational diabetes mellitus (GDM) resembles type 2 DM in several respects, involving a combination of relatively inadequate insulin secretion and responsiveness and occurs in 2–10% of all pregnancies)

Etiology

Gestational DM: 2

- After pregnancy approximately 5–10% of women with gestational DM found to have most commonly type 2 DM
- Gestational DM is fully treatable, but requires careful medical supervision throughout the pregnancy

Etiology

Gestational DM: 3

- Gestational DM can damage the health of the fetus or mother, and risks to the baby include macrosomia (high birth weight), congenital heart and central nervous system abnormalities, skeletal muscle malformations, respiratory distress syndrome, and red blood cell destruction.

Mechanisms

Type 1 DM: 1

- Type 1 DM is the culmination of autoimmune inflammatory lymphocytic infiltration with destruction of insulin-secreting beta cells of the islets of Langerhans in the pancreas
- As beta-cell mass declines, insulin secretion decreases until the available insulin no longer is adequate to maintain normal blood glucose levels type 1 DM.

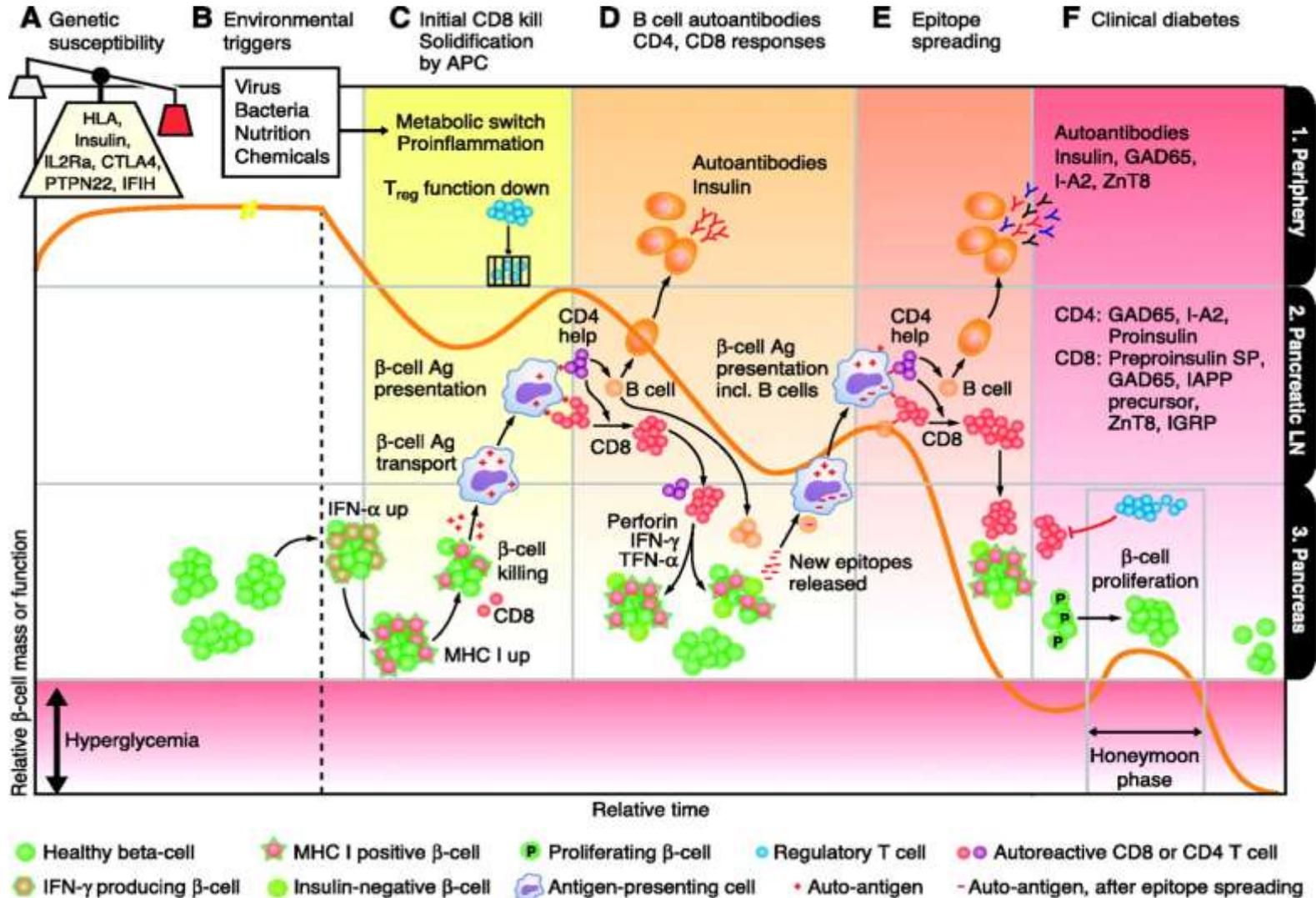
Mechanisms

Type 1 DM: 2

- After 80-90% of the beta cells are destroyed, hyperglycemia develops and diabetes may be diagnosed
- Polymorphisms of the class II human leukocyte antigen (HLA) genes that encode DR and DQ are the major genetic determinants of type 1 DM.

Mechanisms

Type 1 DM: 3



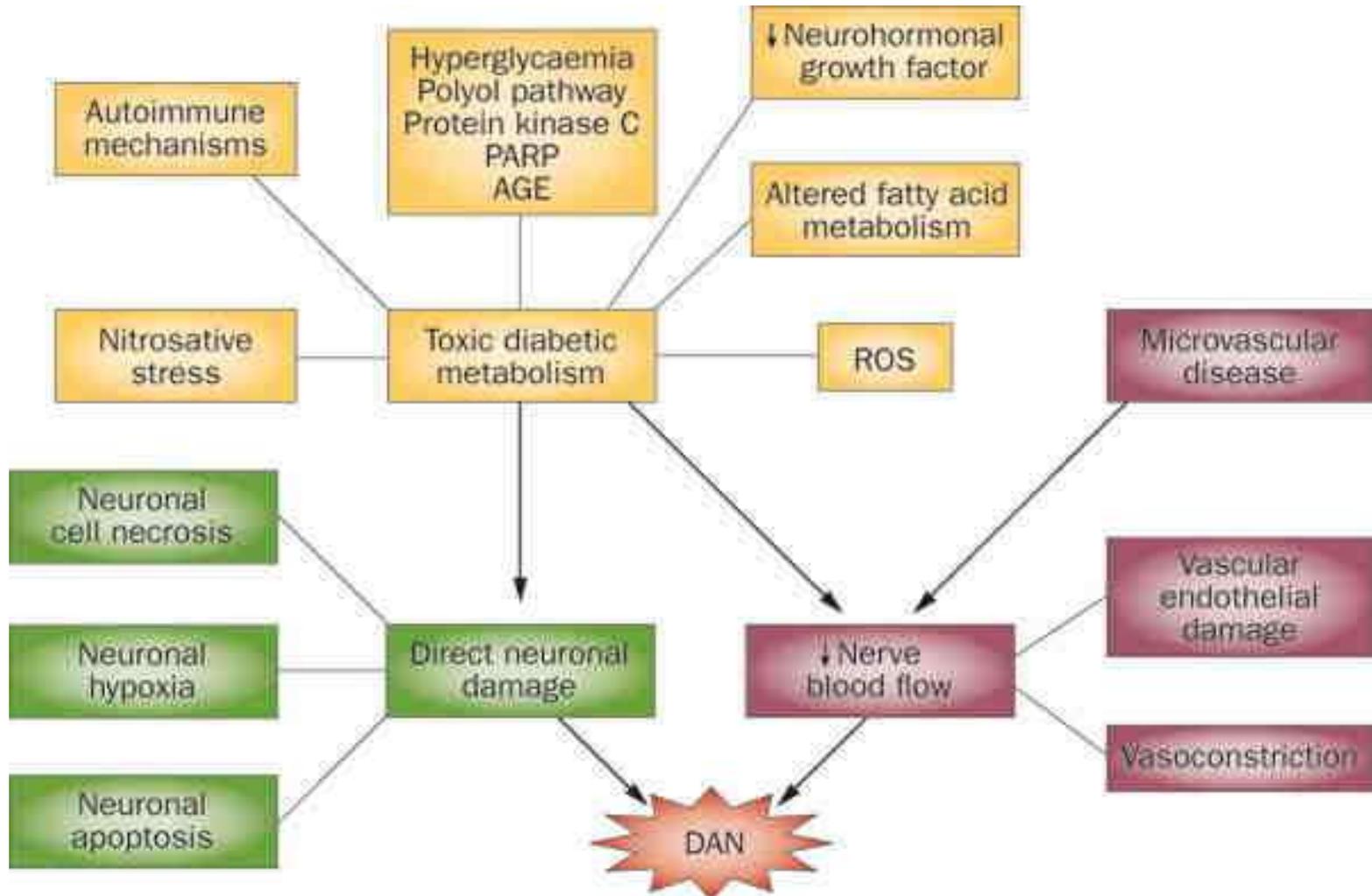
Mechanisms

Type 1 DM and Neuropathy: 1

- Sensory and autonomic neuropathy in people with DM are caused by axonal degeneration and segmental demyelination
- Many factors are involved, including the accumulation of sorbitol in peripheral sensory nerves from sustained hyperglycemia
- Motor neuropathy and cranial mononeuropathy result from vascular disease in blood vessels supplying nerves.

Mechanisms

Type 1 DM and Neuropathy: 2



Mechanisms

Type 1 DM and Angiopathy: 1

- Microvascular disease causes multiple pathologic complications in people with DM
- Hyaline arteriosclerosis, a characteristic pattern of wall thickening of small arterioles and capillaries, is widespread and is responsible for ischemic changes in the kidney, retina, brain, and peripheral nerves

Mechanisms

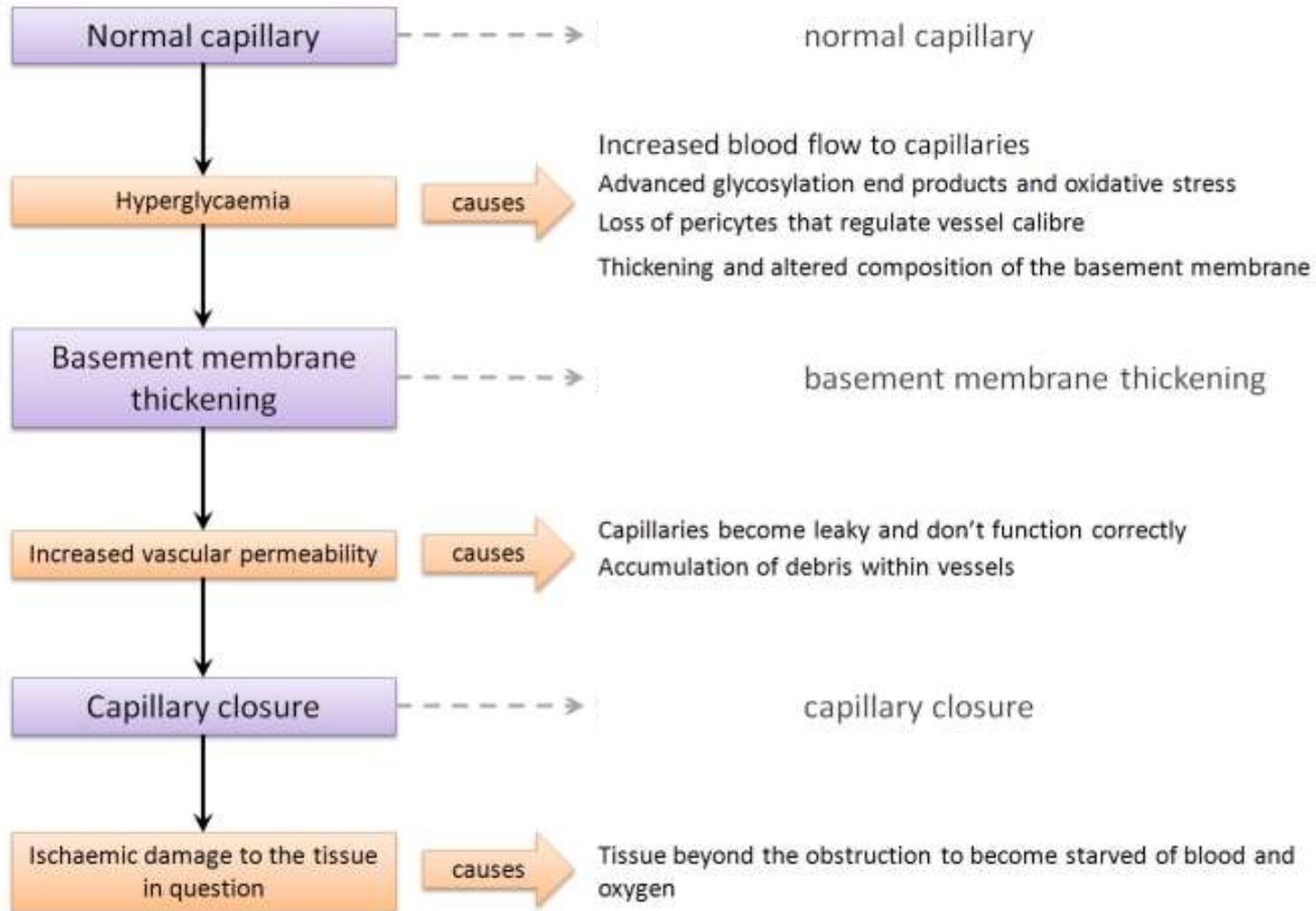
Type 1 DM and Angiopathy: 2

- Atherosclerosis of the main renal arteries and their intrarenal branches causes chronic nephron ischemia
- Vitamin D deficiency is an important independent predictor of development of coronary artery calcification in individuals with type 1 DM.

Mechanisms

Type 1 DM and Angiopathy: 3

Mechanisms leading to microvascular damage



Mechanisms

Type 1 DM and Nephropathy: 1

- In the kidneys, the characteristic wall thickening of small arterioles and capillaries leads to diabetic nephropathy, which is characterized by proteinuria, glomerular hyalinization (Kimmelstiel-Wilson), and chronic renal failure

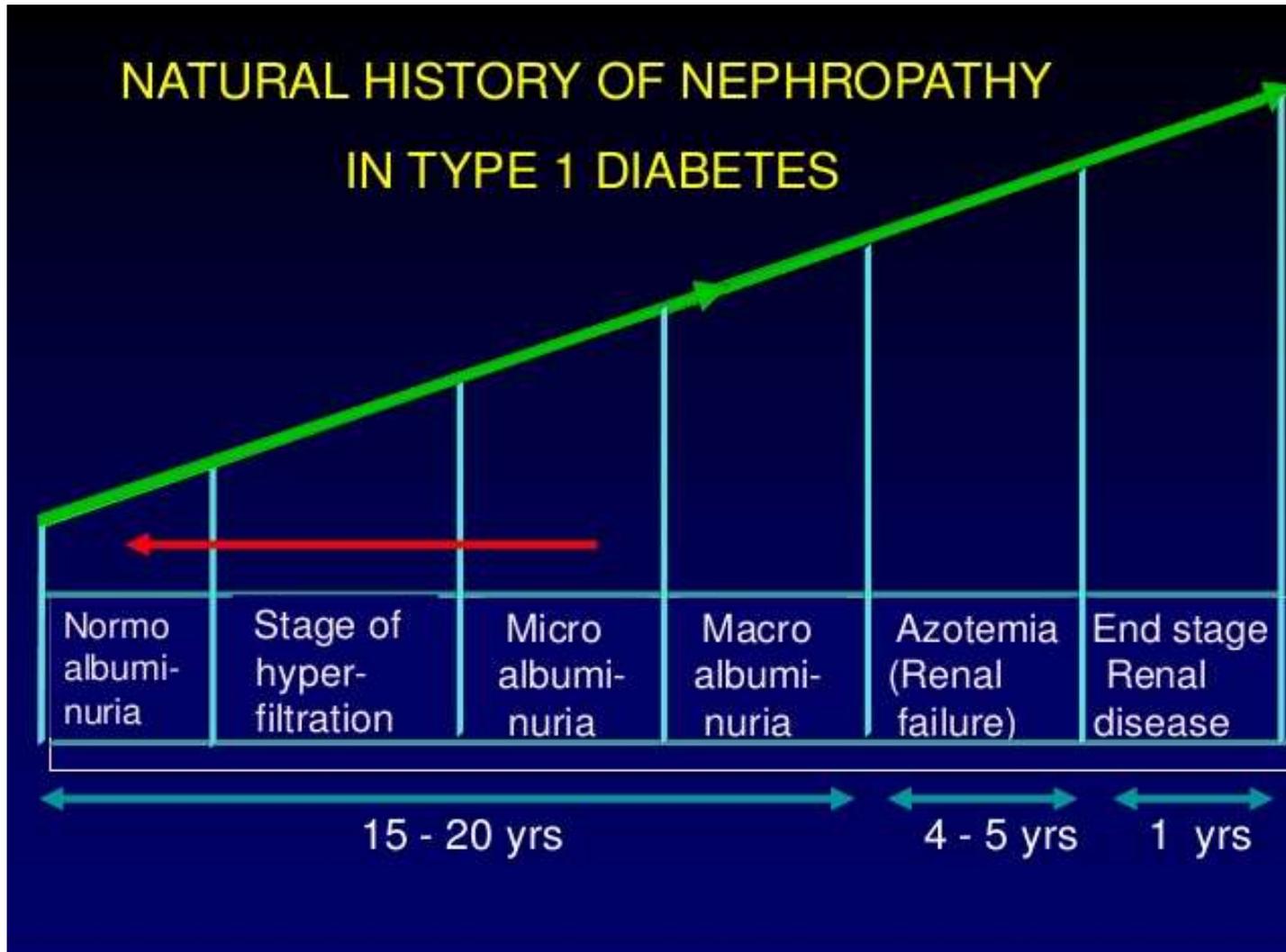
Mechanisms

Type 1 DM and Nephropathy: 2

- Exacerbated expression of cytokines such as tumor growth factor beta 1 is part of the pathophysiology of glomerulosclerosis, which begins early in the course of diabetic nephropathy
- Single-nucleotide polymorphisms affecting the factors involved in its pathogenesis appear to influence the risk for diabetic nephropathy in different people with type 1 DM.

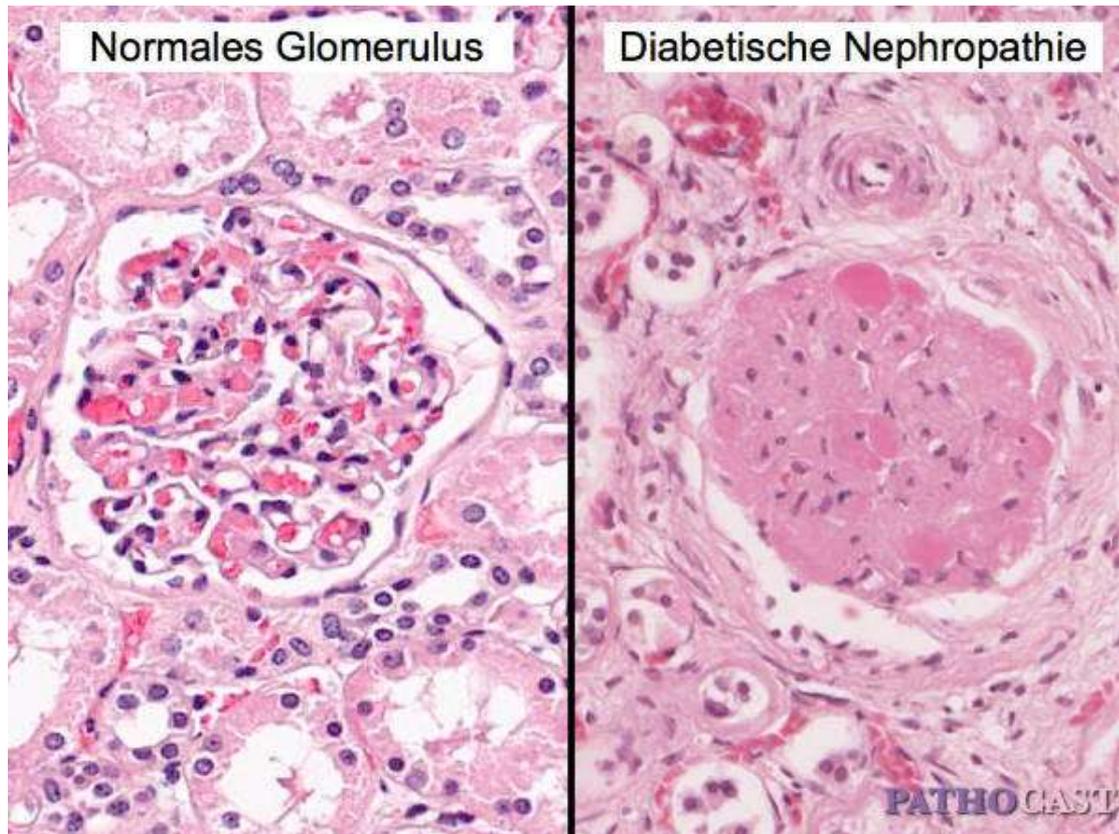
Mechanisms

Type 1 DM and Nephropathy: 3



Mechanisms

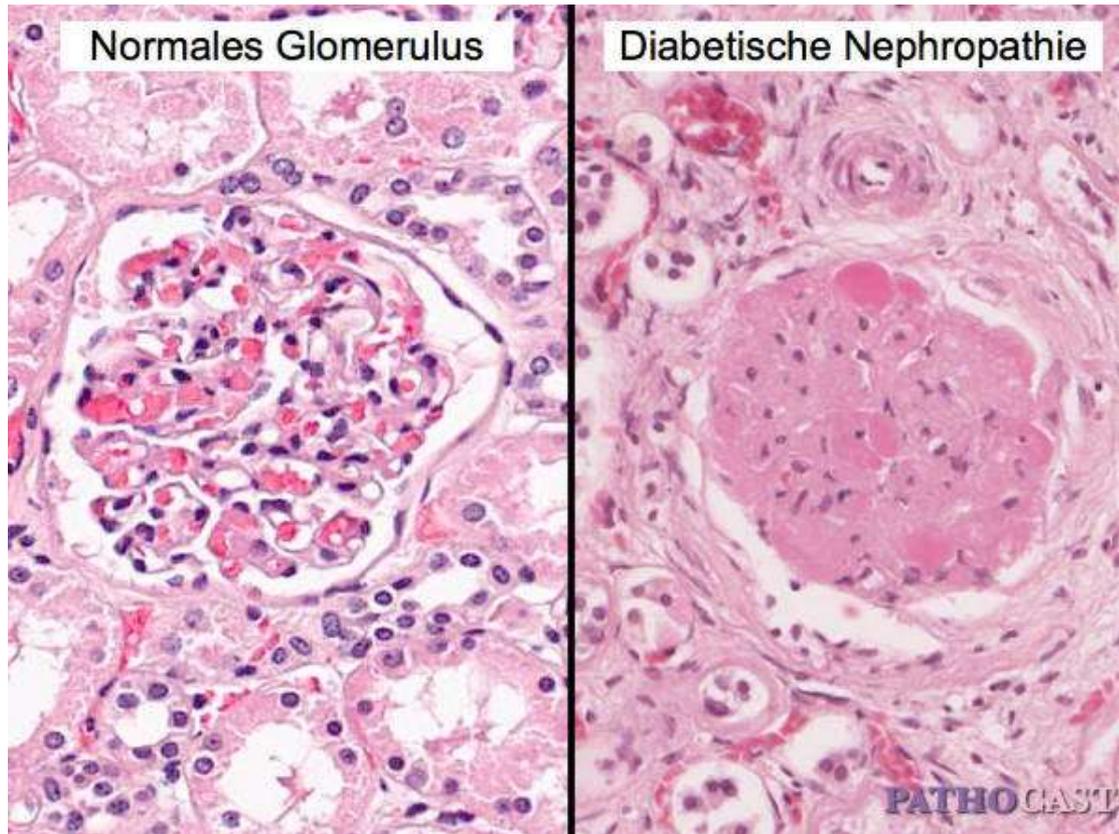
Type 1 DM and Nephropathy: 4



- Histological comparison of a healthy glomerulus and a glomerulus in diabetic nephropathy
- One can notice an augmentation of the mesangial matrix

Mechanisms

Type 1 DM and Nephropathy: 5



- The matrix appears in light pink and has a nodular structure, the capillary lumen is obstructed
- This condition is called complete glomerular sclerosis

Mechanisms

Type 1 DM: Double diabetes

DOUBLE DIABETES

Symptoms of Both Diseases

- Increased Thirst
- Frequent Urination
- Blurred Vision
- Slow Healing Sores
- Frequent Infections

In areas where rates of type 2 DM and obesity are high, individuals with type 1 DM may share genetic and environmental factors that lead to their exhibiting type 2 DM features such as reduced insulin sensitivity (double diabetes).

Mechanisms

Type 2 DM: 1

- Type 2 DM is characterized by a combination of peripheral insulin resistance and inadequate insulin secretion by pancreatic beta cells
- Insulin resistance, which has been attributed to elevated levels of free fatty acids and proinflammatory cytokines in plasma, leads to decreased glucose transport into muscle cells, elevated hepatic glucose production, and increased breakdown of fat

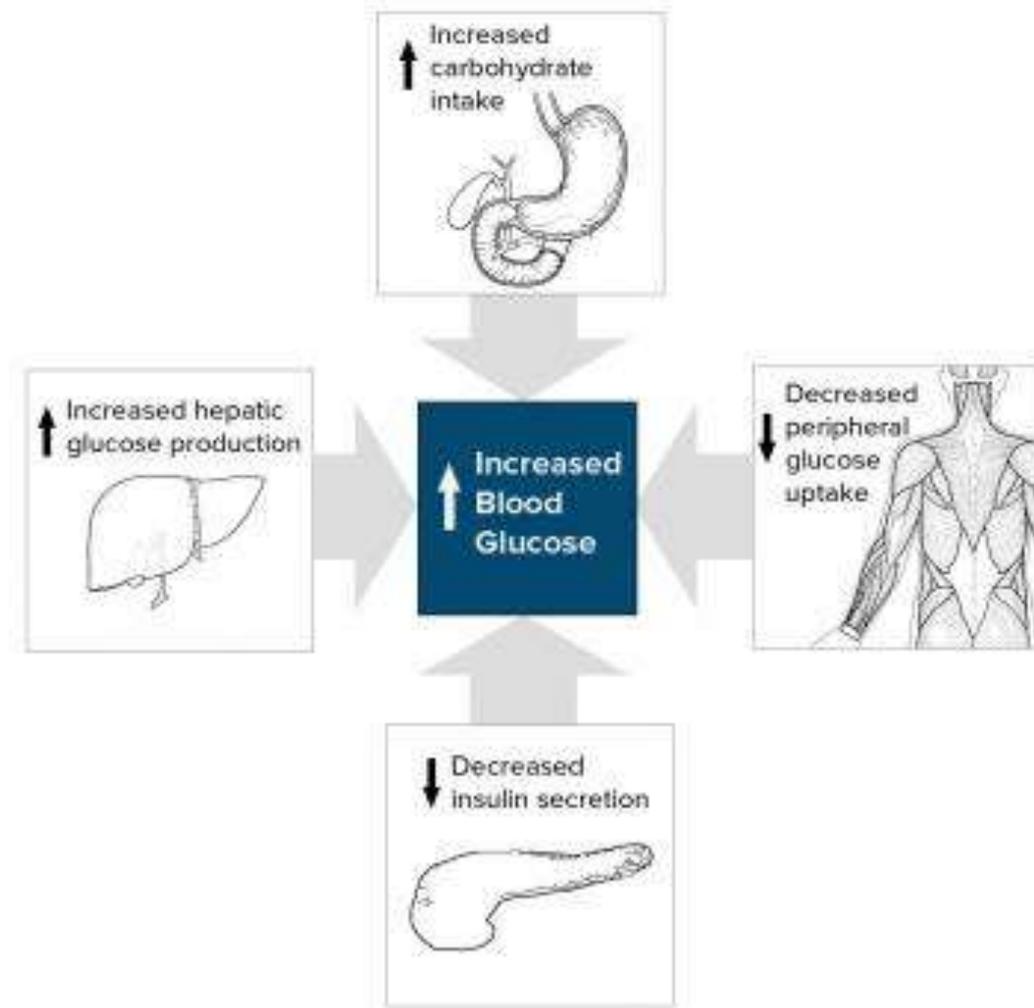
Mechanisms

Type 2 DM: 2

- A role for excess glucagon cannot be underestimated; indeed, type 2 diabetes is an islet paracrinopathy in which the reciprocal relationship between the glucagon-secreting alpha cell and the insulin-secreting beta cell is lost, leading to hyperglucagonemia and hence the consequent hyperglycemia
- With prolonged diabetes, atrophy of the pancreas may occur

Mechanisms

Type 2 DM: Scheme of abnormal glucose metabolism



Mechanisms

Type 2 DM and Beta-cell Dysfunction: 1

- Beta-cell dysfunction is a major factor across the spectrum of prediabetes to DM
- Beta-cell dysfunction develops early in the pathologic process and does not necessarily follow the stage of insulin resistance

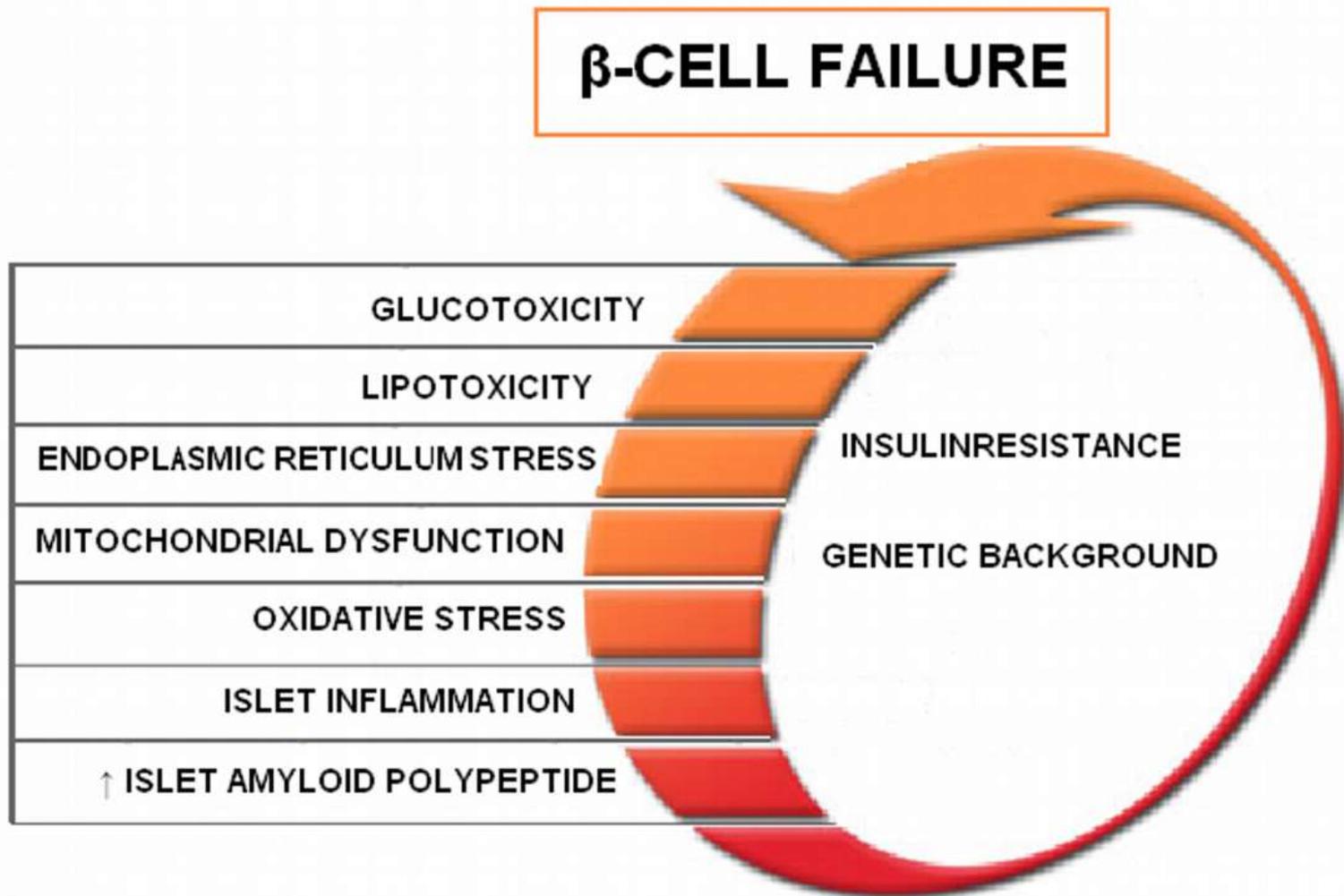
Mechanisms

Type 2 DM and Beta-cell Dysfunction: 2

- Singular focus on insulin resistance as the "be all and end all" is gradually shifting, and hopefully better treatment options that address the beta-cell pathology will emerge for early therapy

Mechanisms

Type 2 DM and Beta-cell Dysfunction: 3



Mechanisms

Type 2 DM and Insulin Resistance: 1

- In the progression from normal to abnormal glucose tolerance, postprandial blood glucose levels increase first
- Eventually, fasting hyperglycemia develops as suppression of hepatic gluconeogenesis fails

Mechanisms

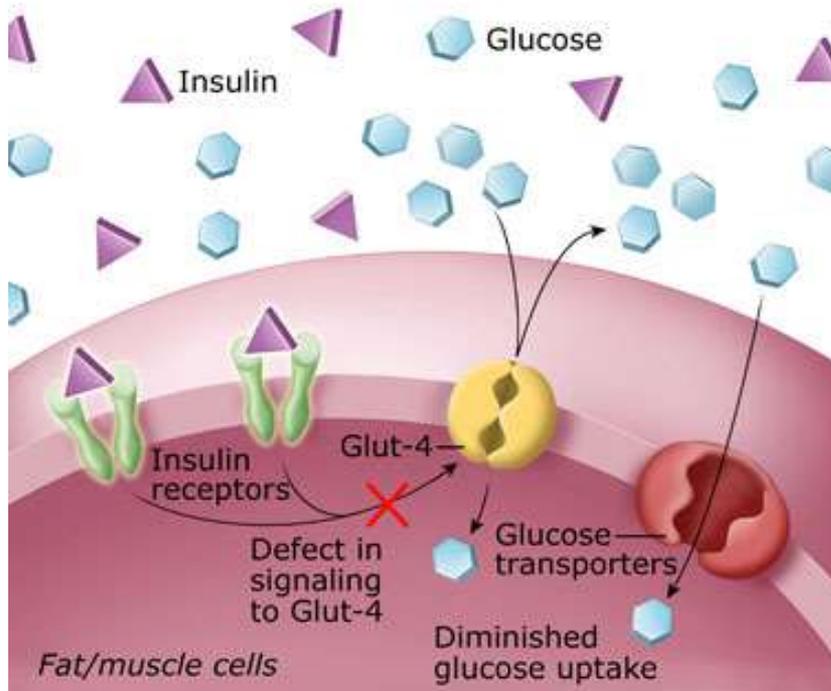
Type 2 DM and Insulin Resistance: 2

- During the induction of insulin resistance (such as occurs with a high-calorie diet, steroid administration, or physical inactivity), increased glucagon levels and increased glucose-dependent insulinotropic polypeptide (GIP) levels accompany glucose intolerance
- The postprandial glucagonlike peptide-1 (GLP-1) response is unaltered

Mechanisms

Type 2 DM and Insulin Resistance: 3

Type 2 Diabetes: Insulin Resistance

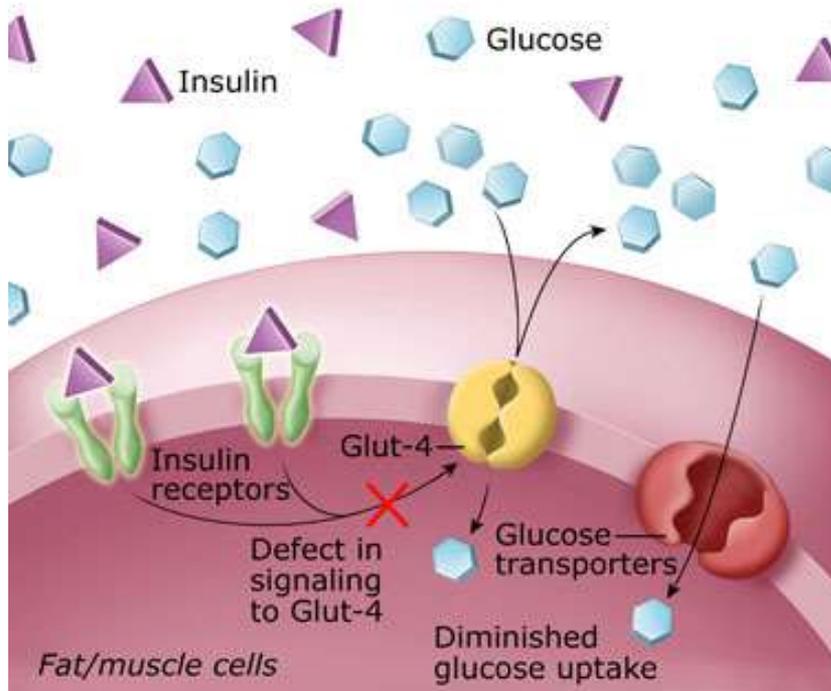


- Insulin resistance means the signal insulin gives to a cell is weakened
- This results in less glucose uptake by muscle and fat cells and a reduction in insulin mediated activities inside cells

Mechanisms

Type 2 DM and Insulin Resistance: 4

Type 2 Diabetes: Insulin Resistance



- Compounding this problem of resistance, there is additional defect in insulin production and secretion by the insulin producing beta cells in the pancreas.

Mechanisms

Type 2 DM: Genomic factors

- Genome-wide association studies of single-nucleotide polymorphisms (SNPs) have identified a number of genetic variants that are associated with beta-cell function and insulin resistance
- Some of these SNPs appear to increase the risk for type 2 diabetes
- Over 40 independent loci demonstrating an association with an increased risk for type 2 diabetes have been shown

Mechanisms

Gestational DM: 1

- If the maternal pancreatic insulin response is inadequate, maternal and, then, fetal hyperglycemia results, that are the most significant source of the accelerated growth exhibited by the fetus
- Surging maternal and fetal glucose levels are accompanied by episodic fetal hyperinsulinemia

Mechanisms

Gestational DM: 2

- Fetal hyperinsulinemia promotes excess nutrient storage, resulting in macrosomia. The energy expenditure associated with the conversion of excess glucose into fat causes depletion in fetal oxygen levels that are accompanied by surges in adrenal catecholamines, which, in turn, cause hypertension, cardiac remodeling and hypertrophy, stimulation of erythropoietin, red cell hyperplasia, and increased hematocrit

Mechanisms

Gestational DM: 3



Classification

American Diabetes Association: 1

- Type 1 DM (β -cell destruction, usually leading to absolute insulin deficiency): immune-mediated, idiopathic

Classification

American Diabetes Association: 2

- Type 2 DM (ranging from predominantly insulin resistance with relative insulin deficiency to predominantly an insulin secretory defect with insulin resistance)

Classification

American Diabetes Association: 3

- Gestational DM (GDM) (diabetes diagnosed in the second or third trimester of pregnancy that is not clearly overt DM)

Classification

American Diabetes Association: 4

- Other specific types of DM: genetic defects of the β -cell, genetic defects in insulin action, diseases of the exocrine pancreas, endocrinopathies, drug- or chemical-induced DM, infections, uncommon forms of immune-mediated DM, other genetic syndromes sometimes associated with DM, impaired glucose tolerance (IGT) and impaired fasting glucose (IFG).

Classification

International Classification of Diseases (ICD): 1

IV Endocrine, nutritional and metabolic diseases

(E10-E14) Diabetes mellitus

E10 Type 1 diabetes mellitus

E11 Type 2 diabetes mellitus

E12 Malnutrition-related diabetes mellitus

E13 Other specified diabetes mellitus

E14 Unspecified diabetes mellitus

Classification

International Classification of Diseases (ICD): 1

XV Pregnancy, childbirth and the puerperium

 O20-O29 Other maternal disorders
predominantly related to pregnancy

O24 Diabetes mellitus in pregnancy

Clinical Investigation

Signs and Symptoms: 1

- The classic symptoms of untreated DM are weight loss, polyuria (increased urination), polydipsia (increased thirst), and polyphagia (increased hunger) that may develop rapidly (weeks or months) in type 1 DM, while they usually develop much more slowly and may be subtle or absent in type 2 DM

Clinical Investigation

Signs and Symptoms: 2

- Several other signs and symptoms are not specific to DM and include blurry vision, headache, fatigue, slow healing of cuts, and itchy skin
- Prolonged high blood glucose can cause glucose absorption in the lens of the eye, which leads to changes in its shape, resulting in vision changes
- A number of skin rashes are collectively known as diabetic dermatomes

Clinical Investigation

Signs and Symptoms: 3



Weight Loss



Extreme Tiredness



Increased Hunger



Excessive Thirst



Frequent Urination



Tingling and Numbness



Blurred Vision



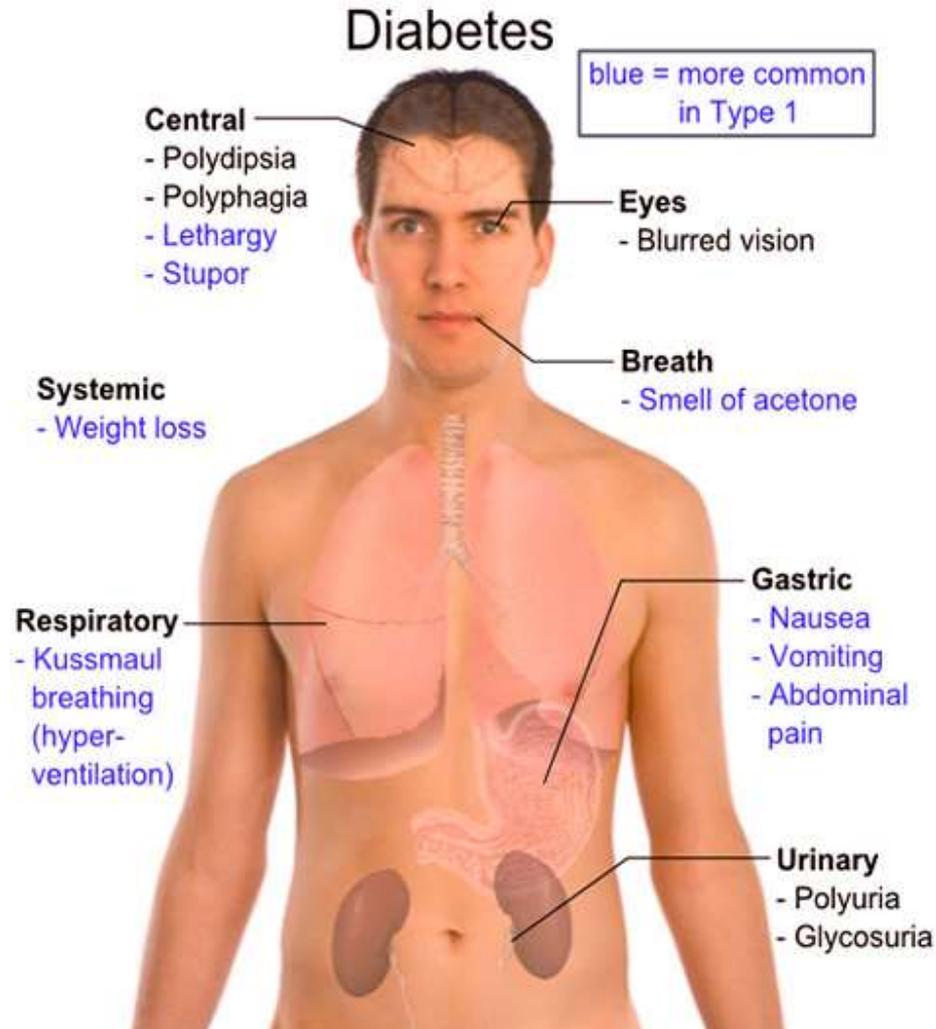
Unhealed Wound



Urine Attracting Ants

Clinical Investigation

Signs and Symptoms: 4



Clinical Investigation

Diabetic emergencies: 1

- Low blood sugar is common in patients with DM, but most cases are mild and are not considered medical emergencies
- Effects can range from feelings of unease, sweating, trembling, and increased appetite in mild cases to more serious issues such as confusion, aggressiveness, seizures, unconsciousness, and (rarely) permanent brain damage or death in severe cases

Clinical Investigation

Diabetic emergencies: 2

- Moderate hypoglycemia may easily be mistaken for drunkenness
- People (usually with type 1 DM) may also experience episodes of diabetic ketoacidosis, characterized by nausea, vomiting and abdominal pain, the smell of acetone on the breath, Kussmaul breathing, and a decreased consciousness
- A rare possibility is hyperosmolar nonketotic state, which is more common in type 2 DM and is mainly the result of dehydration

Clinical Investigation

Diabetic emergencies: 3

Low Blood Sugar Symptoms



SHAKING



SWEATING



ANXIOUS



DIZZINESS



HUNGER



FAST HEARDBEAT



IMPAIRED VISION



WEAKNESS
FATIGUE



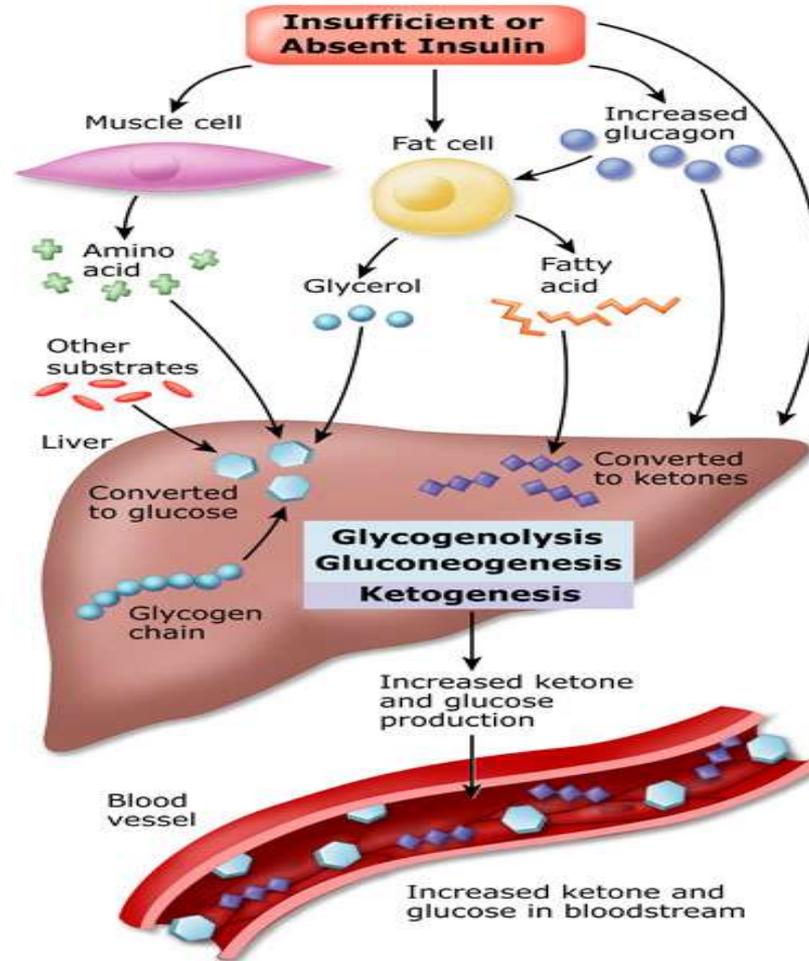
HEADACHE



IRRITABLE

Clinical Investigation

Diabetic emergencies: 4



Diabetic ketoacidosis (DKA)

Clinical Investigation

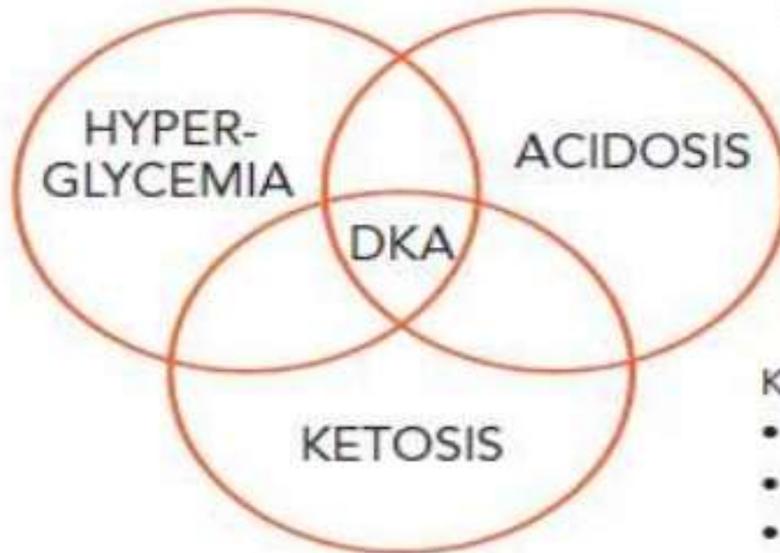
Diabetic emergencies: 5

HYPERGLYCEMIC STATES

- Diabetes Mellitus
- Hyperosmolar Hyperglycemic State
- Impaired Glucose Tolerance
- Stress Hyperglycemia

METABOLIC ACIDOTIC STATES

- Lactic Acidosis
- Hyperchloremic Acidosis
- Uremic Acidosis
- Drug-Induced Acidosis
(eg, salicylates, methanol,
ethylene glycol)



KETOTIC STATES

- Ketotic Hypoglycemia
- Alcoholic Ketosis
- Starvation Ketosis

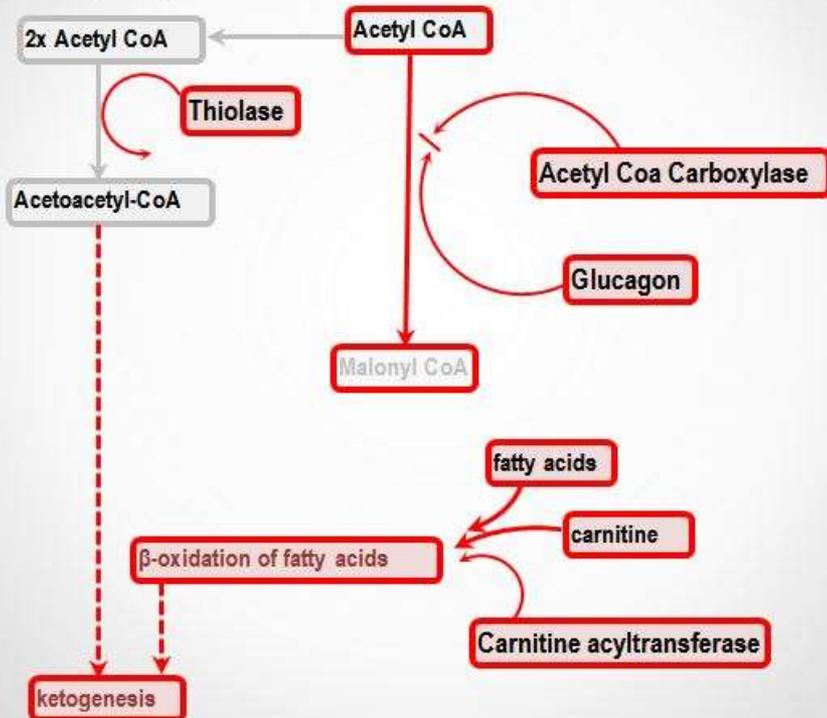
Diagnostic triad of diabetic ketoacidosis (DKA)

Clinical Investigation

Diabetic emergencies: 6

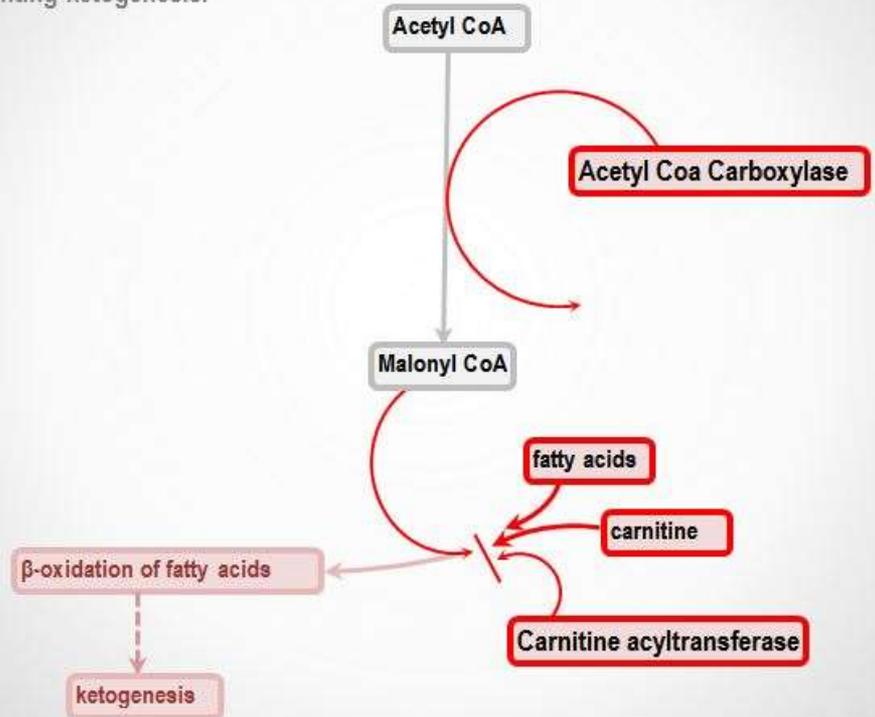
In DKA:

In the absence of insulin, glucagon inhibits the synthesis of malonyl CoA, resulting in an unregulated entry of fatty acids into the β -oxidation pathway, promoting ketogenesis.



In HONK:

Under the regulatory influence of insulin, malonyl CoA exerts a normal inhibitory effect on the entrance of fatty acids into the β -oxidation pathway, thus limiting ketogenesis.



Differences in diabetic ketoacidosis (DKA) and hyperosmolar nonketotic state (HONK)