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CT-BASED DETECTION OF MYOSTEATOSIS IN PATIENTS WITH SARCOPENIA ASSOCIATED WITH ONCOLOGICAL DISEASES




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ОНКОЛОГИК КАСАЛЛИКЛАР БИЛАН БОҒЛИҚ САРКОПЕНИЯЛИ БЕМОРЛАРДА МИОСТЕАТОЗНИ КТ-ТАШҲИСЛАШ

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КТ-ДИАГНОСТИКА МИОСТЕАТОЗА У ПАЦИЕНТОВ С САРКОПЕНИЕЙ, АССОЦИИРОВАННОЙ С ОНКОЛОГИЧЕСКИМИ ЗАБОЛЕВАНИЯМИ

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Резюме. *Тадқиқотга тананинг таркибий тузилишини баҳолаш билан L3 даражасида компьютер томографияси (КТ) ўтказилган 102 нафар онкологик бемор киритилди. Саркопения 56,8% беморларда, миостеатоз — 48,0% беморларда, уларнинг биргаликда учраши эса — 36,2% ҳолларда аниқланди. Саркопенияли беморларда скелет мушаклари зичлиги сезиларли даражада пасайган (SMD 36,9 ± 6,2 HU га нисбатан 42,7 ± 5,8 HU; p < 0,001). Миостеатоз IL-6 ва CRP даражалари ошиши билан боғлиқ бўлиб, кимёотерапиянинг юқори токсиклиги ҳамда бир йиллик тирик қолиш даражасининг пасайиши (68,9% га нисбатан 84,6%) билан чамбарчас боғлиқ эди. КТ-асосида миостеатозни баҳолаш онкологик беморларда саркопения ҳолатида самарали диагностик ва прогностик усул ҳисобланади.*

Калит сўзлар: *саркопения, миостеатоз, компьютер томографияси, саратон, скелет мушаклари зичлиги, IL-6, яллиғланиш, прогноз.*

Abstract. *The study included 102 oncological patients who underwent computed tomography (CT) with body composition assessment at the L3 vertebral level. Sarcopenia was detected in 56.8% of patients, myosteatosis in 48.0%, and their combination in 36.2%. Patients with sarcopenia showed a significant reduction in skeletal muscle density (SMD 36.9 ± 6.2 HU vs. 42.7 ± 5.8 HU; p < 0.001). Myosteatosis correlated with elevated IL-6 and CRP levels and was associated with increased chemotherapy toxicity and reduced one-year survival (68.9% vs. 84.6%). CT-based assessment of myosteatosis is an effective diagnostic and prognostic tool in oncological patients with sarcopenia.*

Keywords: *sarcopenia, myosteatosis, computed tomography, cancer, skeletal muscle density, IL-6, inflammation, prognosis.*

Relevance of the Study. In modern oncology, the problem of body composition disorders, particularly sarcopenia and myosteatosis, is gaining increasing clinical and prognostic importance. Sarcopenia is a progressive decline in skeletal muscle mass and strength observed in 50–80% of patients with advanced malignant tumors. However, an equally significant component of muscle dysfunction is myosteatosis — fat infiltration of skeletal muscle tissue, reflecting a qualitative deterioration in its structure and metabolic activity [3, 7].

According to international studies [2, 5], the presence of myosteatosis in cancer patients is associated with a 30–50% higher risk of surgical and chemotherapeutic complications, increased hospitalization rates, and reduced overall survival. Unlike sarcopenia, myosteatosis may develop even with preserved total muscle mass, making it an independent predictor of poor disease course and reduced tolerance to anticancer therapy [1, 4, 6].

Pathogenetically, myosteatosis is closely related to chronic inflammation and cytokine-induced catabolism. Elevated levels of IL-6, TNF-α, and CRP contribute to mitochondrial dysfunction, insulin resistance, and intramuscular fat infiltration, leading to a decrease in muscle density and functional capacity.

Computed tomography (CT) is currently the most accurate tool for objective assessment of skeletal muscle condition. Analysis of axial CT slices at the third lumbar vertebral level (L3) enables quantitative determination of muscle area and density (SMA, SMD), providing precise diagnostics of both sarcopenia and myosteatosis [3, 4, 6].

In the context of a growing need for a personalized approach to the management of cancer patients, CT-based assessment of myosteatosis has particular clinical value. This parameter can serve as a simple and reliable criterion for stratifying patients by risk of complications, treatment intolerance, and survival outcomes [5, 7].

Given the high prevalence of structural and functional muscle disorders among oncological patients and the limited amount of domestic research data, investigating the frequency, severity, and prognostic significance of myosteatosis in patients with sarcopenia appears to be a relevant and clinically justified direction in modern oncoradiology and nutritional medicine [2].

Objective: to evaluate the incidence and severity of myosteatosis in oncological patients with sarcopenia using computed tomography (CT) and to determine its clinical and prognostic significance.

Materials and Methods. The study included 102 oncological patients (47 men and 55 women, mean age 61.4 ± 8.7 years) with various malignant tumors: stomach (n = 34), pancreas (n = 21), colon (n = 19), and breast (n = 28). All patients underwent chest and abdominal computed tomography (CT) with body composition analysis at the level of the third lumbar vertebra (L3).

For quantitative assessment, the following parameters were evaluated:

-SMI (Skeletal Muscle Index, cm^2/m^2) – skeletal muscle area normalized for height;

-SMD (Skeletal Muscle Density, HU) – mean muscle tissue density in Hounsfield units;

-IMAT (Intermuscular Adipose Tissue, cm^2) – intermuscular adipose tissue area.

-Sarcopenia was diagnosed when SMI < 41 cm^2/m^2 in women and < 53 cm^2/m^2 in men (EWGSOP2, 2019).

Table 1. Indicators of Skeletal Muscle Condition and Inflammatory Markers in Oncological Patients

Parameter	Total group, (n = 102)	Without sarcopenia, (n = 44)	With sarcopenia, (n = 58)	p-value
Sarcopenia, n (%)	58 (56.8%)	—	—	—
Myosteatosis, n (%)	49 (48.0%)	—	—	—
Combination of sarcopenia + myosteatosis, n (%)	37 (36.2%)	—	—	—
Muscle density (SMD), HU	39.4 ± 6.1	42.7 ± 5.8	36.9 ± 6.2	< 0.001
Most pronounced myosteatosis	—	—	Stomach, pancreas	—
IL-6 level, pg/mL (mean)	14.2 ± 4.8	11.0 ± 3.9	16.8 ± 5.1	< 0.001
CRP level, mg/L (mean)	12.7 ± 5.3	10.1 ± 4.0	15.4 ± 5.7	< 0.01
Correlation SMD – IL-6	—	—	r = –0.63	p < 0.001
Correlation IMAT – CRP	—	—	r = 0.52	p < 0.01
Chemotherapy toxicity, %	—	21.7 %	43.2 %	< 0.05
1-year survival, %	—	84.6 %	68.9 %	< 0.05

Notes: SMD — Skeletal Muscle Density; IMAT — Intermuscular Adipose Tissue; CRP — C-reactive protein; CT — chemotherapy.

-Myosteatosis was defined as SMD < 41 HU in patients with BMI < 25 kg/m² and < 33 HU in those with BMI ≥ 25 kg/m².

-Biochemical indicators (albumin, IL-6, and CRP) were used for correlation analysis.

Results. Sarcopenia was identified in 58 patients (56.8%), myosteatosis in 49 patients (48.0%), and their combination in 37 patients (36.2%).

The most pronounced myosteatosis was observed in patients with pancreatic and gastric cancer. A significant negative correlation was found between SMD and IL-6 levels ($r = –0.63$, $p < 0.001$), and a positive correlation between IMAT and CRP ($r = 0.52$, $p < 0.01$). Patients with myosteatosis had a significantly higher risk of chemotherapy-related toxicity (43.2 % vs 21.7 %, $p < 0.05$) and lower one-year survival (68.9 % vs 84.6 %, $p < 0.05$).

Discussion. The results of this study confirm that myosteatosis is an important component of the sarcopenic syndrome in oncological patients, reflecting qualitative deterioration in the structure and metabolism of skeletal muscles. Nearly half of the examined patients (48.0%) showed signs of myosteatosis, and in one-third of cases (36.2%) it was combined with pronounced sarcopenia. These findings are consistent with international data, according to which the prevalence of myosteatosis in cancer patients ranges from 40% to 60% (Prado C.M. et al., 2020; Baracos V.E., 2022), most frequently occurring in tumors of the gastrointestinal tract.

The obtained values of skeletal muscle density (SMD) demonstrated a significant reduction in patients with sarcopenia (36.9 ± 6.2 HU) compared with those without it (42.7 ± 5.8 HU; $p < 0.001$), indicating a decline in muscle metabolic quality and fat infiltration. The most pronounced changes were found in patients with pancreatic and gastric cancers, likely due to severe hypercatabolism, nutritional deficiency, and systemic inflammation characteristic of these tumor localizations.

The correlations identified between decreased SMD and elevated IL-6 levels ($r = –0.63$; $p < 0.001$), as well as between increased IMAT and CRP ($r = 0.52$; $p < 0.01$), confirm the role of inflammatory cytokines in the development of myosteatosis. Elevated IL-6 and CRP reflect activation of the cytokine cascade and chronic inflammation, leading to mitochondrial dysfunction, enhanced lipolysis, and intramuscular fat deposition. These mechanisms, described in both experimental and clinical studies, are recognized as key elements in the pathogenesis of cancer cachexia and sarcopenia.

The clinical significance of myosteatosis is manifested in its direct impact on the tolerance to anticancer therapy. In our study, patients with myosteatosis had almost twice the risk of chemotherapy-related toxicity (43.2% vs. 21.7%; $p < 0.05$), which can be explained by reduced volume of functionally active muscle tissue and altered pharmacokinetics of cytostatic drugs. Moreover, a significant reduction in one-year survival was observed in patients with myosteatosis (68.9% vs. 84.6%; $p < 0.05$), confirming its independent prognostic value.

Thus, the decrease in skeletal muscle density (SMD) observed by CT represents not only a morphological but also a clinically meaningful marker of systemic metabolic disturbances. Incorporating CT-based myosteatosis assessment into routine diagnostic protocols allows for early detection of sarcopenic alterations and stratification of patients according to the risk of unfavorable outcomes, including treatment-related complications and reduced survival.

A promising direction for further research is a comprehensive evaluation of the influence of myosteatosis on quality of life, nutritional status, and inflammatory biomarkers (IL-6, TNF-α, CRP), as well as longitudinal monitoring of SMD and IMAT dynamics during treatment and rehabilitation.

Conclusion. Myosteatosis was detected in nearly half of the oncological patients (48%), most often in combination with sarcopenia (36.2%).

A decrease in skeletal muscle density (SMD < 40 HU) was associated with elevated IL-6 and CRP levels and with poorer clinical outcomes.

CT-based body composition analysis is a reliable tool for diagnosing myosteatosis and should be included in the standard evaluation of oncological patients with signs of sarcopenia.

Literature:

1. Cruz-Jentoft, A. J., Bahat, G., Bauer, J., et al. (2019). Sarcopenia: revised European consensus on definition and diagnosis. Age and Ageing, 48(1), 16–31. https://doi.org/10.1093/ageing/afy169

2. Paiva, S. I., Borges, L. R., Halpern-Silveira, D., et al. (2010). Standardized phase angle from bioelectrical impedance analysis as a prognostic factor in cancer. BMC Cancer, 10, 267. https://doi.org/10.1186/1471-2407-10-267

3. Norman, K., Stobäus, N., Pirlich, M., & Bosy-Westphal, A. (2012). Bioelectrical phase angle and impedance vector analysis – Clinical relevance and applicability of impedance parameters. Clinical Nutrition, 31(6), 854–861. https://doi.org/10.1016/j.clnu.2012.05.008

4. Kazakevich, E. V., Kondratyeva, E. I., & Chizhova, V. P. (2019). Bioimpedance analysis in the assessment of nutritional status in cancer patients. Voprosy Onkologii, 65(3), 410–415. [In Russian].

5. Sukhanov, V. A., Laptev, B. I., & Ivanova, T. I. (2020). Clinical significance of phase angle in oncological diseases. Russian Oncological Journal, 25(4), 45–51. [In Russian].

6. Kazemi-Bajestani, S. M. R., Mazurak, V. C., & Baracos, V. (2016). Computed tomography-defined muscle and fat wasting are associated with cancer

clinical outcomes. Seminars in Cell & Developmental Biology, 54, 2–10. https://doi.org/10.1016/j.semcdb.2015.09.006
7. Martin, L., Birdsell, L., Macdonald, N., et al. (2013). Cancer cachexia in the age of obesity: Skeletal muscle depletion is a powerful prognostic factor, independent of body mass index. Journal of Clinical Oncology, 31(12), 1539–1547. https://doi.org/10.1200/JCO.2012.45.2722
8. Rizaev J. A. et al. The need of patients with systemic vasculitis and coronavirus infection in the treatment of periodontal diseases //Applied Information Aspects of Medicine (Prikladnye informacionnye aspekty mediciny). – 2022. – Т. 25. – №. 4. – С. 40-45.
9. Rizaev J. A., Kuliev O. A. Risk factors of anemia in children and prognosing of it //Электронный инновационный вестник. – 2018. – №. 4. – С. 62-65.
10.Rizaev J. A., Ruzimurotova Y. S., Khaydarova G. A. The impact of social and health factors at work and at home on nurses'health //Вестник магистратуры. – 2022. – №. 2-1 (125). – С. 10-12.
11.Rizaev J. A. et al. Immunological and Clinical Aspects of Oral Inflammatory Diseases in the Development of Postpartum Septic Complications //International Journal of Integrative and Modern Medicine. – 2024. – Т. 2. – №. 12. – С. 253-257.
12.Rizaev J. A. et al. Physico-chemical parameters of mixed saliva and their correction in patients in the post-covid period //Cardiometry. – 2022. – №. 25. – С. 1168-1173.
13.Rizaev J. A., Khazratov A. I., Iordanishvili A. K. Morphofunctional characteristics of the mucous membrane of the masticatory apparatus in experimental carcinogenesis //Russian Journal of Dentistry. – 2021. – Т. 25. – №. 3. – С. 225-231.
14.Rizaev J. A., Imamov O. S., Toxtayev G. S. Clinical and histological characterization of oral pemphigus lesions in patients // Central Asian Journal of Medicine. – 2025. – №. 2. – С. 99-105.
15.Rizaev J. A. et al. Medical and organizational measures to improve the provision of medical care in the dermatovenerology profile //International Journal of Current Research and Review. – 2020. – Т. 12. – №. 24. – С. 120-122.
16.Rizaev J. A., Shodmonov A. A., Olimjonov K. J. Periimplantitis-early complications in dental implantations //Биомедицина ва амалиёт журнали. – С. 28.

КТ-ДИАГНОСТИКА МИОСТЕАТОЗА У ПАЦИЕНТОВ С САРКОПЕНИЕЙ, АССОЦИИРОВАННОЙ С ОНКОЛОГИЧЕСКИМИ ЗАБОЛЕВАНИЯМИ

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Резюме. *В исследование были включены 102 онкологических пациента, которым проводилась компьютерная томография (КТ) с оценкой состава тела на уровне позвонка L3. Саркопения была выявлена у 56,8% пациентов, миостеатоз — у 48,0%, а их сочетание — у 36,2%. У пациентов с саркопенией отмечалось значительное снижение плотности скелетной мускулатуры (SMD 36,9 ± 6,2 HU против 42,7 ± 5,8 HU; p < 0,001). Миостеатоз коррелировал с повышенными уровнями IL-6 и CRP, а также был связан с увеличением токсичности химиотерапии и снижением одногодичной выживаемости (68,9% против 84,6%). КТ-оценка миостеатоза является эффективным диагностическим и прогностическим инструментом у онкологических пациентов с саркопенией.*

Ключевые слова: *саркопения, миостеатоз, компьютерная томография, онкологические заболевания, плотность скелетной мускулатуры, IL-6, воспаление, прогноз.*