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# Peculiarities of MRI in patients with Charcot's foot in the active stage

## Summary

**Purpose of the study:** Explore the role of MRI in the diagnosis of Charcot foot in patients with active diabetic osteoarthropathy.

**Material and methods research:** 35 patients (prospectively) with type 2 diabetes mellitus and Charcot foot in the active phase were examined in the period 2022-2023 at the Acad. Y.H. Turakulova, in the department reconstructive plastic surgery of complications of diabetes mellitus.

The control group consisted of 20 people with type 2 diabetes mellitus without Charcot foot in compensation. Of the 35 patients, there were 28 men and 7 women. Average age: men was 64.12 ± 5.8 years, women - 62.15 ± 4.6 years. The duration of type 2 diabetes mellitus ranged from 17 to 20 years.

**Research methods included:** biochemical, hormonal and instrumental: ECG, MRI of the feet, ultrasound of the internal organs, DECA of the body, fundus.

**Research results:** All patients were in a state of carbohydrate metabolism decompensation. In addition, pathological changes in bone tissue increased as the average values of glycated hemoglobin increased. As the level of carbohydrate metabolism decompensation increased, the degree of bone tissue recovery decreased (inverse correlation).

**Conclusions:** 1. An early symptom on MRI with Charcot foot was the presence ofconcavity of the articular surface of the talus against the background of sclerosis in the talonavicular joint. 2. Pathological changes in the bone tissue increased as the average values of the level of glycated hemoglobin increased. 3. A direct correlation was found between the MRI parameters in Charcot foot and the HbA1c level: as the level of carbohydrate metabolism decompensation increased, the degree of bone tissue recovery decreased.

Volume 10 Issue 3 - 2023

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**Received:** May 19, 2023 | **Published:** June 02, 2023

## Relevance

It is known that type 2 diabetes mellitus (DM 2) is one of the urgent problems in endocrinology. Among the complications of type 2 diabetes, Charcot's foot occupies a special place, since the issues of pathogenesis and early diagnosis, as well as the prevention and treatment of this complication, are still relevant.

At the same time, an examination such as MRI can be very useful for the early diagnosis of Charcot's foot. This is explained by the fact that MRI can determine the stage of the disease, the condition of bone and soft tissues, as well as the success of unloading treatment. Thanks to MRI, we can monitor the effectiveness of treatment. Another very important role of MRI lies in its ability to additionally evaluate complications of the Charcot foot, in particular soft tissue infections and osteomyelitis.[1-3] In patients with MRI contraindications, radionuclide imaging or PET-CT with Te99 can be performed.

It should be noted that the diagnosis of Charcot foot cannot be made on the basis of imaging alone and must always be considered in the context of clinical parameters (polyneuropathy, foot redness, etc.).[4,5] However, there are some typical MRI features for early and late Charcot foot.

According to the authors, MRI is currently the best imaging modality for confirming the diagnosis of suspected early active Charcot disease.[6] This can be critical, as plain radiographs may appear falsely normal at a very early stage in Charcot's disease (Eichengoltz stage 0). Early signs of Charcot foot on MRI are bone marrow and soft tissue edema, articular effusion, and eventually microfractures (subchondral).[7] At the early stage of the Charcot foot, there are no fractures of the cortical layer and gross deformation of the bones.[8]

OnCharcot foot MRI of the middle and late stage (from fragmentation to consolidation) already shows symptoms of joint destruction, cortical fractures and joint dislocations. Bone marrow edema may be very common in mid Charcot foot or absent, depending on disease activity. Especially the involvement of the Lisfranc joint leads to the typical superior and lateral displacement of the metatarsals, leading to a complete collapse of the longitudinal arch. On radiograph: the head of the talus is usually tilted towards the sole of the foot a) the navicular bone is usually displaced to a medial and superior position, often with fractures and fragmentation. At the same time, protruding well-defined subchondral cysts are a typical sign of chronic Charcot foot. Bone proliferation and sclerosis, debris, and intraarticular bodies may be observed.[8]

In summary, MRI remains the best imaging modality for monitoring disease activity. As long as significant bone marrow edema is detected on MRI, subsequent unloading therapy with removable total contact plaster casts should be continued.[9] After a significant reduction or complete disappearance of bone marrow edema, the cast can be removed and orthopedic shoes adapted.

Despite the study of this issue, the pathogenesis, early diagnosis, prevention and treatment of Charcot's foot remain debatable.

## Purpose of the study

To study the role of MRI in the diagnosis of Charcot footin patients with diabetic osteoarthropathy in the active stage of complications.

## Material and research methods

35 patients (prospectively) with type 2 diabetes mellitus and Charcot foot in the active phase were examined in the period 2022-2023 at the Acad. Y.H. Turakulova, in the department reconstructive plastic surgery of complications of diabetes mellitus.

The control group consisted of 20 people with type 2 diabetes without Charcot foot in compensation.

Of the 35 patients, there were 28 men and 7 women. Average age: men was 64.12 ± 5.8 years, women - 62.15 ± 4.6 years. The duration of type 2 diabetes ranged from 17 to 20 years.

**Research methods included:** biochemical (bilirubin, direct, indirect, lipid spectrum, ALT, AST, PTI, coagulogram, blood sugar, glycated hemoglobin, urea, creatinine, total calcium, alkaline phosphatase, Beta-Cross Laps, GFR, calcium, alkaline phosphatase), hormonal (insulin , C-peptide, parathyroid hormone, vitamin D3, blood osteocalcin) and instrumental: ECG, MRI of the feet, ultrasound of the internal organs, DECA of the body, fundus.

Statistical calculations were carried out in the Microsoft Windows software environment using the Microsoft Excel-2007 and Statistica version 6.0, 2003 software packages. The obtained data are shown as M±m, where M is the mean value of the variation series, m is the standard error of the mean value. Quantitative variables were compared using Student's t-test. A p value below 0.05 was considered statistically significant.

## Research results

Table 1 shows the distribution of patients by sex and age.

As can be seen from Table 1, most of the patients were aged 60 to 74 years - 26 (74.2%), while the number of men was more.

Hormonal and biochemical characteristics of patients of the studied groups are presented in Table 2.

As can be seen from Table 2, in terms of biochemical and hormonal parameters in patients of the main group, significant differences were found in comparison with the control group. Observedsignificant violations of carbohydrate metabolism in all groups, which shows the state of decompensation in these patients. At the same time, the values of the lipid spectrum significantly differed from the norm, especially TC, triglycerides, HDL.

Thus, in patients of the main groups, PTH levels were significantly elevated ($p<0.05$), whileaverage values of vit D3in group 1, in patients with the acute stage of Charcot's foot, the values of Vit D3 were still within the lower limit of normal.

From the side of biochemical parameters of blood, the average values of total calcium were unreliably lower than in the control group, higher in the main group($p > 0.05$), that is, these patients were characterized by a tendency to hypocalcemia. The level of Ca++ was insignificantly reduced in 55.5% of patients ($p<0.001$).

At the same time, the levels of alkaline phosphatase were within the normal range or unsignificantly increased ($p> 0.05$).

It was found that the average value of the bone marker**Beta-Cross Laps was significantly higher in the main group of patients** ($p <0.05$), which indicates the processes of destruction of bone tissue.

The next stage of our work was the study of MRI of the feet in the study groups.patients (Table 3).
Next, we decided to study the relationship between the state of foot MRI depending on the level of glycated hemoglobin (Table 4). To this end, we divided 35 patients into 3 subgroups depending on the mean HbA1c values.

Table 4 shows that all patients were in a state of carbohydrate metabolism decompensation. In addition, pathological changes in bone tissue increased as the average values of glycated hemoglobin increased.

Next, we studied the correlation R between the MRI parameters and the HbA1c level in dynamics after the treatment according to the degree of achievement of carbohydrate metabolism compensation (Table 5).

**Table 1** Distribution of patients by sex and age

| Age, years | Number of men | Number of women |
|---|---|---|
| 30-44 | - | - |
| 45-59 | 5 | 4 |
| 60-74 | 23 | 3 |
| 75 and older | - | - |
| Total: n=35 | 28 | 7 |

**Table 2** Hormonal and biochemical characteristics of patients in the study groups

| Index | Main group n=35 | Control n=20 |
|---|---|---|
| fasting glycemia, mmol/l | 9.21±4.29* | 4.3±0.3 |
| Postprandial hyperglycemia, mmol/l | 11.08±3.12* | 6.8±0.7 |
| HbA1c, % | 11.83±2.1** | 4.3±0.6 |
| PTH, pg/ml | 71.8±5.1* | 23.2 ± 2.1 |
| Calcium total, mmol/l | 2.1±0.5 | 2.2±0.5 |
| 25(OH)-D or vit D3, pg/ml | 28.6 ± 1.3* | 36.2 ± 8.5 |
| beta cross laps,ng/ml | 1.8±0.2 | 0.512±0.07 |
| Alkaline phosphatase, μm / l | 0.6±0.04 | 0.5±0.04 |
| Osteocalcin ng/ml | 30.3±5.4 | 38.1±5.2 |
| total cholesterol | 6.89±0.18* | 4.1±0.6 |
| triglycerides | 2.05±0.08* | 0.82±0.04 |
| Beta-lipoproteins | 0.58±0.01 | 0.44±0.03 |
| HDL | 1.01±0.03* | 1.2±0.31 |
| LDL | 4.03±0.07 | 1.1±0.26 |

**Note:** HDL, high density lipoproteins; LDL, low density lipoproteins; *reliability of differences in groups in comparison with control. At the same time, *$p<0.005$ **$p< 0.001$

**Citation:** Kamalov TT, Tojiboev SS. Peculiarities of MRI in patients with Charcot's foot in the active stage. *Int J Radiol Radiat Ther.* 2023;10(3):47–49. DOI: 10.15406/ijrrt.2023.10.00354

**Table 3** Comparative characteristics of foot MRI indicators

| Index | Main group N=35 |
|---|---|
| Concavity of the articular surface of the talus against the background of sclerosis in the talonavicular joint | 35 (100%) |
| Progressive destruction in the talonavicular joint, debris migration | 12 (34.3%) |
| Massive effusion stretching the joint | 35(100%) |
| Bone destruction on both sides of the joint | 35(100%) |
| Bone destruction on both sides of the joint outlined by effusion | 14 (40%) |

**Table 4** The relationship between the state of MRI of the foot depending on the level of glycated hemoglobin

| Index | I subgroup N=0 HbA1c 6-6.9% | I subgroup N=17 HbA1c 7.0-8.9% | I subgroup N=18 HbA1c 9% and above |
|---|---|---|---|
| Concavity of the articular surface of the talus against the background of sclerosis in the talonavicular joint | - | 17 (100%) | 18(100%) |
| Progressive destruction in the talonavicular joint, debris migration | - | 5 (29.4%) | 7 (38.8%) |
| Massive effusion stretching the joint | - | 17(100%) | 18(100%) |
| Bone destruction on both sides of the joint | - | 17(100%) | 18(100%) |
| Bone destruction on both sides of the joint outlined by effusion | | 6 (35.3%) | 8 (44.4%) |

**Table 5** Correlation R between MRI parameters and HbA1c level in dynamics after conservative treatment (3 months) according to the degree of achievement of carbohydrate metabolism compensation

| Index | I subgroup N=0 HbA1c 6-6.9% | I subgroup N=17 HbA1c 7.0-8.9% | I subgroup N=18 HbA1c 9% and above |
|---|---|---|---|
| Concavity of the articular surface of the talus against the background of sclerosis in the talonavicular joint | - | 0.82 | 0.89 |
| Progressive destruction in the talonavicular joint | - | 0.69 | 0.73 |
| Massive effusion stretching the joint | - | 0.65 | 0.67 |
| Bone destruction on both sides of the joint | - | 0.64 | 0.73 |
| Bone destruction on both sides of the joint outlined by effusion | - | 0.72 | 0.83 |
| Bone Consolidation | - | -0.88 | -0.23 |

As can be seen from Table 5, there is a direct correlation between the MRI parameters in Charcot foot and the HbA1c level: as the level of carbohydrate metabolism decompensation increased, the degree of bone tissue recovery decreased.

Thus, the performed studies confirm the literature data on the importance of MRI in the examination of patients with Charcot's foot and it is necessary to continue these works.

## Conclusion

An early symptom on MRI with Charcot foot was the presence ofconcavity of the articular surface of the talus against the background of sclerosis in the talonavicular joint. 2. Pathological changes in the bone tissue increased as the average values of the level of glycated hemoglobin increased. 3. A direct correlation was found between the MRI parameters in Charcot foot and the HbA1c level: as the level of carbohydrate metabolism decompensation increased, the degree of bone tissue recovery decreased.

## Conflicts of interest

All authors declare that there is no conflicts of interest.

## Acknowledgements

None.

## References

1. Schoots IG, Slim FJ, Busch–Westbroek TE, et al. Neuro–osteoarthropathy of the foot–radiologist: friend or foe? *Semin Musculoskelet Radiol.* 2010;14(3):365–376.
2. Rosskopf AB, Berli MC. The role of radiological imaging for treatment of Charcot foot [article in German]. *Fuss and Sprunggelenk.* 2018;16:99–108.
3. Toledano TR, Fatone EA, Weis A, et al. MRI evaluation of bone marrow changes in the diabetic foot: a practical approach. *Semin Musculoskelet Radiol.* 2011;15(3):257–268.
4. Ergen FB, Sanverdi SE, Oznur A. Charcot foot in diabetes and an update on imaging. *Diabetic Foot & Ankle*. 2013;4:21884
5. van Netten JJ, Prijs M, van Baal JG, et al. Diagnostic values for skin temperature assessment to detect diabetes–related foot complications. *Diabetes Technol Ther.* 2014;16(11):714–721.
6. Mautone M, Naidoo P. What the radiologist needs to know about Charcot foot. *J Med Imaging Radiat Oncol.* 59(4):395–402.
7. Ahmadi ME, Morrison WB, Carrino JA, et al. Neuropathic arthropathy of the foot with and without superimposed osteomyelitis: MR imaging characteristics. *Radiology.* 2006;238:622–631.
8. Ledermann HP, Morrison WB. Differential diagnosis of pedal osteomyelitis and diabetic neuroarthropathy: MR imaging. *Semin Musculoskelet Radiol.* 2005;9(3):272–283.
9. Renner N, Wirth SH, Osterhoff G, et al. Outcome after protected full weightbearing treatment in an orthopedic device in diabetic neuropathic arthropathy (Charcot arthropathy): a comparison of unilaterally and bilaterally affected patients. *BMC Musculoskeletal Disorders.* 2016;17:1–9.

**Citation:** Kamalov TT, Tojiboev SS. Peculiarities of MRI in patients with Charcot's foot in the active stage. *Int J Radiol Radiat Ther.* 2023;10(3):47–49. DOI: 10.15406/ijrrt.2023.10.00354