ISSN NO: 2770-2936
Date of Publication:06-05-2023

To Develop Treatment of Acute Phase Diabetic Osteoarthropathy in Diabetic Foot Syndrome

Ismailov U.S., Matmuratov K.J., Yakhubov I.Y.
Tashkent Medical Academy

Resume

In this article, we can get an effective result by using timely adequate treatment of diabetic osteoarthropathy in patients with diabetic paw syndrome who have diabetic osteoarthropathy. In doing so, we can prevent this disease from recurring and possible further complications by applying the necessary treatment in a case that takes into account each phase of diabetic osteoarthropathy.

Key words: diabetic osteoarthropathy, diabetic foot, diabetes mellitus.

Relevance. Diabetic foot syndrome (DFS) combines pathological changes in the peripheral nervous system, arterial and microcirculatory bed and the phenomena of osteoarthropathy, which pose an immediate threat to the development of ulcerative necrotic processes and gangrene of the foot. Every year in the world, new cases of DFS are detected in 2.2–5.9% of patients with diabetes mellitus (DM). One of the types of SDS is diabetic osteoarthropathy (DOAP). This is often a pain-free progressive destructive arthropathy of one or more joints, accompanied by neurological deficiency. DOAP is a rare, but extremely severe complication of DM, which leads to anatomical destruction of the bone–ligamentous apparatus of the foot, deformities of the foot and the development of ulcerative defects. In the absence of treatment specific to this pathology, the patient is expected to be severely disabled and permanently disabled

Diabetic osteoarthropathy (Charcot's arthropathy, DOAP) is one of the late complications of diabetes mellitus (DM), which is accompanied by aseptic destruction of the bone skeleton of the foot against the background of severe diabetic neuropathy and mediacalcinosis. The incidence of DOAP ranges from 1.5% among all DM patients to 30% among patients with diabetic neuropathy. Given that the life expectancy of patients with DM is increasing, the frequency of DOAP is also increasing. Despite the fact that the characteristic changes in DOAP were described more than a hundred years ago, there is still no unambiguous data on the prevalence, pathogenesis and the most effective treatment tactics for this pathology. Motor and sensory neuropathy, injuries, including micro-fractures and joint disintegration, as well as an inflammatory reaction accompanied by an increase in cytokine expression, play a key role in the development of DOAP. Osteopenia prior to injury is not a proven factor. In any case, the separation of the processes of bone resorption and bone formation in the acute stage of DOAP is obvious. This imbalance of bone remodeling while maintaining the load on the limb leads to changes in both the quantity and quality of bone tissue, which leads to a decrease in bone strength. Some researchers believe that the presence of osteopenia predisposes more to the development of fractures than to the formation of instability of the ligamentous apparatus of the joints.

A number of researchers put forward and confirm the hypothesis of a higher incidence of osteopenia in patients with type 1 diabetes (DM1), although the frequency of development of DOAP is the same for type 1 and type 2 diabetes (DM2). Also, some studies have shown a higher incidence of systemic manifestations of osteopenia, in particular in the femoral neck in patients with DM1. This fact is important when choosing a treatment strategy for AAP.

The study of blood flow in the lower extremities of patients with DOAP showed a marked increase in its linear velocity in the acute stage of DOAP. In the chronic stage of PREAP, the blood flow rate was lower than in the acute stage, but significantly higher compared to the control. Based on these data, when choosing the tactics of treatment of DOAP, it is necessary to avoid the appointment of vasoactive drugs.

In this regard, the purpose of this study is to develop an algorithm for the treatment of the acute phase of diabetic osteoarthropathy in diabetic foot syndrome.

ISSN NO: 2770-2936
Date of Publication:06-05-2023

Material and methods

The work is based on the experience of the department of purulent surgery and surgical complications of diabetes mellitus at the multidisciplinary clinic of the Tashkent Medical Academy. The results of treatment of 40 people with acute phase osteoarthropathy in the period 2019 to 2023 were analyzed. Criteria for inclusion of patients with DOAP in the study: age from 28 to 66 years. Diagnosis of osteoarthropathy was based on the results of X-ray and histological studies. The diagnosis of neuropathy is based on the assessment of a decrease in the levels of tactile, pain, temperature and vibration sensitivity of the feet. Macroangiopathy was diagnosed in the absence of pulsation at the level of the ankle joint and the dorsal artery of the foot. In this case, changes in blood flow in the main arteries were clarified by the results of ultrasound Dopplerography ("AcusonX-500"), in some cases multispiral computed tomography (MSCT) was used and selective angiography of the vessels of the lower extremities (Philips Allura Xper FD20 device).

In the majority of patients (34 people – 85%), CS developed against the background of peripheral polyneuropathy without disruption of the main blood flow in the lower extremities. However, in 6 patients (15%), the acute phase of Charcot osteoarthropathy developed against the background of a previously diagnosed neuroischemic form of DFS. The criteria for establishing the neuroischemic form of DFS in this group of 6 patients were the development of foot tissue necrosis in their anamnesis (before the development of the acute phase of osteoarthropathy) in combination with the absence of a pulse at the level of the ankle joint and the dorsal artery of the foot, the absence of a pulse wave at this level according to DUS [7]. Patients of this group became the object of the study. In this group of 6 patients, the average duration of diabetes mellitus was 15.6 years, all had type 2 diabetes, the average age of patients was 65 years (3 women and 3 men).

Results

All 6 patients admitted to the hospital with the acute phase of SCI, according to the anamnesis, had multifocal stenosis of the superficial femoral artery, occlusion and subocclusive lesions of the tibial arteries with varying degrees of collateral blood flow in the arteries of the lower leg. In all cases, there was no pulse wave on the tibial arteries in the lower third of the lower leg. The suspicion of the development of acute phase of Charcot's foot in all 6 patients with neuroischemic form of DFS was based on the occurrence of clinical signs of osteoarthropathy in them – acute edema, redness and deformity of the foot. The X-ray examination data confirmed the development of bone and joint destruction in all 6 patients: three in the area of the tarsal-metatarsal joint, two at the level of the metatarsal bones, one patient had a lesion of the tarsal joint.

It is important to note that in the observed group of patients with neuroischemic form of DFS, the development of the acute phase of osteoarthropathy in a short time was accompanied by a change in the nature of the course of the wound process – a rapid transition to the phase of regeneration and proliferation, cleansing of the wound from non-viable tissues, active development of granulations of the area of wound defects of the foot.

After the manifestation of the clinical picture of osteoarthropathy, all 6 patients underwent repeated ultrasound examination of the arteries of the lower extremities in the hospital; no significant differences were obtained with the already available ultrasound data, except for the presence of moderate swelling of the soft tissues of the lower leg and foot on the side of the lesion, which makes it difficult to clearly visualize blood flow in the distal parts of the limb.

A more detailed nature of the pathological processes occurring in the affected lower limb in a patient with an acute phase of CS can be illustrated by the following clinical example: a 65-year-old patient (No. 6 in the table), in 2022, was admitted to the department of purulent surgery and surgical complications of diabetes mellitus at the multidisciplinary clinic of the Tashkent Medical Academy with the diagnosis: "Type 2 diabetes, decompensation stage. Diabetic foot syndrome, neuroischemic form. Condition after amputation of the right foot according to Sharpe (2017) due to gangrene of the fingers. Phlegmon of the rear stump of the right foot." No bone-destructive changes were detected on the performed radiograph of the right foot at the time of admission of the patient to the hospital.

ISSN NO: 2770-2936
Date of Publication:06-05-2023

Table

The nature of the lesion of the foot tissues and the condition of the arteries of the lower extremities in patients with the neuroischemic form of DFS

Patient/ age	The depth of the lesion (according to Wagner)	The nature of the lesion/ intervention performed	The nature of the occlusive-stenotic lesion of the arteries (on the side of the lesion of the foot)
№1, 68 y	IV	gangrene of the toes/ amputation of the distal part of the foot	stenosis (70%) BOTH 2 and Pc3 , collateral blood flow in the tibial arteries
№2, 65 y	IV	gangrene of the toes/ amputation of the toes	stenoses (70%) of PBU 5 stenoses (<70%) of PA and PA, occlusion of ZBBA 4,stenoses (>70%) of PBU 5
№3, 74 y	IV	gangrene of the toes/ amputation of the toes	stenosis (70%) of the tibial arteries stenosis (<70%) EIA, stenosis (<70%) BOTH and PA, multifocal stenosis (>70%) of the tibial arteries
№4, 59 y	III	necrotic phlegmon/ dissection of phlegmon	stenosis (<70%) EIA, stenosis (>70%) BOTH, collateral blood flow in the PA, tibial arteries
№5, 61 y	III	necrotic phlegmon/ dissection of phlegmon	stenosis (<70%) EIA, stenosis (<70%) BOTH and PA, ATA occlusion, collateral blood flow in ATA
№6, 65 y	IV	gangrene of the toes/ amputation of the toes	stenosis (<70%) NPA, stenosis (<70%) BOTH and PA, PTA occlusion, multifocal stenoses in PTA

1 – external iliac artery; 2 – common femoral artery;3 –popliteal artery; 4 – posterior tibial artery;5 –anterior tibial artery

On the day of admission, an operation was performed – an autopsy, drainage of the phlegmon of the foot. During 2 weeks of treatment, there was a gradual decrease in edema and hyperemia of the foot, the disappearance of wound discharge, normalization of laboratory parameters and body temperature, wounds were slowly filled with granulation tissue. However, 14 days after the start of treatment, the patient began to sharply increase swelling of the stump of the right foot, hyperemia and hyperthermia of the skin of the stump of the right foot (Fig. 1). At the same time, in a short time (2-3 days), active formation of granulation tissue in the bottom of the wound was noted. During the revision of the granulating wound of the stump of the right foot, purulent swelling in the soft tissues was not detected, while marked bleeding of the granulation tissue was noted.

ISSN NO: 2770-2936
Date of Publication:06-05-2023

Fig. 1. Patient, 65 years old, DFS, condition after opening the phlegmon of the stump of the right foot. Edema, deformity and hyperemia of the stump of the right foot, granulating wound on the back of the right foot. (indicated by an arrow).

Repeated radiography of the right foot was performed, which revealed an extensive zone of bone-articular destruction of the middle part of the stump of the right foot (Fig.2).

Fig. 2. Patient, 65 years old. X–ray of the stump of the right foot after 14 days from the moment of admission - destruction of the bones of the tarsal-metatarsal joint. (indicated by arrows).

Similar bone-destructive changes characteristic of the acute phase of Charcot osteoarthropathy were detected on CT and MRI of the right foot (Fig.3).

Fig. 3. Patient, 65 years old. CT scan of the right foot – destruction of the bones of the tarsal-metatarsal joint. (indicated by arrows).

According to the conclusion of the ultrasound examination of the arteries of the lower extremities performed on the eve of hospitalization, the patient had stenosis of the superficial femoral artery (SFA) and the anterior tibial artery (ATA) on the right, collateral blood flow in the posterior tibial artery (PTA). Repeated ultrasound of the arteries was performed: arterial altered blood flow in the ATA, occlusion of the ATA from the mouth, moderate swelling of the soft tissues of the right shin. To clarify the nature of the

ISSN NO: 2770-2936
Date of Publication:06-05-2023

lesion of the vessels of the lower extremity on the side of the lesion in the acute phase of osteoarthropathy, the patient underwent MSCT of the arteries of the lower extremities. According to the results of MSCT, the nature and extent of the lesion of the main arteries of the right lower limb are clearly visualized: narrowing of the right superficial femoral artery in the middle third to 40%, tibio-peroneal trunk to 60%, absence of contrast of the posterior tibial artery. There was also a good contrast between the deep and superficial veins of the right lower limb (Fig.4). Taking into account the coincidence of the arterial and venous phase of contrast on the side of the lesion, it was not possible to clearly assess the nature of arterial circulatory disorders in the distal limb using MSCT.

Similar changes were found in other cases when the acute phase of Charcot osteoarthropathy developed against the background of the neuroischemic form of DFS.

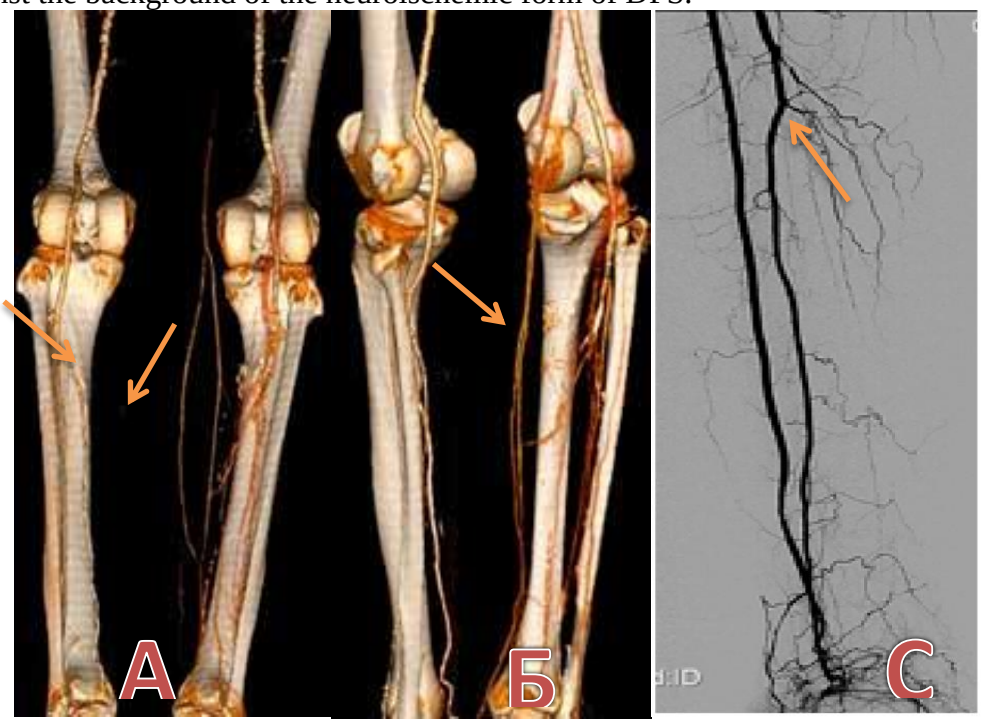

Fig. 4. Patient, 65 years old. MSCT angiography and radiopaque angiography of the lower extremities. A, B – occlusion of the PTA on the right, contrasting veins of the right shin (indicated by arrows); C – occlusion of the right PTA in the upper third (indicated by arrows);

To compare the changes in the blood circulation of the lower extremity against the background of the acute phase of osteoarthropathy, we performed ultrasound examinations of the arteries of the lower extremities and in 5 patients with neuropathic form of DFS. In all cases, the results of ultrasound examination determined the main blood flow in the arteries of the lower extremities. A computed tomography of the arteries of the lower extremities was performed in one of the patients with the acute phase of CS against the background of the neuropathic form of SDS. According to the results of MSCT, even more pronounced arteriovenous shunting in soft tissues was noted on the side of the lesion (Fig. 5 A, B), while it is not possible to differentiate arterial and venous vessels from each other in the distal parts of the limb. On the other limb of the same patient, according to MSCT, occlusive ZBBA lesion was clearly visualized, there was no contrast of the venous bed. Selective angiography demonstrated the main blood flow in the arteries of the limb on the side of the acute phase of CS, otherwise the results coincided with MSCT (Fig. 5 In, D).

ISSN NO: 2770-2936
Date of Publication:06-05-2023

Fig. 5. Patient, 65 years old, DFS, neuropathic form, acute phase of SS, MSCT-angiography, selective radiopaque angiography of the arteries of the lower extremities, A, B – pronounced arteriovenous bypass surgery of the left lower limb (indicated by arrows); C – occlusion of PTA and IBA on the right (indicated by arrows); D – preserved blood flow in the tibial arteries on the left.

Discussion

These examples show that the acute phase of osteoarthropathy can also develop in patients with a violation of the main blood flow against the background of the neuroischemic form of DFS. At the same time, the presence of hemodynamically significant atherosclerotic lesion of the main arteries of the lower extremities does not prevent the development of Charcot's foot. One of the known mechanisms underlying the development of osteoarthropathy is the process of arteriovenous shunting in bone tissue. The data reflected in the study show that the process of arteriovenous bypass surgery in patients with the acute phase of CS also develops in the soft tissues of the affected lower limb. At the same time, the described mechanism is universal both in patients with neuropathic and in patients with the neuroischemic form of diabetic foot syndrome. It is also important that the development of this process in patients with the neuroischemic form of DFS makes significant changes in the nature of the course of the wound process.

The course of the wound process in patients with impaired arterial circulation in the lower extremities, in addition to the presence of classical signs of wound infection, is characterized by the formation of extensive areas of soft tissue necrosis, the absence or sluggish process of granulation tissue formation, which ultimately causes a high risk of progression of purulent-necrotic lesions of the limb and often leads to its amputation. It is also known that the worse the blood supply to the limb, the lower the probability of healing of a trophic ulcer or wound defect. The isolation of such a condition as critical limb ischemia implies the inevitable development of extensive necrosis of the foot tissues and amputation of the limb, if adequate blood flow has not been restored.

A "side effect" in the development of the acute phase of Charcot osteoarthropathy in patients with the neuroischemic form of SDS is an increase in blood supply to the foot tissues, and, as a consequence, activation of the healing processes of wound defects. The clinical effect of the described mechanism, however, can be assessed in two ways. On the one hand, increased local blood flow stimulates the process of cleansing and regeneration of the wound, creating prerequisites for self-healing or performing plastic closure of the wound defect. On the other hand, the pathological functioning of arteriovenous shunts leads to an increase in the level of venous pressure, an increase in filtration through the capillary wall, which leads to the development of pronounced tissue edema, which can aggravate microcirculatory disorders.

ISSN NO: 2770-2936
Date of Publication:06-05-2023

Conclusions

The theories of the origin and development of Charcot osteoarthropathy are currently the subject of discussion. The importance of the vascular component in the occurrence and course of the disease requires further targeted study both to clarify the essence of the pathological changes occurring in the limb on the side of the lesion, and to determine the tactics of treatment of this serious disease and its complications.

Literatures

1. Hartemann-Heurtier A., Van G.H., Grimaldi A. The Charcot foot. Lancet 2002;360:1776—9.
2. Jeffcoate W.J., van Houtum W.H. Amputation as a marker of the quality of foot care in diabetes. Diabetologia 2004;47(12):2051—8.
3. Dedov I.I., Shestakova M.V. Diabetes mellitus. A guide for doctors. M., Universum Publishing; 2003.
4. Charcot J.M. Sur quelaques arthropathies qui paraissent depender d'une lesion du cerveau oude la moeleepiniere. Arch Des Physiol Norm Pathol 1868;1:161—71.
5. Jordan W.R. Neuritic manifestations in diabetes mellitus. Arch Int Med 1936;57:307—66.
6. Sanders L.J., Frykberg R.G. Charcot neuroarthropathy of the foot. In: J.H. Bowker, M.A. Pfeifer (eds). Levin and O'Neal's The Diabetic Foot, 6th ed. St Louis, Mosby; 2001. p. 439—66.
7. Boulton A.J., Scarpello J.H., Ward J.D. Venous oxygenation in the diabetic neuropathic foot: evidence of arterial venous shunting? Diabetologia 1982;22:6—8.
8. Armstrong D.G., Todd W.F., Lavery L.A. et al. The natural history of acute Charcot's arthropathy in a diabetic foot specialty clinic. Diabet Med 1997;14:357—63.
9. Banks A.S., McGlamry E.D. Charcot foot. J Am Podiatr Med Assoc 1989;79:213—35.
10. The foot in diabetes. 3rd ed. A.J.M. Boulton, H. Connor, P.R. Cavanagh (eds). Chichester, John Wiley &Sons Ltd; 2000.
11. Guryeva I.V., Kotukhova Ya.I., Meleshkevich T.A. Diabetic foot. Is effective prevention possible? RMJ 2001;9(24):1122-7.
12. Sanders L.J., Frykberg R.G. Diabetic neuropathic neuroarthropathy: the Charcot foot. In: R.G. Frykberg (ed). The high risk foot in diabetes mellitus. N Y, Churchill Livingstone; 1991. p. 297—33