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THE IMPORTANCE OF MAGNETIC RESONANCE IMAGING IN THE DIAGNOSIS AND TREATMENT OF DIABETIC FOOT SYNDROME

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Abstract: For many years, practically the only additional diagnostic method was radiography of the foot. Analysis of the latest research and publications. In the early stages of DFS, radiography has low sensitivity to pathological processes of soft tissue articular structures, ligaments, bone marrow, paraarticular and paraosseous soft tissues. Evaluation of these structures is possible only by indirect signs that do not have a decisive diagnostic value. The introduction of magnetic resonance imaging (MRI) into widespread clinical practice has significantly expanded the possibilities of radiological diagnosis of diseases of the osteoarticular system. Identification of previously unresolved parts of the general problem. The main advantages of MRI include the ability to directly visualize and simultaneously assess the condition of the synovium, fibrocartilaginous structures, bones and paraosseous soft tissues, as well as the morphological characteristics of tissues based on their different signal characteristics in different study modes. However, this research method has not currently received due attention from medical institutions at the district level.

Keywords: diabetes mellitus, diabetic foot syndrome, magnetic resonance imaging, hyperglycemia.

Introduction: The 21st century, despite significant advances in the treatment of many diseases, has revealed a certain phenomenon: diabetes mellitus (DM) has become an epidemic among non-infectious diseases. The prevalence of diabetes is growing in economically developed countries and is about 6% [2,3,6]. More recently, the focus has been on the prevention and management of acute complications of diabetes. The more medicine is developed and time is devoted to these patients, the life expectancy of this category of patients increases. In this regard, issues of prevention and treatment of late complications of diabetes began to come to the fore. Many doctors of other specialties are faced with manifestations of diabetes, since this disease affects almost all systems of the body [4,5,6,10]. However, in second place in terms of referral after endocrinologists, this category of patients is treated by surgeons. Approximately 25% of patients with newly diagnosed diabetes are diagnosed in surgical departments, where they are hospitalized for emergency or planned surgical treatment. In this case, the most dramatic complications of diabetes occur in the lower extremities. Diabetic foot syndrome (DFS) occurs in various forms in 30-80% of patients with diabetes [1,3,5,6]. This category of patients accounts

for 50-70% of the total number of lower limb amputations [2,5]. Every hour in the world, 55 lower limb amputations are performed in patients with diabetes mellitus [3,8,9]. Over the past two decades, extensive clinical and scientific experience has been accumulated, which has made it possible to illuminate the pathophysiological mechanisms of the formation of DFS from a new perspective and to carry out pathogenetically based treatment and prevention.

The pathogenesis of diabetes mellitus is based on the toxic effect of hyperglycemia, which develops as a result of a deficiency of insulin secretion or a defect in its action, or a combination of both. The aggressive effect of hyperglycemia leads to the development of diabetic angiopathy. It affects both small vessels (microangiopathy) and medium and large vessels (macroangiopathy). Changes in large vessels in diabetes mellitus have specific differences - distal arteries are affected, aggressive course, young age, multisegmental localization of stenoses.

The group of diabetic microangiopathies includes: diabetic neuropathy, retinopathy and nephropathy. Damage to the peripheral nervous system is one of the most common complications of diabetes; it is often combined with diabetic retinopathy and nephropathy, which indicates common mechanisms of pathogenesis. Diabetic polyneuropathy (DPN) reduces the quality of life of patients and is one of the main risk factors for the development of foot ulcers, diabetic foot syndrome, and non-traumatic amputations. The incidence of neuropathies depends not only on the duration of diabetes, but also on timely diagnosis and the effectiveness of its treatment. Glucotoxicity (chronic hyperglycemia) plays a key role in the pathogenesis of microangiopathies. The DCCT (Diabetes Control and Complication Trial) study proved that hyperglycemia is responsible for the development of diabetic peripheral neuropathy. A number of authors show that the main role in the development of vascular complications of diabetes belongs to oxidative stress, that is, the formation of free oxygen radicals, which is facilitated by insulin deficiency and hyperglycemia. Free radicals are formed during many biochemical reactions that are activated during hyperglycemia. In patients with diabetes mellitus with the development of angiopathy, as a result of many years of research, some hemodynamic features have been established: the presence of high blood viscosity, platelet hyperaggregation, hypercoagulation syndrome and decreased fibrinolysis.

The state of vascular wall tone and blood flow is coordinated by several body systems, including the kallikreinin blood system and the function of the vascular endothelium. A number of researchers have shown that diabetes mellitus is accompanied by dysfunction of the vascular endothelium, as a result of which the synthesis of vasodilators by the endothelium is disrupted. The content of endothelins and nitric oxide (NO), which is a powerful vasodilator, changes. Decreased nitric oxide production leads to vasoconstriction, ischemia, and slowing of nerve impulse velocity.

In general, it should be noted that many issues of the state of blood circulation of the lower extremities in patients with diabetes mellitus remain unresolved and require further study. Using modern research methods, it has been established that vascular lesions in various organs are detected already in the first years of detection of diabetes mellitus and even with prediabetes. Moreover, morphological changes in the tissues of the vascular wall occur long before the clinical manifestations of vascular complications. Therefore, it is obvious that increasing the effectiveness of the prevention and treatment of diabetic angiopathy is possible only with timely diagnosis and correction of the early stages of vascular disorders. This is an urgent and complex scientific problem, the solution of which will prevent the development of clinical signs of the disease.

The degree of circulatory impairment of the lower extremities is determined according to the Fontaine-Leriche-Pokrovsky classification of chronic arterial insufficiency, based on the clinical manifestations of the pathology: Stage I: Asymptomatic (there are only signs of atherosclerosis of the arteries during instrumental examination). Stage II: Intermittent claudication. Pain occurs in the muscles of the legs or (less commonly) thighs, occurring after walking a certain distance (relatively constant for each patient). This pain forces the patient to stop and goes away quite quickly after stopping. Due to a decrease in pain sensitivity (diabetic neuropathy), the patient may not feel pain, but its equivalent

(discomfort, weakness in the legs), which also forces him to stop. Stage IIA: Walking distance more than 200 m Stage IIB: Walking distance less than 200 m Stage III: Ischemic rest pain. The patient experiences extremely intense pain that occurs when the body is in a horizontal position. Lowering the affected leg down reduces pain (by increasing hydrostatic blood pressure in the area of the stenotic area). Stage IV: Trophic ulcers, gangrene Diabetic macroangiopathy - damage to large and medium-sized arteries in patients with diabetes in the form of atherosclerosis, less often - in the form of calcific Mönckeberg sclerosis or diffuse intimal fibrosis. At the same time, glycosylated atherogenic LDL increases in the blood, which are not recognized by the corresponding normal receptors and their half-life in plasma increases significantly, and anti-atherogenic HDL does not provide sufficient transport of cholesterol from the affected areas of the artery.

Classification of diabetic macroangiopathies:

1. Atherosclerosis of the aorta and coronary arteries (IHD, MI)
2. Atherosclerosis of the cerebral arteries (CCA, atherosclerotic encephalopathy)
3. Atherosclerosis of the peripheral arteries, including the arteries of the lower extremities.

Clinical picture of diabetic macroangiopathy of the lower extremities: - chilliness of the legs, weakness in the legs when walking, standing for long periods of time; intermittent claudication syndrome (pain in the calf muscles that appears or intensifies when walking and decreases at rest, which forces the patient to interrupt walking and stop; as damage to the arteries progresses, the pain becomes constant)

- trophic changes and dry skin of the legs and feet, cold feet; dark dry nails, often affected by a fungal infection, painful deep cracks in the skin on the heels
- marbling of the skin of the feet and legs, cyanosis of the fingers
- atrophy of the muscles of the legs, hair loss on the legs
- weakening or absence of pulse on a. tibialis posterior and a. dorsalis pedis
- with an extreme degree of circulatory disorders in the feet
- dry gangrene in the toe area
- first a dark spot appears, then dry skin necrosis develops, sometimes with self-amputation of the toe; blisters with serous or hemorrhagic contents often form, skin ulceration with the spread of a necrotic ulcerative process and subsequent complication with bacterial infection (wet gangrene) Diabetic foot syndrome (DFS) is a pathological condition of the feet of a patient with diabetes, which occurs against the background of damage to peripheral nerves, blood vessels, skin, soft tissues, bones and joints and manifests itself in acute and chronic ulcers, osteoarticular and purulent-necrotic processes.

The main risk factors for diabetic foot syndrome are: peripheral neuropathy, angiopathy, foot deformity (use of unsuitable shoes, increased plantar pressure).

Groups of risk factors that contribute to the action of the main ones:

1) inadequate foot care
2) excess body weight, alcohol consumption, smoking.
3) visual impairment, severe retinopathy
4) diabetic nephropathy
5) infectious and fungal lesions of the feet
6) poorly corrected hyperglycemia
7) sports competitions, intense
8) age over 60 years
9) duration of diabetes mellitus
10) previous ulcers and amputations of the foot
11) arterial hypertension and hypercholesterolemia.

Clinical forms of DFS:

A) neuropathic form – damage to the somatic and autonomic nervous system with sufficient preservation of the arterial blood flow of the lower extremities.

1) neuropathic edema – occurs due to vasomotor disorders (increased hydrodynamic pressure in the microcirculatory bed); clinically, the foot and lower leg are swollen, traces of compression remain on the swollen tissue; the skin of the leg and foot is warm, its color does not change, there is no pain.

2) neuropathic ulcer - an ulcer in a place of increased pressure and mechanical irritation (most often on the sole and in the interdigital spaces, in the area of the heads of the II-III metatarsal bones), accompanied by increased hyperkeratosis, dry skin (atrophy of the sweat glands), absence or insignificance of pain ; neuropathic ulcers are often infected with staphylococci, streptococci, colibacteria, anaerobic infection is often associated, which leads to the spread of necrosis to subcutaneous fat, muscle tissue, and ligamentous apparatus, promotes microthrombosis in the microcirculatory system and the involvement of new large areas of soft tissue of the foot in the ulcerative necrotic process with the subsequent development of gangrene.

3) osteoarthropathy – a syndrome of aseptic destruction of bones and joints in diabetes, manifested by characteristic clinical and radiological symptoms (Charcot's foot). The most commonly affected areas are the metatarsal part of the foot and the ankle joint; bone changes manifest themselves as osteoporosis, osteolysis, hyperostosis, gradually progress and lead to severe deformation of the foot.

Clinically characteristic: redness and swelling of the foot; protrusion and deformation of the bones of the foot, the foot becomes flat, pathological movements are noted, disorganization of the joints ("a bag filled with bones"); often the foot takes on a cubic or gurney shape; Spontaneous fractures of the foot bones often occur; X-ray reveals osteoporosis, severe bone destruction with sequestration and resorption of bone tissue, impaired condition of articular surfaces, periarticular hypertrophic changes in soft tissues, subchondral osteosclerosis, formation of osteophytes, intra-articular fractures.

B) neuroischemic form - a combined interaction of diabetic macroangiopathy, microangiopathy and neuropathy of the lower extremities, clinically characterized by:

- severe pain in the area of the affected foot, disturbing both when walking and at rest, somewhat decreasing when hanging the legs from the bed, in an elevated position of the head end of the bed
- the skin of the foot is dry, pale or cyanotic, cold - ulcerative defects such as acral (end) necrosis in the area of the fingertips, the marginal surface of the heels, often complicated by gangrene (develop with the onset of critical ischemia)
- sharply weakened or absent pulsation in a. tibialis posterior and a. dorsalis pedis - decreased blood flow in the area of the affected foot, assessed by the following methods:

1) Doppler ultrasound with measurement of the ankle-brachial index (ratio of SBP in the ankle region to SBP in the brachial artery, normally 0.9-1.0, decreases with ischemia; critical index value <0.6, prognostically unfavorable <0.3).

2) double scanning using B-mode echography and Dopplerography - reveals the localization of hemodynamically significant damage (a local increase in blood flow velocity indicates stenosis)

3) dynamic capillaroscopy, laser Doppler flowmetry, measurement of transcutaneous partial oxygen tension to assess the state of microcirculation of the foot

4) angiography arteries of the lower extremities - the most informative, allows you to diagnose the level of stenosis or thrombosis of the artery and its extent

C) mixed form - a combination of neuropathic and neuroischemic forms. Diagnosis of diabetic foot syndrome:

A) examination and palpation of the feet and legs (pay attention to the color of the limbs, deformations, swelling, the state of tissue trophism, pulsation of the arteries, the presence of ulcerative lesions, etc.)

B) neurological examination (study of vibration sensitivity using a biothesiometer or a graduated tuning fork; study of tactile and temperature sensitivity; study of tendon reflexes, including Achilles)

C) assessment of the state of arterial blood flow of the foot - Doppler ultrasound with determination of the ankle-brachial index and linear blood flow velocity. -duplex scanning of arteries. - MSCT angiography of the aorta and arteries of the lower extremities

D) radiography of the bones and joints of the foot in two projections Principles of treatment of diabetic foot syndrome:

Conservative treatment, which involves solving the following issues: - normalization of carbohydrate metabolism (HBvA1C>7%) - correction of blood pressure - prescription of drugs that reduce the increased thrombogenic potential of the blood - antibacterial therapy - correction of the lipid spectrum of the blood - adherence to a dosed walking regimen - cessation of smoking If If conservative treatment fails, surgical treatment is used. X-ray endovascular treatment methods. Under X-ray control, using special long thin instruments, through a small puncture in the femoral artery (less commonly, other arteries), we can reach the affected vessel (vascular area) of the lower extremities. Modern technical capabilities make it possible to expand a section of the vessel from the inside with a special balloon and, if necessary, install a thin metal frame (stent) that prevents re-narrowing.

Open surgical interventions. For patients with blockage of a vessel lasting no more than 7-9 cm, the internal modified layer of the artery with atherosclerotic plaque and blood clots is removed (endarterectomy). With a more significant spread of the occlusive process, pronounced calcium deposition in the artery wall, a bypass of the blood flow (bypass) or resection of a section of the artery and its replacement with a synthetic prosthesis or biomaterial (prosthetics) is indicated.

Amputation: If, despite the treatment, ischemia of the affected limb increases and gangrene progresses, amputation is indicated: its level must be strictly individual and carried out taking into account the blood supply to the limb. Symptomatic interventions:

- Sympathectomy (intersection of the nerve plexuses responsible for spasm (narrowing) of the arteries) is performed for repeated blockages of the arteries and in addition to reconstructive operations. This operation improves blood circulation in the extremities by dilating small arteries.

- Revascularizing osteotomy is also an auxiliary technique, improving blood circulation by stimulating the formation of new small vessels in the lower extremities after bone damage.

- Arterialization of the venous bed is rarely used at this time, since its implementation is associated with various technical difficulties, and long-term results are worse than the methods described above. Prevention of diabetic foot complications Compensation for diabetes is the first necessary condition for preventing damage to the lower extremities. For the most effective treatment of foot lesions, early identification of patients at increased risk of developing diabetic foot syndrome is necessary. the risk increases with age and duration of illness. Patients at particularly high risk should be examined by a specialist for urgent action. Adequate patient education significantly reduces the incidence of lower limb amputations. An examination of the legs of a patient with diabetes in order to identify mycosis should be carried out by a dermatologist at least once a year.

Purpose of the article: to improve the results of treatment of patients with DFS by determining the nature, clarifying the localization and extent of the process using MRI. Presentation of the main material. An analysis of the treatment of 47 patients aged 39 to 72 years with a neuropathic form of DFS, complicated by phlegmon of the foot, was carried out. All patients were examined according to a standard scheme: collection of anamnesis of the disease, examination, as well as laboratory and instrumental examination, including ultrasound examination of the arteries of the lower extremities, radiography of the feet and MRI. X-ray examination was performed using a Diagnost-56 device (Philips), the dose to the limb was 0.01 mSv. (SANPiN 2.6.1.1192-03 dated 02/18/2003) radiographs of the foot were taken in two or three projections - plantar, oblique and strictly lateral. All patients were examined on a Magnetom impact expert 1.0 tesla (Siemens) magnetic resonance imaging scanner. FSE protocols were used in T1 and T2BI, IRSTIR, in coronal, sagittal and transversal projections. The study was carried out according to the developed method - the patient lay on his back, the foot was placed in the head coil to completely cover the study area. The standard study included obtaining target scans in transversal or coronal projections to obtain sagittal sections, then exposed coronal sections. T1, T2 and STIR weighted images were performed and the slice thickness was 4 - 5 mm.

The complaints of patients upon admission corresponded to the nature of the process, but in 13 (27.6%) with severe neuropathy, the assessment of pain intensity was sharply reduced. All patients were clinically diagnosed with phlegmon of the plantar surface of the foot. Of these, 24 (51.06%) had phlegmon of the median plantar space; 16 (34.04%) had phlegmon of the lateral plantar space; in 4 (8.51%) medial plantar space. In 3 (6.38%), the localization of phlegmon could not be identified due to severe swelling of the plantar surface. General laboratory parameters corresponded to the severity of the process in the foot area. The most pronounced leukocytosis 16.4 ± 3.2x109/l with a shift of the leukocyte formula to the left was observed in patients with deep plantar phlegmon, as well as with widespread forms of phlegmon. Changes in biochemical tests also corresponded to the degree of severity. Glucose levels on admission ranged from 9.7 mmol/L to 23.4 mmol/L. High glycemic numbers also corresponded to common phlegmons of the foot. In most patients, X-ray images revealed changes in the form of osteoporosis, exostoses in the area of the heads of the metatarsal bones, destructive fragmentation of bones, intraosseous cysts, and destruction of the metatarsophalangeal joints. An MRI study made it possible to significantly expand the picture of changes not only in bone tissue, but also in changes in the soft tissues of the foot. The following were detected: soft tissue edema - hyperintense diffuse MR signal on T2VI, without clear contours.

Changes in the bones of the foot on MRI were represented by pronounced intraosseous edema - high hyperintensity on T2WI and hypointensity on T1WI, signs of bone destruction which are defined as destruction of integrity, blurred contours of the metatarsal bones at the level of the heads and articular surfaces. Severe swelling of soft and bone tissues in patients with phlegmon could often veil small sequesters and contours of the periosteum. The presence of purulent contents on the magnetic resonance imaging was represented by a pronounced diffuse hyperintense MR signal on T2WI and increased on T1WI in soft tissues and was sometimes combined with the presence of an abscess - a round-shaped formation with clear contours, contents hyperintense on VI, surrounded by perifocal edema.

Conclusions

1. The inclusion of MRI in the complex examination of patients with diabetes mellitus complicated by phlegmon of the foot expands the understanding of the nature of changes in soft tissues and bones, thereby changing surgical tactics. 2. If it is difficult to clinically diagnose the localization of a purulent-necrotic process, MRI examination allows one to determine the localization and extent of the purulent process.

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