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Correlation between CT severity scores and oxygen requirement amongst adult cases with COVID-19 pneumonia

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ABSTRACT

The clinical status, i.e. oxygen need, of adult COVID-19 infection cases were linked with the 25 Point CT severity score in this investigation. An observational case control study after institutional research review board approval (NKPSIMS & RC and LMH / IEC-RADIOLOGYY/ 06/2020) including 123 case record of symptomatic cases presented to our hospital and who were RTPCR positive for COVID-19 infection, was collected for 3 months (August 2020 to Oct 2020). All patients underwent non-contrast HRCT scan on TOSHIBA Activion 16 slice CT (computed tomography). In our study, the mean age amongst the cases was ranging from 51-60 years [69.9% males, 30.1% females]. The oxygen requirements, as well as other variables such as age and sex, were found to be strongly correlated with CT severity score. CT severity score shows positive correlation with requirement of oxygen in cases with COVID-19.

Keywords: COVID-19, CT severity score, RT-PCR, High-resolution computed tomography

1. INTRODUCTION

COVID-19 is a viral infection that has broadly as well as aggressively infected worldwide and formed a pandemic witha significant influence on the socio-political status and healthcare systems (Yilmaz et al., 2021). Clinical appearances in a covid patient differ from being carriers with no symptoms to cases requiring assisted ventilation support and ICU admissions. The RT-PCR result was the standard for approval as covid-19 although there some cases of false negative result too. A non-contrast HRCT thorax imaging is important in the early stage disease finding, mostly in patients with false negative RT-PCR findings, all so in managing the sequence and treatment of disease. The disease can be evaluated from results of imaging and correlated clinically and thus confirming effective and management. It may affect the prognosis in

critically ill cases as per the severity of the disease and thus priority to require intensive care.

2. MATERIALS AND METHODS

Data collection

In this study we include 123 cases with diagnosed COVID-19 infection and HRCT thorax been done. Ethics committee approval (NKPSIMS & RC and LMH / IEC-RADIOLOGYY/ 06/2020) and informed consent was taken. Data obtained from medical record system was collected and analysed over a three-month period (From August to October 2020).

HRCT Examination

All preliminary chest HRCT thorax images were taken with a TOSHIBA Activion 16 slice CT machine on the day of the patients' arrival. Scan was done in single breath hold in supine position. Scanning parameters were: scan direction (craniocaudally), tube voltage (120KV), tube current (100-600 mA)-smart mA dose modulation, slice collimation (16 X 0.625 mm), width (0.625 X 0.625 mm), pitch (1), rotation time of 0.5 s (Francone et al., 2020).

Analysis of HRCT image

Each patient image was evaluated by two radiologists to analyse the severity score. The scans were then examined for typical COVID19 pneumonia Severity as per visual assessment of each lung lobe involved (Table 1 and 2).

Table 1 Lobar involvement and corresponding HRCT score.

Lobar involvement (in percentage)	Score
Less than 5 %	1
5%-25%	2
26%-49%	3
50%-75%	4
More than 75%	5

Table 2 HRCT total score (numerical) and corresponding severity criteria.

Score total (numerical)	Severity criteria
Less than 7	Mild
8 to 17	Moderate
More than or equal to 17	Severe

Inclusion criterion include all patients clinically suspected or diagnosed with COVID – 19 on RTPCR and referred to the Department of Radio-diagnosis and who were willing to undergo HRCT Chest during the study period. Exclusion criteria are pregnant females and those not willing to undergo the scan. The statistical analysis was done with the help of Microsoft excel and Epi info software.

3. RESULTS

A total of 123 cases were included in our study, all of which were suspected of having COVID-19 infection. A nasopharyngeal swab was used to confirm infection using a (RT-PCR) assay. All patients underwent a series of HRCT scans, as well as RT-PCR assays. Eventually, 123 sample cases were included having following information viz: age, gender, maximum Oxygen requirement and requirement for intubation and ICU admission. The average age was 51-60 years old [range 21-80 years old, 86 men (69.9%), 37 women (30.1%)] (figure 1). The age was further broken down into six categories (Figure 2). 86 (69.9%) study subjects were males and 37 (30.1%) were females (Figure 3).

Association in between CT severity score and clinical parameters

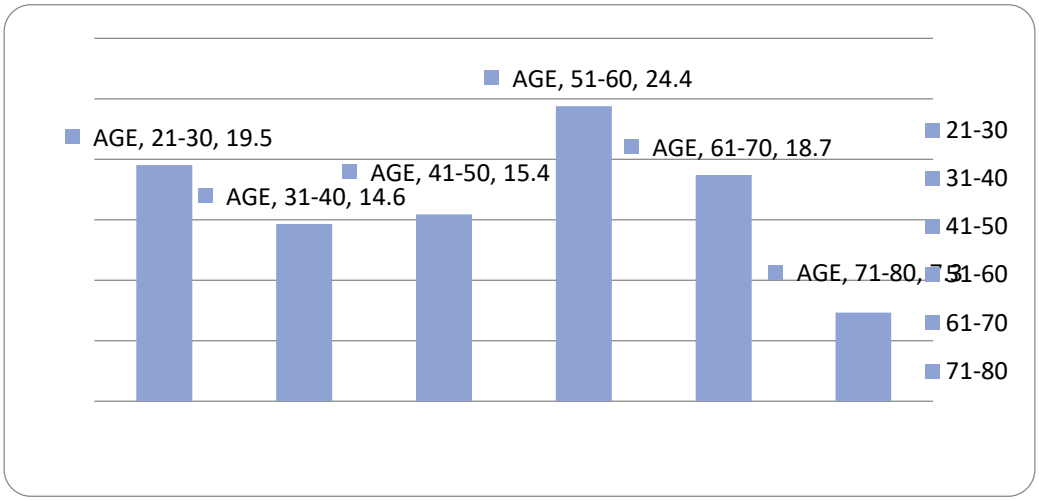

Figure 1 Age wise distribution of study subjects.

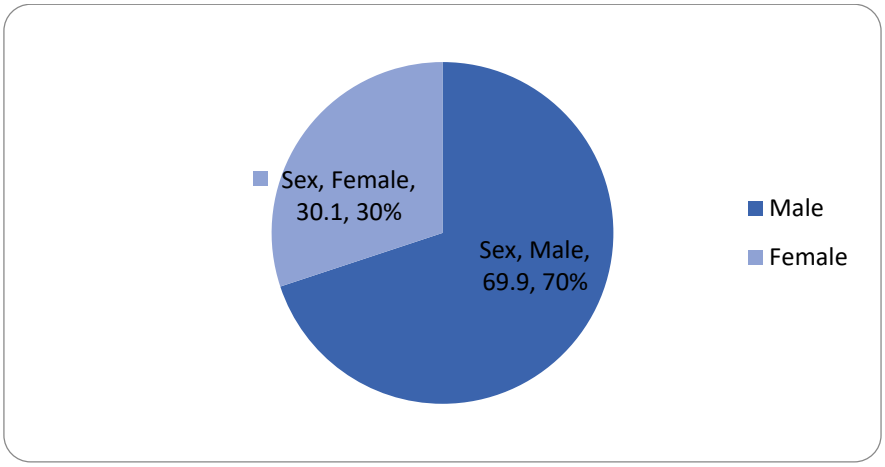

Figure 2 Sex wise distributions of study subjects.

In our study, 21(17.1%) patients belonged to negative group, 30(24.4%) patients belonged to mild group, 44(35.8%) belonged to moderate group and 28 (22.8%) belonged to severe group (Table 3). Out of the 123 cases, 59 cases (48%) did not need any oxygen. The rest of the 64 cases needed oxygen as follows: 21 cases (17.1%) required nasal cannula, 9 cases (7.3%) required facemask, 5 cases (4.1%) required non-breather mask, 10 cases (8.1%) required a (BiPAP) or (HFNC), and 18 cases (14.6%) cases required intubation (Table 4).

Table 3 Grade of severity as per HRCT score.

GRADE		
Grade	Frequency	Percent
Negative	21	17.1
Mild	30	24.4
Moderate	44	35.8
Severe	28	22.8
Total	123	100.0

Table 4 Maximum requirement of O2 in each category

GRADE		None	Nasal cannula	Facemask	Non-rebreather	Intubation	HFNC/BIPAP
Negative	Count	13	4	2	0	1	1
	% within GRADE	61.9%	19.00%	9.50%	0.00%	4.80%	4.80%
	% of Total	10.6%	3.30%	1.60%	0.00%	0.80%	0.80%
Mild	Count	21	2	2	1	3	1
	% within GRADE	70.0%	6.70%	6.70%	3.30%	10.00%	3.30%
	% of Total	17.1%	1.60%	1.60%	0.80%	2.40%	0.80%
Moderate	Count	22	13	3	1	3	2
	% within GRADE	50.0%	29.50%	6.80%	2.30%	6.80%	4.50%
	% of Total	17.9%	10.60%	2.40%	0.80%	2.40%	1.60%
Severe	Count	3	2	2	3	11	6
	% within GRADE	10.7%	7.10%	7.10%	10.70%	39.30%	21.40%
	% of Total	2.4%	1.60%	1.60%	2.40%	8.90%	4.90%
Total	Count	59	21	9	5	18	10
	% within GRADE	48.0%	17.10%	7.30%	4.10%	14.60%	8.10%
	% of Total	48.0%	17.10%	7.30%	4.10%	14.60%	8.10%

In mild category, each 2(6.7%) required nasal cannula and face mask whereas each of the 1 (3.3%) patient required non breather and HFNC/ BIPAP and 3(10%) required intubation only. 20 (70%) patients did not required oxygen in category (Table 4). 22 (50 %) patients did not required oxygen, 13(29.5%) patients with moderate findings required nasal cannula, 1 (2.3%) required non breather and 2(4.5%) required HFNC/ BIPAP. Each 3(6.8%) patient required face mask and intubation (Table 4). Each 2 (7.1%) patients from severity group required nasal cannula and face mask. 3(10%) required non breather, 11(39.3%) required intubation and 6(21.4%) required HFNC. 3(10.7%) did not required oxygen (Table 4).

Table 5 Gender wise maximum oxygen requirement in each severity category

SEX		NONE	Nasal cannula	Facemask	Nonrebreather	Intubation	HFNC/BIPAP
Male	Count	37	20	6	5	11	7
	% within SEX	43.0%	23.30%	7.00%	5.80%	12.80%	8.10%
	% of Total	30.1%	16.30%	4.90%	4.10%	8.90%	5.70%
Female	Count	22	1	3	0	7	3
	% within SEX	59.5%	2.70%	8.10%	0.00%	18.90%	8.10%
	% of Total	17.9%	0.80%	2.40%	0.00%	5.70%	2.40%
Total	Count	59	21	9	5	18	10
	% within SEX	48.0%	17.10%	7.30%	4.10%	14.60%	8.10%
	% of Total	48.0%	17.10%	7.30%	4.10%	14.60%	8.10%

20 (23.3%) males required nasal cannula, 6(7.0%) required face mask, 5(5.8%) required non breather, 11 (12.8%) required intubation and 7 (8.1%) required HFNC/BIPAP. 37(43%) males did not have the requirement of oxygen. Whereas 1(2.7%) female needed nasal cannula, 3(8.1%) needed face mask, 7(18.9%) needed intubation and 3 (8.1%) required HFNC/BIPAP. 22(59%) of females did not have the requirement of oxygen (Table 5).

Table 6 Age wise maximum requirement of O2 in each category

AGE		None	Nasal canula	Facemask	Nonrebreather	HFNC/BIPAP	Intubation
21-30	Count	17	4	1	0	2	0
	% within AGE	70.8%	16.70%	4.20%	0.00%	8.30%	0.00%
	% of Total	13.8%	3.30%	0.80%	0.00%	1.60%	0.00%
31-40	Count	9	3	3	1	1	1
	% within AGE	50.0%	16.70%	16.70%	5.60%	5.60%	5.60%
	% of Total	7.3%	2.40%	2.40%	0.80%	0.80%	0.80%
41-50	Count	9	3	1	0	0	6
	% within AGE	47.4%	15.80%	5.30%	0.00%	0.00%	31.60%
	% of Total	7.3%	2.40%	0.80%	0.00%	0.00%	4.90%
51-60	Count	10	7	2	1	3	7
	% within AGE	33.3%	23.30%	6.70%	3.30%	10.00%	23.30%
	% of Total	8.1%	5.70%	1.60%	0.80%	2.40%	5.70%
61-70	Count	8	2	2	2	4	4
	% within AGE	34.8%	8.70%	8.70%	8.70%	17.40%	17.40%
	% of Total	6.5%	1.60%	1.60%	1.60%	3.30%	3.30%
71-80	Count	6	2	0	1	0	0
	% within AGE	66.7%	22.20%	0.00%	11.10%	0.00%	0.00%
	% of Total	4.9%	1.60%	0.00%	0.80%	0.00%	0.00%
Total	Count	59	21	9	5	10	18
	% within AGE	48.0%	17.10%	7.30%	4.10%	8.10%	14.60%
	% of Total	48.0%	17.10%	7.30%	4.10%	8.10%	14.60%

In 21-30 years age group, 4(17.7%) patients needed nasal cannula, 1(4.2%) required facemask and 2(8.3%) needed HFNC/BIPAB. 17(70.8%) patients did not required oxygen in 21-30 years group. In 31-40 years group, each of the 3(16.7%) patients needed nasal cannula and face mask whereas each 1(5.6%) cases needed non breather, HFNC and intubation. 9(50%) patients did not required oxygen in 31-40 years group. 3(15.8%) patients needed nasal cannula, only 1(5.3%) required face mask and 6(31.6%) needed intubation. 9(47.4%) patients did not require oxygen. All patients were in age group 41-50 years (Table 6). In 51 to 60 years group, 7(23.3%) patients needed nasal cannula, 2(6.7%) required facemask, only one patient needed non breather, 3 (10%) required HFNC

and 7(23.3%) needed intubation.10 (33.3%) patients dint have requirement of oxygen in this group (Table 6). In 61-70 years group each of the 2(8.7%) study subjects needed nasal cannula, face mask and non breather. Each 4(17.4%) patients required HFNC and intubation. 8(34.8%) study subjects did not require oxygen (Table 6). In 71-80 years group, 2(22.2%) patients required nasal cannula and only one patient required non breather. 6(66.7%) study subjects did not require oxygen in this group (Table 6) (Yuan et al., 2020).

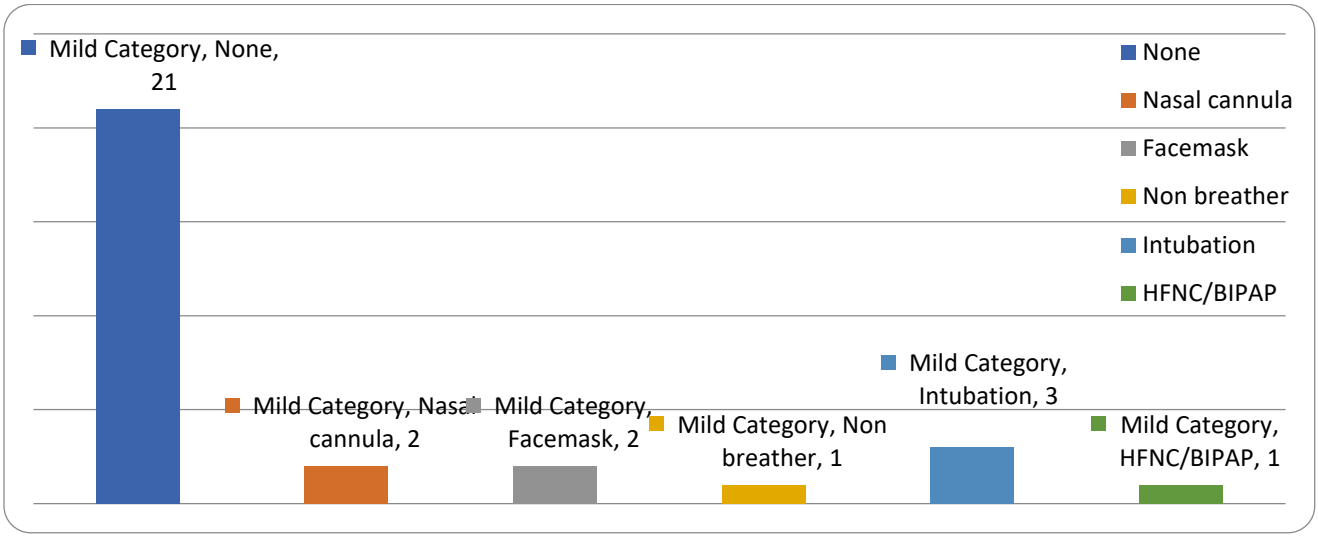

Figure 3 Distribution of cases as per their requirement of oxygen in mild category

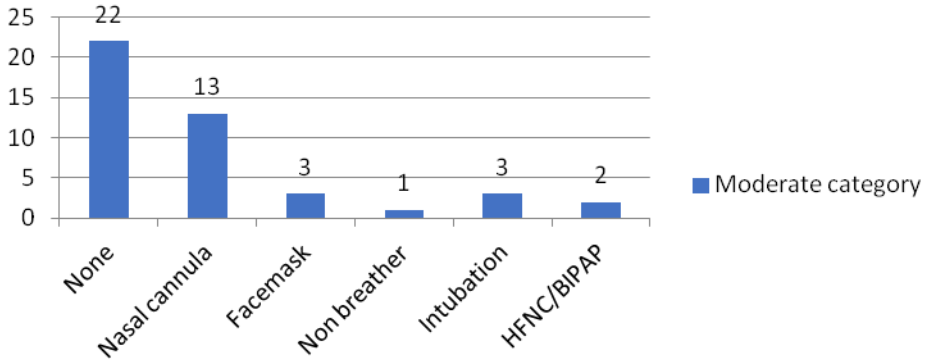

Figure 4 Distribution of cases as per their requirement of oxygen in moderate category

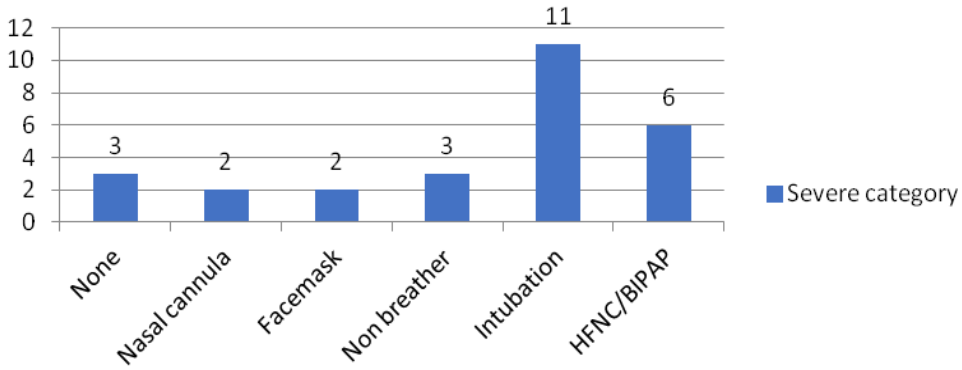

Figure 5 Distribution of cases as per their need of oxygen in severe category

Each of the 2 patients required nasal cannula and facemask, each 1 patient required nasal cannula and HFNC in mild category. 21 study subjects did not require oxygen in mild category (figure 3). 13 patients required nasal cannula, each 3 patients required

intubation and face mask, 2 patient required HFNC and 1 required non breather in moderate category. 22 study subjects did not require oxygen in moderate category (Figure 4). Each of the 2 cases required nasal cannula and face mask, 3 required non breathers, 11 required intubation and 6 required HFNC. 3 study subjects did not require oxygen in severe category (Figure 5).

Requirement of oxygen and comparison with outcome

In comparison to maximum oxygen requirement, 13 out of 21 cases with negative HRCT thorax scan didn't require any oxygen support. 4 needed nasal cannula; 2 needed facemask; zero needed non-breather masks; one required BiPAP support or HFNC and 1 required intubation. In the mild group, 21 out of 30 cases didn't require any oxygen support; 2 needed nasal cannula; 2 having facemask; in one case, a non-breather mask was required; in another, BiPAP or HFNC was required; and in three cases, intubation was required. There was no need for oxygen support in 22 of 44 individuals with moderate HRCT thorax scan findings. 13 required a nasal cannula, three required a facemask, one required a non-breather mask, two required BiPAP or HFNC, and three required intubation. Only three patients with severe scan results didn't require oxygen support; 2 needed nasal cannula; 2 needed facemask; 3 with non-breather mask; 6 required BiPAP or HFNC and 11 were in need of intubation. The need of oxygen and CT severity scores were found to have statistically significant relation ($p < 0.0001$, $r = 0.529$).

4. DISCUSSION

When RT-PCR was not available, or in case of suspicion of COVID19 despite an initial negative RT-PCR report, the WHO recommends using HRCT thorax to diagnose of covid-19 infection (Lessmann et al., 2021). HRCT thorax is a valuable method for assessing disease load. The quantitative severity is determined using a visual or software method that uses deep learning algorithms to identify the percentage that impacts lung volumes similar to our study. COVID19 severity levels were categorised as per the total CT severity score (Gupta et al., 2020).

Our sample had a male inclination and was of a significantly older age (mean 51-60 years. Similar to our study, the UAE's unique population characteristics, which include a high proportion of young male foreign workers (Dangis et al., 2020). Males were the ones who had the most severe sickness (93.4 percent). According to studies, this disparity can be attributable to a variety of variables, including behavioural differences and the potential protective impact of oestrogen. The age group (50-59 years) had the most severe disease as well as the greatest fatality rates. This can be influenced by a variety of factors, like the stage of the pandemic, the presence of patient comorbidities, as well as the presence of senior nursing homes where disease can spread more quickly (Guan et al., 2020).

The presence of risk variables had no significant link with CT severity scores in our study, although there was a significant correlation (p-value 0.0001) amongst ICU admissions and risk factors. As the CT severity score raises, so does the oxygen need. Because of the virus's direct damage to the lung parenchyma, which causes severe inflammatory alterations in the alveolar wall, oxygen exchange is interrupted, resulting in respiratory distress and leading to death (Ackermann et al., 2020). There were some flaws in this research. The first is the requirement for a greater sample size in order to improve the accuracy of results. The second factor is the subjective results of CT scan reports. However, by involving two radiologists, this was minimised.

5. CONCLUSION

To conclude, CT scans have an important role in identifying the disease severity and possible outcome and assisting physicians in the management plan. CT severity score shows positive correlation with oxygen requirement in cases with COVID-19. More such studies will improve accuracy of information in this novel disease.

Abbreviations

COVID-19 (corona virus disease), CT (computed tomography), RT-PCR (reverse transcription polymerase chain reaction).

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Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

Ethical considerations

Ethics approval for the study was obtained from the institutional ethics committee. Data were kept anonymous and confidential during all stages of the study.

Funding

This study has not received any external funding.

Conflicts of interest

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

REFERENCES AND NOTES

1. Dangis A, De Brucker N, Heremans A, Gillis M, Frans J, Demeyere A . Impact of Gender on Extent of Lung Injury in COVID-19. Clin Radiol 2020; 75(7):554–6. doi: 10.1016/j.crad .2020.04.005
2. Francone M, Iafrate F, Masci GM, Coco S, Cilia F, Manganaro L, Panebianco V, Andreoli C, Colaiacomo MC, Zingaropoli MA, Ciardi MR, Mastroianni CM, Pugliese F, Alessandri F, Turriziani O, Ricci P, Catalano C.. Chest CT Score in COVID-19 Patients: Correlation with Disease Severity and Short-Term Prognosis. Eur Radiol 2020; 30(12):6808–17. doi: 10.1007/s00330-020-07033-y
3. Ackermann M, Verleden SE, Kuehnel M, Haverich A, Welte T, Laenger F, Vanstapel A, Werlein C, Stark H, Tzankov A, Li WW, Li VW, Mentzer SJ, Jonigk D. Pulmonary Vascular Endothelialitis, Thrombosis, and Angiogenesis in Covid-19. N Engl J Med 2020; 383(2):120–8. doi: 10.25934/00005576
4. Lessmann N, Sánchez CI, Beenen L, Boulogne LH, Brink M, Calli E, Charbonnier JP, Dofferhoff T, van Everdingen WM, Gerke PK, Geurts B, Gietema HA, Groeneveld M, van Harten L, Hendrix N, Hendrix W, Huisman HJ, Išgum I, Jacobs C, Kluge R, Kok M, Krdzalic J, Lassen-Schmidt B, van Leeuwen K, Meakin J, Overkamp M, van Rees Vellinga T, van Rikxoort EM, Samperna R, Schaefer-Prokop C, Schalekamp S, Scholten ET, Sital C, Stöger JL, Teuwen J, Venkadesh KV, de Vente C, Vermaat M, Xie W, de Wilde B, Prokop M, van Ginneken B. Automated assessment of COVID-19 reporting and data system and chest CT severity scores in patients suspected of having COVID-19 using artificial intelligence. Radiology 2021; 298(1):E18–28. doi: 10.1148/radiol.2020202439
5. Gupta S, Parker J, Smits S, Underwood J, Dolwani S. Persistent viral shedding of SARS-CoV-2 in faeces - a rapid review. Colorectal Dis. 2020; 22(6):611–20. doi: 10.1111/codi .15138
6. Guan WJ, Liang WH, Zhao Y, Liang HR, Chen ZS, Li YM, Liu XQ, Chen RC, Tang CL, Wang T, Ou CQ, Li L, Chen PY, Sang L, Wang W, Li JF, Li CC, Ou LM, Cheng B, Xiong S, Ni ZY, Xiang J, Hu Y, Liu L, Shan H, Lei CL, Peng YX, Wei L, Liu Y, Hu YH, Peng P, Wang JM, Liu JY, Chen Z, Li G, Zheng ZJ, Qiu SQ, Luo J, Ye CJ, Zhu SY, Cheng LL, Ye F, Li SY, Zheng JP, Zhang NF, Zhong NS, He JX; China Medical Treatment Expert Group for COVID-19. Comorbidity and Its Impact on 1590 Patients with COVID-19 in China: A Nationwide Analysis. Eur Respir J 2020; 55(5):2000547
7. Yilmaz A, Sabirli R, Seyit M, Ozen M, Oskay A, Cakmak V. Association Between Laboratory Parameters And Ct Severity In Patients Infected With Covid-19: A Retrospective, Observational Study. Am J Emerg Med 2021; 42:110–14. doi: 10.1016/j.ajem.2021.01.040
8. Yuan M, Yin W, Tao Z, Tan W, Hu Y. Association of Radiologic Findings with Mortality of Patients Infected with 2019 Novel Coronavirus in Wuhan, China. PloS One 2020; 15(3):e0230548. doi: 10.1371/journal.pone.0230548