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СОПОСТАВЛЕНИЕ ДАННЫХ КОМПЬЮТЕРНОЙ ТОМОГРАФИИ С ИСХОДАМИ, КЛИНИЧЕСКИМИ И ЛАБОРАТОРНЫМИ ХАРАКТЕРИСТИКАМИ ПАЦИЕНТОВ С COVID-19

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Association of Computer Tomography Features Of COVID-19 with Outcomes, Clinical and Laboratory Parameters

Резюме

Цель: сопоставить данные компьютерной томографии (КТ) с исходами, клиническими и лабораторными данными пациентов с коронавирусной инфекцией. **Материалы и методы:** ретроспективный анализ результатов 962 КТ исследований органов грудной клетки, клинических и лабораторных данных всех 354 пациентов, проходивших лечение от COVID-19 во ФГАУ «Лечебно-реабилитационный центр» Минздрава России с апреля по июнь 2020г. **Результаты:** Чувствительность и специфичность КТ при верификации диагноза с помощью полимеразной цепной реакции (ПЦР) составили: 98,0 % и 5,7 % соответственно; для ПЦР при верификации с помощью КТ: 54,6 % и 70,7 % соответственно. У пациентов с положительными и отрицательными результатами ПЦР тяжесть поражения легких и вероятность COVID-19 по системе CO-RADS статистически значимо не отличались (p=0.05). Кумулятивная выживаемость пациентов была лучше при меньшем объеме поражения легких (статистическая значимость достигалась на пике заболевания (p=0.05), но не в момент госпитализации (p=0.05)). У умерших (n=15) и выживших (n=339) пациентов градация поражения легких по данным КТ изменялась соответственно с 2 (1,5-3) до 4 (4-4), p=0,001 и с 2 (1-2) до 2 (1-2), p <0,001. Меньший объем поражения легочной ткани и лучшая кумулятивная выживаемость наблюдалась у женщин, пациентов младше медианы возраста (59 лет), с суммой баллов NEWS <3, без фибрилляции предсердий. Сахарный диабет и ожирение, не влияя на выживаемость, были ассоциированы с большей тяжестью поражения легких. Другие сопутствующие заболевания не были связаны с тяжестью поражения легочной ткани. Наличие хронической обструктивной болезни легких, ишемической болезни сердца и хронической сердечной недостаточности статистически значимо ухудшало прогноз. **Заключение:** КТ существенно улучшает точность диагностики COVID-19 в условиях недостаточной чувствительности молекулярно-биологических тестов и оценку прогноза пациентов.

Ключевые слова: *COVID-19, коронавирусная пневмония, компьютерная томография, полимеразная цепная реакция, чувствительность, специфичность, NEWS, прогноз, коморбидность*

Конфликт интересов

Авторы заявляют, что данная работа, её тема, предмет и содержание не затрагивают конкурирующих интересов

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Abstract

Aim: to assess the results of chest computer tomography (CT) of patients with novel coronavirus infection in correspondence with their outcomes, clinical and laboratory data. **Methods:** retrospective analysis of 962 chest CT scans, outcomes, clinical and laboratory data of all 354 COVID-19 patients hospitalized from April to June 2020. **Results:** Sensitivity and specificity of CT with polimerase chain reaction (PCR) as a reference were: 98.0 % and 5.7 % respectively; for PCR with CT as a reference: 54.6 % and 70.7 % respectively. Patients with positive and negative PCR tests had no significant differences in mean CT score and CO-RADS score. Cumulative survival was better in patients with lower CT score (significant only for maximal, not baseline scores). CT score changed during hospitalization in survived patients clinically insignificant (from 2 (1-2) to 2 (1-2), p=0.001), and increased in dead (from 2 (1,5-3) to 4 (4-4), p <0.001). Lower CT score and better survival was in females, patient younger than 59 years, with NEWS score <3, without atrial fibrillation. Diabetes mellitus and obesity was associated with higher CT score, but not with survival. Chronic obstructive pulmonary disease, coronary heart disease and chronic heart failure was associated with lower survival, but not CT score. **Conclusion:** chest CT significantly increases diagnostic accuracy and assessment of the prognosis in COVID-19 patients.

Key words: *COVID-19, coronavirus pneumonia, computer tomography, polymerase chain reaction, sensitivity, specificity, NEWS, prognosis, comorbidities*

Conflict of interests

The authors declare no conflict of interests

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AF — atrial fibrillation, BMI — body mass index, CHF — chronic heart failure, COPD — chronic obstructive pulmonary disease, CO-RADS — COVID-19 Reporting and Data System, COVID-19 — novel coronavirus disease, CT — computed tomography, DM — diabetes mellitus, IHD — ischemic heart disease, NEWS — National Early Warning Score, PCR — polymerase chain reaction, P_{MW} — Mann-Whitney method, TO — thoracic organs, TRC — Treatment and Rehabilitation Center of the Ministry of Health of the Russian Federation

Introduction

As COVID-19 cases surge, given the insufficient sensitivity of routine X-ray examination, molecular biological tests, and in the absence of highly sensitive serological methods, the multispiral computed tomography (CT) of thoracic organs (TO) has become the most informative diagnostic method.

Due to the specific features of TO lesions in coronavirus disease, a CT scan is required if COVID-19 is suspected, both for the initial assessment of the lesion and further monitoring of changes [1]. As there is no correlation of auscultatory signs of pneumonia with the volume of the lung lesion and due to the frequent false-negative primary polymerase chain reaction (PCR) results, CT became a first-line method for diagnosing COVID-19 and assessing disease severity.

Definite patterns of TO lesions (bilateral changes, ground glass symptom, peripheral localization of lesions, localization in the lower lobes of lungs, involvement of more than three pulmonary fields) detected on CT made it possible to differentiate the manifestations of COVID-19 from other pneumonias and TO diseases [2].

For determining the probability of coronavirus disease based on typical patterns of changes detected by TO CT, the COVID-19 Reporting and Data System (CO-RADS) is used. It estimates the probability of coronavirus disease according to a 5-point scale, where 1 is a very low probability, and 5 is a very high probability of coronavirus pneumonia [3].

Russian studies of various aspects of CT in COVID-19 were mainly focused on X-ray patterns of coronavirus lung damage and their description [4–6]. The association of CT results with outcomes [7], clinical and laboratory [8], as well as autopsy [9] data has been studied in only a handful of studies.

It should be noted that there is a significant variability in the design of the studies performed, the heterogeneity of the enrolled patients in terms of the severity of clinical and radiological symptoms, the time of disease onset and the frequency of verification of coronavirus etiology (Tables 1, 2).

Table 1. *Distribution of CT score in patients with COVID-19 included in various Russian studies*

Study		CT0, 0% n (%)	CT1, <25% n (%)	CT2, 25-50% n (%)	CT3, 50-75% n (%)	CT4, 75-100% n (%)	Positive PCR n (%)
Own data	During the admission	13 (4,0)	111 (32,1)	150 (43,4)	60 (17,3)	11 (3,2)	246 (69,5)
	At the peak of the disease	7 (2,0)	85 (24,4)	119 (34,2)	100 (28,7)	37 (10,6)	
Зельтер П.М. и соавт. [4]			142 (75,9)	37 (19,8)	7 (3,7)	1 (0,6)	
Устюжанин Д.В. и соавт. [5]			164 (25,7)	261 (41)	164 (25,7)	48 (7,6)	
Петриков С.С. и соавт. [6]		7 (11,7)	36 (60)	12 (20)	5 (8,3)		60 (100)
Морозов С.П. и соавт. [7]		5075 (39)	4004 (30,8)	2852 (21,9)	986 (7,6)	86 (0,7)	
Бойцов С.А. и соавт. [8]		29 (7,2)	66 (16,5)	127 (31,7)	139 (34,7)	40 (10,0)	258 (64,2)
Паршин В.В. и соавт. [9]			23 (12,17)	61 (32,27)	78 (41,26)	27 (14,3)	31 (49,2)
Кармазановский Г.Г. и соавт. [10]		34 (3,5)	180 (18,9)	341 (35,9)	261 (27,4)	136 (14,3)	
Корб Т.А. и соавт. [11]			48 (74)	13 (20)	5 (6)		65 (100)

Table 2. *The sensitivity and specificity of PCR, chest CT and X-ray for the diagnosis of COVID-19*

Study	n	Day of the disease at the moment of investigation	Sensitivity, %		Specificity, %		Diagnostic accuracy, %	
			CT verified by PCR	PCR verified by CT	CT verified by PCR	CT verified by PCR	CT verified by PCR	CT verified by PCR
Own data	354	8 (5-11)	98,0	54,6	5,7	70,7	70,7	98%
Корб Т.А. и соавт. [11]	140		76,2		92			
Ai T et al [12]	1014		97	65,3	25	83,3	68	96,5
Long C et al [13]	36	3	97,2	83,3				
Bai HX et al [14]	424	4,9	67-97		7-100		53-97	
Fang Y et al [15]	51	3	98	71				
Mirahmadizadeh A et al [16]	54		78,6		42,3			
He JL et al [17]	82		77	79	96	100		
Duarte ML et al [18]	1204		95,3	81,4	43,8	100	63,3	92,3
Herpe G et al [19]	4824		90	87	91	99	90	97
Caruso D et al [20]	158		97		56		72	
Wong HYF et al [21] Рентгенография	64		69	91				

The purpose of our study was to compare TO CT results in patients with coronavirus disease with their clinical and laboratory test results.

Materials and Methods

We performed a retrospective analysis of medical records and computed tomograms of a continuous sample of all 354 patients hospitalized in the Treatment and Rehabilitation Center of the Russian Ministry of Health (TRC) from April to June 2020 with suspected or confirmed COVID-19.

The outcome was known for all patients, as well as the sum of NEWS scale points on admission, the results of SARS-CoV-2 RNA by PCR, and comorbidities; body mass index (BMI) was calculated retrospectively.

To assess the severity of patients at admission, the National Early Warning Score (NEWS) developed in 2012 in the UK was used; it was well validated not only in patients with acute infectious and non-infectious diseases but also in patients with COVID-19 [22].

To assess changes of pulmonary parenchyma in patients, we used temporary guidelines for the prevention, diagnosis and treatment of COVID-19 of the Ministry of Health of Russia, version 5 as of 04/08/2020, version 6 as of 04/28/2020, and version 7 as of 06/03/2020. The volume of lung tissue lesions was described by five grades: CT0 — no changes, CT1 — lesion < 25% of parenchyma, CT2 — 25–50%, CT3 — 50–75%, CT4 — > 75%. For the analysis, we used the data on lesion volume obtained at the time of hospitalization, at the latest CT scan before discharge, and the maximum volume of lesion recorded during the observation period ("disease peak"). To assess the specificity of the detected changes, the CO-RADS classification was used [3].

Sensitivity, specificity and diagnostic accuracy of methods were calculated using standard formulas (sensitivity = (number of true positive + false positive tests) / number of true positive tests; specificity = (number of true negative + false negative tests) / number of true negative tests; diagnostic accuracy = (number of true positive + true negative tests) / total number of tests).

Since the diagnosis of COVID-19 was established based on a combination of clinical, CT and molecular biology criteria, CT and PCR were mutually verified using each method in turn as the "gold standard".

Statistical processing of the data obtained was carried out using SPSS Statistics and Jamovi software. Data are presented as medians and interquartile ranges. Non-parametric statistical methods were used: for the analysis of qualitative features, the χ2 (p_{X}^{2}) criterion was used; for comparing two independent values, the Mann-Whitney method (p_{MW}) was used; for dependent values, Wilcoxon's method (p_{Wilc}) was used. Cumulative survival rate was assessed by the Kaplan-Meier method with the assessment of the log-rank test and Gehan's test ($p_{log\text{-}rank}$, p_{Gehan}).

Results

Fifty-six percent of the 354 enrolled patients were female (n = 200). The patients were aged 59 (49–70) years, BMI — 28.7 (24.9–32.2) kg/m^2, the duration of COVID-19 at the time of admission was 8 (6–11) days, the sum of points on the NEWS scale at the time of admission was 2 (1–4) points, the duration of hospitalization was 16 (14–20) days. During inpatient treatment, 15 patients died (4.2%). The incidence of comorbidities was as follows: arterial hypertension 42.9% (n = 152), cancer — 13.0% (n = 46), diabetes mellitus (DM) — 12.4% (n = 44), ischemic heart disease (IHD) — 7.9% (n = 28), atrial fibrillation (AF) — 5.4% (n = 19), dementia — 4.5% (n = 16), history of stroke — 3.7% (n = 13), chronic obstructive pulmonary disease (COPD) — 2.0% (n = 7), chronic heart failure (CHF) — 2.0% (n = 7).

A total of 962 TO CT examinations conducted for 354 patients were analyzed; 867 (90.1%) of them were performed at the Treatment and Rehabilitation Center (TRC), and 95 (9.9%) at other hospitals prior to hospitalization at the TRC. Median and interquartile range of CT scan frequency per patient was 3 (2–3). Twenty-five (7%) patients underwent only one examination.

The first CT scan was performed for patients on day 8 (5–11) of disease, from 1 to 53 days.

On admission, 13 (3.6%) patients demonstrated no signs of pneumonia on CT; the appearance of inflammatory foci in lungs was registered during follow-up in two of them (0.5%).

Five (1.4%) patients had no CT signs of COVID-19; the diagnosis was made based on the detection of SARS-CoV-2 RNA by PCR; they were hospitalized for social and epidemiological reasons. One hundred (28.2%) patients had negative PCR results, and the diagnosis was made based on clinical and epidemiological data and CT signs. Another 2 (0.5%) patients were hospitalized with the consequences of past coronavirus disease. In 6 (1.7%) individuals, the diagnosis of COVID-19 was excluded (Fig. 1).

Therefore, sensitivity, specificity and diagnostic accuracy of CT in verifying the diagnosis using PCR were as follows: 98.0, 5.7 and 70.7%, respectively; for PCR with CT verification: 54.6, 70.7 and 98% respectively.

The frequency of different estimates of the COVID-19 probability according to the CO-RADS classification based on the data of the first CT scan in patients with at least one positive PCR result for SARS-CoV-2 RNA and in patients who had no positive test from the series demonstrated no statistically significant differences (5 (4–5) and 5 (4–5) respectively, $p_{MW} = 0.4$).

Medians and the distribution of lesion severity grades at the first CT scan and at the disease peak in patients with positive and negative PCR results demonstrated no statistically significant differences.

There were interesting changes of the distribution of the severity of pulmonary lesion assessed by CT in the observed patients as the disease progresses. Fig. 2 shows a tendency towards an increase in lesion volume from day 1 to day 10 of the disease. Starting from the third week of the disease, lesion volume slightly decreases. The number of studies conducted during the more distant period from disease onset was very small; this fact caused a wide range of volume and characteristics of lung tissue damage and did not allow to unambiguously evaluate the changes of the process. The duration of persistence of radiological changes and its association with the quality and longevity of patients who contracted COVID-19 is still to be determined during long-term observational studies. However, the correlation of changes on CT with disease duration was similar to other studies [1, 24, 25].

There were 13 (9–17) days between the first and the last examination. During this time, the grade of lesion severity statistically changed but with no clinically significant changes (2 (1–2) and 2 (1–2), $p_{Wilc} = 0.019$).

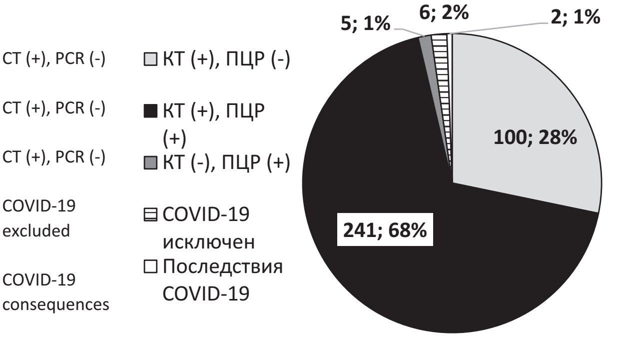

Figure 1. *The presence and absence of CT features of coronavirus pneumonia in patients with positive and negative PCR tests*

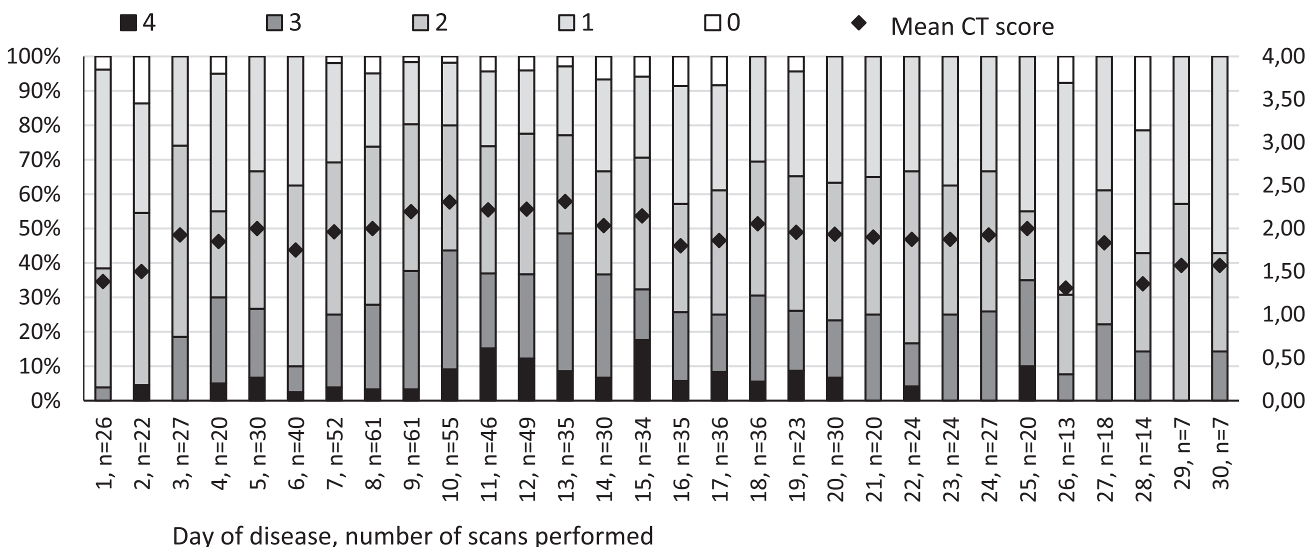

Figure 2. *The proportion of patients with different CT scores by the day of disease (CT 0-4, the axis of values is on the left). The markers indicate the mean CT score on a certain day of disease (the axis of values is on the right)*

Cumulative survival rate was better in patients with less lesion on CT and vice versa (Fig. 3). However, this relationship was statistically significant only for the maximum values of lesion volume recorded during hospitalization, but not for the results of the first CT studies ($p_{log-rank}$ and p_{Gehan} = 0.2); this fact somewhat reduces the value of CT for assessing the in-hospital prognosis.

In surviving (n = 339) and deceased (n = 15) patients, the differences in lesion grades at the first CT scan (2 (1–2) and 2 (1.5–3.0), respectively, p_{MW} = 0.25) and its distributions were not statistically significant (p_{X2}= 0.2). At the latest CT scan, lesion grades did not change significantly in the surviving patients, and were higher in deceased patients (2 (1–2) and 4 (4–4), respectively, p_{MW} < 0.001), as was the proportion of more extensive changes (Fig. 4). The maximum severity of lesion registered on CT was significantly higher in deceased patients (4 (3–4) and 2 (1–3), p_{MW} < 0.001).

The cumulative survival rate of patients with NEWS score $\geq$ 3 was statistically significantly worse than that of patients with lower scores (Fig. 5A).

In patients above the median age in comparison with younger patients at the time of admission, the gradation of the severity of pulmonary parenchyma lesions revealed no significant differences (2 (1–2) and 2 (1–2), p_{MW} = 0.056). However, at the peak of the disease, it was statistically significantly higher (2 (2–3) and 2 (1–3), p_{MW} = 0.003). The expected survival rate of younger patients was statistically significantly better than that of elderly patients (Fig. 5Б).

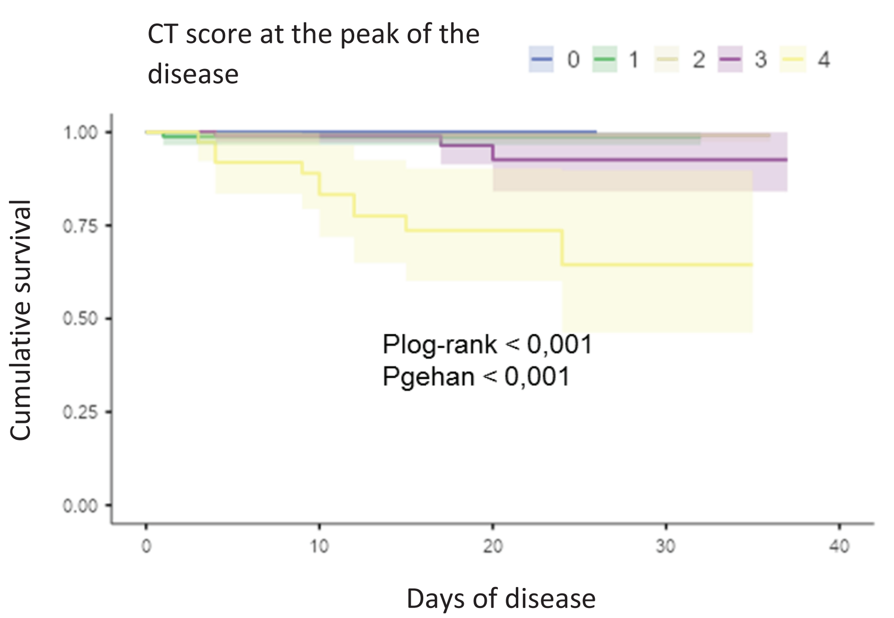

Figure 3. *Kaplan-Meier cumulative survival curves of patients with different CT scores at the peak of the disease. The colored areas represent the 95 % confidence interval*

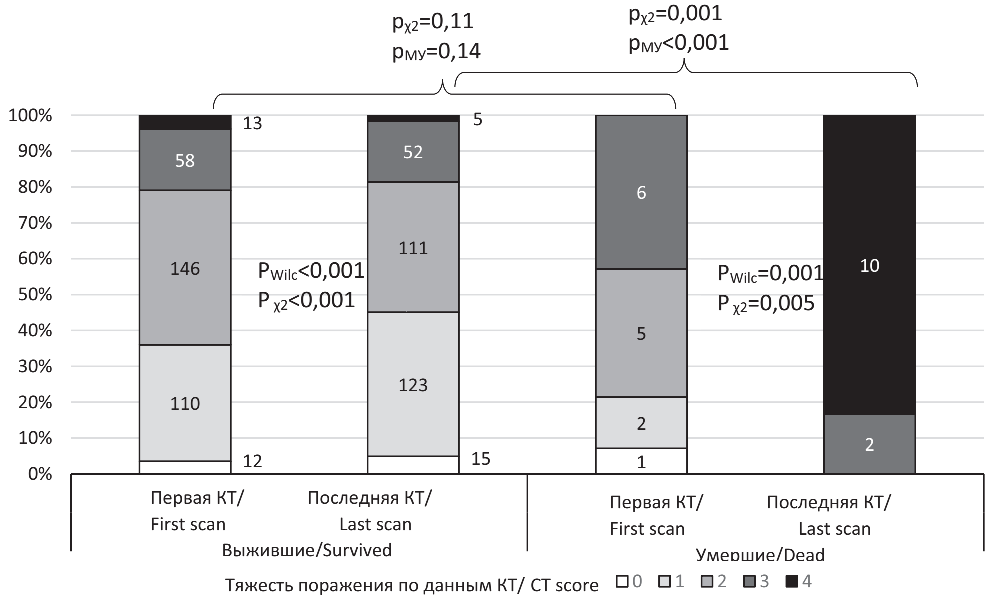

Figure 4. CT scores in deceased and surviving patients at admission and in the end of follow up

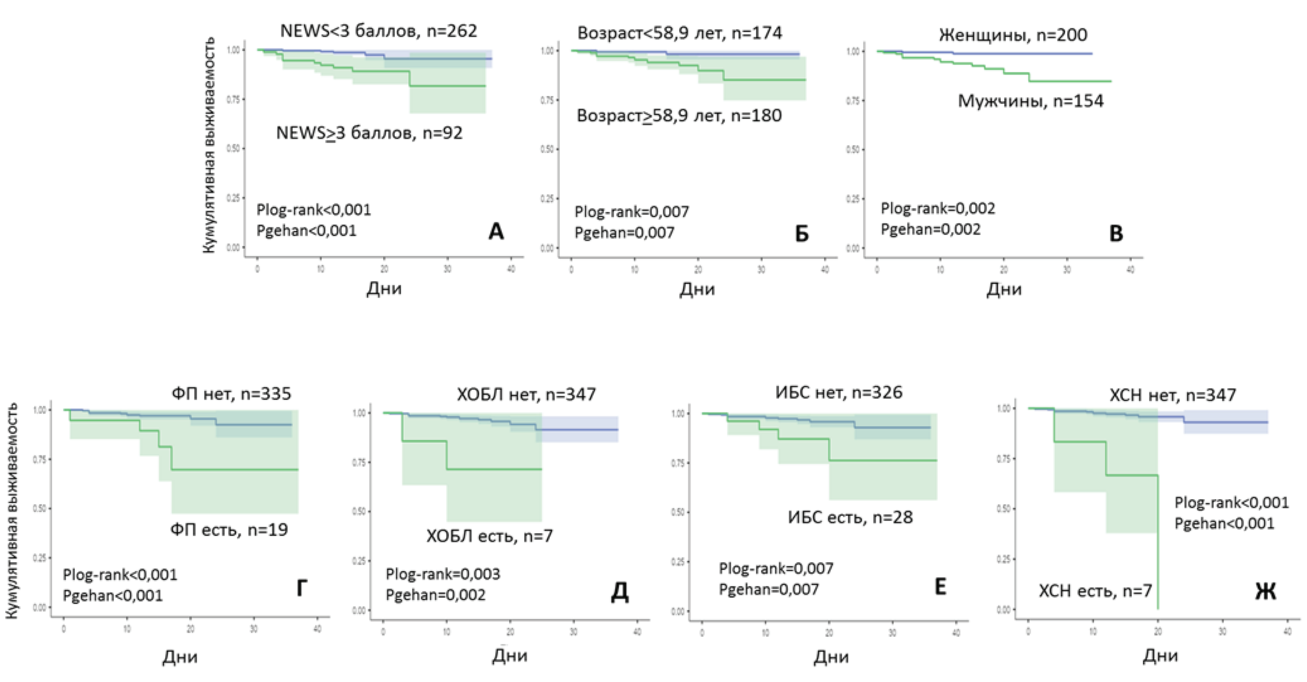

Figure 5. Kaplan-Meier survival curves among observed patients after dividing them into subgroups based on: А — median of the total News score during the admission, Б — age median, В — sex, Г — presence or absence of Af, Д — Presence of Absence of COPD, Е — Presence or absence of CHD, Ж — presence or absence of CHF. Colored zones indicate 95 % confidence interval

As shown in Fig. 6, more severe patients with NEWS score of 4–10 had a larger lung lesion volume more often than less severe patients with a score of 0-3, both at admission to the hospital (grade 2 (2–3) and 2 (1–2), respectively, $p_{MU} < 0.001$) and at the peak of disease (3 (2–3) and 2 (1–3), respectively, $p_{MW} < 0.001$). At the same time, 60% of clinically stable and asymptomatic patients at the time of hospitalization had lesion volume over 25%; some of them reached CT4 grade.

The cumulative survival rate of women was statistically significantly better than that of men (Fig. 5B); grades of lung tissue damage were as follows: 2 (1–2) and 2 (1–3), $R_{MW} = 0.3$ during the first examination and 2 (1–3) and 2 (2–3), $p_{MW} = 0.004$ at the peak of disease. The differences in the distribution of lung lesion severity in men and women are shown in Fig. 7.

Among patients with BMI more than the median value, the percentage of those with more severe lung tissue lesions at the time of admission was statistically significantly higher than patients with a lower BMI (Fig. 8); lesion grades differed statistically, but not clinically significantly (2 (1–2) and 2 (1–2) respectively, $p_{MW} = 0.021$). Lesion severity at the peak of disease in these subgroups demonstrated no statistically significant differences ($p_{X2} = 0.75$), as well as the survival rate ($p_{log\text{-}rank}$ and $p_{Gehan} = 0.9$).

The presence of DM also did not statistically significantly affect survival ($p_{log\text{-}rank}$ and $p_{Gehan} = 0.1$). However, the percentage of patients with a large volume of lung tissue lesion was statistically significantly higher among patients with DM than without it (Fig. 9). Lesion severity grade at the time of admission was 2 (2–3) and 2 (1–2), $p_{MW} = 0.003$; at the peak of disease — 2 (2–3) and 2 (1–3), $p_{MW} = 0.037$, respectively.

The cumulative survival rate of patients with AF was worse than that of patients without AF (Fig. 5Г). In patients with AF, grades of lung lesion severity at the time of admission statistically insignificantly differed from that in patients with sinus rhythm (2 (1.5–3.0) and 2 (1–2), $p_{MW} = 0.076$), as well as its distribution. The grade of maximum lesion severity registered during hospitalization was higher in patients with AF (3 (2.0–3.5) and 2 (1–3), respectively, $p_{MW} = 0.01$). The distribution of lesion severity gradation at the peak of disease in patients with and without AF also demonstrated statistically significant differences (Fig. 10).

Both during hospitalization and at the peak of disease, there were no statistically significant differences in the grade of lesions and their distribution when the patients were divided according to the presence or absence of COPD ($p_{MW} = 0.08$ and 0.07, $p_{X2} = 0.054$

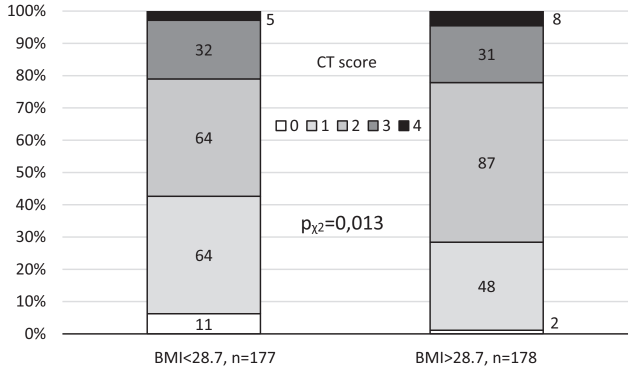

Figure 8. *CT scores at admission in patients with BMI greater or less than the median*

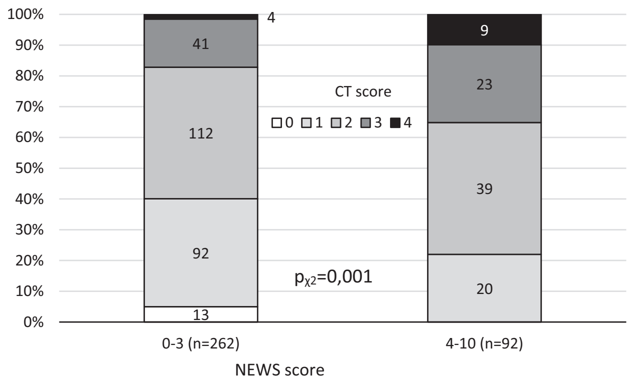

Figure 6. *CT scores at admission in patients with NEWS scores 0-3 and 4-10*

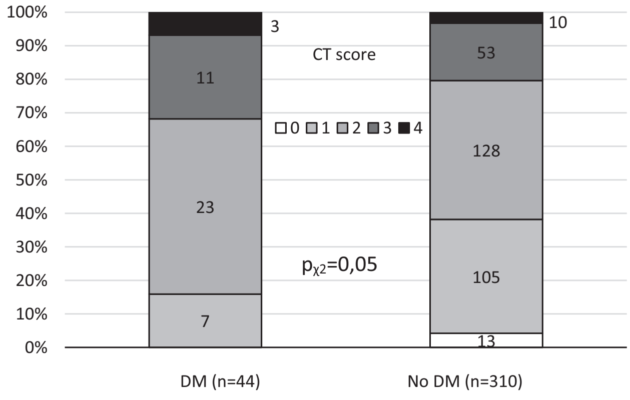

Figure 9. *CT scores at admission in patients with and without diabetes mellitus*

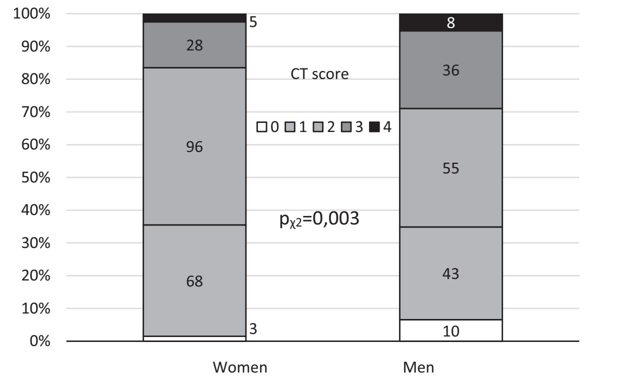

Figure 7. *Gender differences in the distribution of CT scores at admission*

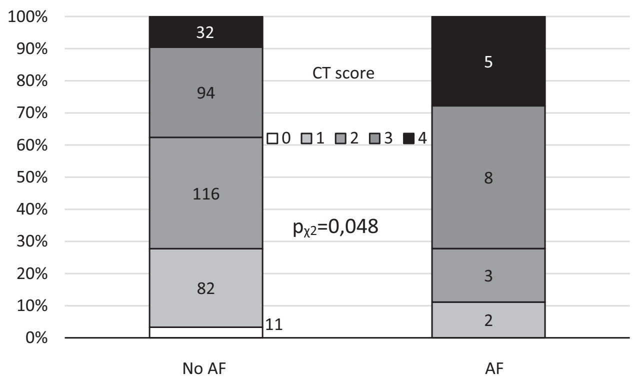

Figure 10. *CT scores at the peak of the disease in patients with and without atrial fibrillation*

and 0.1, respectively), arterial hypertension (p_{MW} = 0.4 and 0.3, p_{X2} = 0.2 and 0.5, respectively), ischemic heart disease (p_{MW} = 0.9 and 0.2, p_{X2} = 0.5 and 0.8, respectively), CHF (p_{MW} = 0.6 and 0.9, p_{X2} = 0.9 and 0.9, respectively), stroke (p_{MW} = 0.2 and 0.3, p_{X2} = 0.3 and 0.5, respectively), dementia (p_{MW} = 0.3 and 0.7, p_{X2} = 0.9 and 0.9, respectively), cancer (p_{MW} = 0.7 and 0.7, p_{X2} = 0.35 and 0.5, respectively), median duration of COVID-19 at the time of admission (p_{MW} = 0.2 and 0.2, p_{X2} = 0.1 and 0.5, respectively). At the same time, several listed comorbidities (COPD, IHD and CHF) significantly worsened the prognosis of patients (Fig. 5 Д, Е, Ж).

Discussion

The distribution of the patients we observed according to the severity of lung tissue damage detected by CT is presented in Table 1 in comparison with the data of other Russian studies of patients with COVID-19. Noticeable differences can be explained by the different principles of enrolling patients into studies (for example, depending on PCR results, the presence of symptoms, outpatient or inpatient care) or by different disease stages at the time of the study.

Since our study is a retrospective analysis of a continuous sample from actual clinical practice, we did not select patients based on the basis of stage, verification of disease etiology, severity of symptoms, or the volume of lung tissue lesions based on CT results.

Despite that the number of patients with PCR-verified coronavirus etiology in our sample was higher than in other observations [8, 9], the sensitivity of this test was low (Table 2). This, in particular, can be explained by the longer, compared to other works, disease duration at the time of the beginning of the diagnosis, as well as by possible errors during sampling for PCR. In our study, coronavirus disease was diagnosed based on clinical and radiological data with no verification by PCR in almost a third of the cases. This explains the observed low specificity of CT calculated using PCR as a “gold standard”.

In a recent meta-analysis, the averaged values of sensitivity and specificity of CT in various studies were 91 and 31%, and PCR — 84 and 100%, respectively. This emphasizes the need for the combined use of these diagnostic methods [25].

The above reasons did not allow us to demonstrate in our sample a statistically significant relationship between PCR results and COVID-19 probability assessment according to the CO-RADS system. However, studies with different designs demonstrated the high diagnostic accuracy of this system [26, 27].

Our data confirm the results of studies that revealed the independent prognostic significance of CT symptoms typical for coronavirus pneumonia [28] and their severity [8, 29, 30].

In our study, the relationship between the volume of lung tissue lesion and in-hospital mortality was statistically significant only for CT studies performed at the peak of disease, but not for examinations at earlier stages. This complies well with the data of other studies that compared the probability of unfavorable outcomes with the volume of lung tissue lesion at different times from the onset of COVID-19 symptoms [31, 32].

At the same time, the integral clinical indicator of the patient’s severity, the sum of points according to the NEWS scale, assessed at the time of admission was statistically significantly associated with the severity of lung lesion as measured by CT performed both at the time of admission and at the peak of disease. Similar correlations were demonstrated by other authors [33].

We observed an improvement in clinical and laboratory parameters in most patients, which allowed them to be discharged to continue treatment on an outpatient basis. The severity of changes detected by CT at the time of discharge may have remained significant but their quality notably changed: despite that the consolidation in most cases was “resorbed”, areas of “ground glass” persisted, particularly in subpleural regions. Subpleural bands of high density were also evident, including among patients who underwent such changes in lung tissue as consolidation and “cobblestone appearance”. These changes may represent the initial stages of pulmonary fibrosis; its development was noted in the cases of pneumonia caused by COVID-19 [23, 24]. Therefore, long-term changes on CT do not always reflect the severity of COVID-19 and have to be interpreted in the context of clinical findings.

Male gender is an independent unfavorable prognostic factor in COVID-19, and is also associated with a greater severity of lung tissue lesion according to CT results[34]; this fact is also confirmed by our data. However, one study showed that a less favorable prognosis in men is not accompanied by more severe lung lesion according to CT results [35].

Negative effects of age, overweight and comorbidity on prognosis are well known [8, 36]. In our sample, we were able to trace the relationship between in-hospital mortality and the presence of IHD, AF, CHF, and COPD. However, these diseases were not associated with the severity of lung tissue lesion according to CT results. Diabetes mellitus, overweight and obesity did not affect survival but were associated with a greater lung lesion volume. No such patterns were found in a smaller sample [37].

Conclusion

In actual clinical practice, the sensitivity and specificity of CT with diagnosis verification using PCR were as follows: 98.0 and 5.7%, respectively; for PCR with verification using CT: 54.6 and 70.7%, respectively. In patients with positive and negative PCR results, the severity of lung lesion and the probability of COVID-19 according to the CO-RADS system demonstrated no statistically significant differences.

Survival rate was better in patients with a smaller volume of lung lesion. However, the relationship between the grade of lung tissue lesion and prognosis was only revealed for CT studies performed at the peak of disease, not at the time of hospitalization.

Smaller volume of lung tissue lesion and better cumulative survival rate were observed in women, patients below the median age (58.9 years), with NEWS score < 3, with no atrial fibrillation. Diabetes mellitus, overweight and obesity did not affect survival but were associated with greater severity of lung lesion. No relationship between other comorbidities and the volume of lung tissue lesion was found.

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