







## Preoperative inference of chest radiography assessment in COVID-19 pandemic

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### ABSTRACT

Preoperative patient management is difficult in a pandemic. It is important to diagnose COVID-19 in the preoperative period as it will affect contamination and mortality during hospitalization and operation. We aimed to show how the place of chest X-ray in the diagnosis of COVID may vary according to the branch of the evaluating physician and, accordingly, what inferences can be made about the patients in the preoperative period. 250 patients who underwent Chest X-Ray during COVID-19 pandemic were included. 100 Real-time Reverse Transcription-Polymerase Chain Reaction (RT-PCR) positive COVID-19 cases were included to the patients category and 150 cases with RT-PCR negative and Thorax Computerized Tomography (CT) COVID-related negative were included to the control group. Chest X-Ray soft the both groups have been blindly evaluated by family physicians, internal medicine specialists and chest diseases specialists in a random order. Chest X-Ray comments of physicians were compared with the reference of CT results and also the diagnostic value of the Chest X-Ray was determined. In the evaluation of compliance of the chest X-Ray with PCR the results were; the negative predictive value (78%), sensitivity (74.5%) and specificity (60.8%). The results of the compliance of the Chest X-Ray and Thorax CT were; the negative predictive value (71%), sensitivity (73%) and specificity (66.5%). We concluded that the chest X-Ray is not sufficient to be used alone not only at the stage of diagnosis but also in the pre-evaluation process in order to evaluate the COVID risk with regard to the patients with the planned surgical operations.

**Keywords:** COVID-19, chest X-Ray, preoperative evaluation, thorax computerized tomography.

Received/Geliş: 02/08/2021

Revised/Revizyon: 06/09/2021

Accepted/Kabul: 18/11/2021

## INTRODUCTION

SARS-Co-2 is a new virus that caused the pandemic in March 2020 [1]. It is necessary to take new measures in order to protect individuals and public health in the pandemic. For example, it is recommended not to make hospital applications unless necessary, and to post pone surgical interventions that are not considered urgent. In cases where surgery is required, accurate diagnosis of COVID-19 before surgery is important in terms of contagiousness and patient mortality [1-3]. Chest X-ray is used to evaluate the patient in the preoperative period and evaluated by physicians from different branches. The role of chest X-ray in the diagnosis of COVID-19 is controversial [4-9]. Here, since the Chest X-ray is two-dimensional, the education and experience of the physician regarding the evaluation of the Chest X-rays play an important role. Even among radiologists, there may be different interpretations on the same examination [4-6]. In our study, we aimed to indicate how the role of chest X-ray may vary in the diagnosis of COVID according to the branch of the evaluating physician and, accordingly, what kind of inference can be made about patients in the preoperative period.

## MATERIALS AND METHODS

After the ethics committee approval; date: 30 September 2020 and number: 2020/182, 2500 patients have been examined retrospectively who applied to and then hospitalized in University of Health Sciences Sultangazi Haseki Educational and Research Hospital between the dates 01 April – 31 May 2020. 250 patients who underwent both Chest X-ray and Thorax CT all with RT-PCR test results were included to the study. Among them, 100 patients with RT-PCR positive results were included to the COVID group and 150 patients with RT-PCR negative test results and also with Thorax CT results with out-of-COVID findings were included to control group. The Chest X-rays have been evaluated by 3 family physicians, 4 internal diseases specialists and 3 chest diseases specialists (pulmonologists) each with at least 5 years of field experience both blinded to laboratory and radiology results as well as blinded to each other. Each physician stated and marked the result as either “There is COVID possibility” and “Out of COVID”.

Thorax CT have been reported by 3 radiologists with more than 5 years of experience blinded to RT-PCR results. Their reports were evaluated over hospital computer system. The RT-PCR results were learned from the Public Health Management System (PHMS) and recorded accordingly. The consent among Chest X-ray and Thorax CT as well as among Chest X-ray and RT-PCR were evaluated.

**Chest X-ray:** Patients underwent Chest X-ray with Diamond 6A, DRGEM and Jumong, SG Healthcare Digital roentgen devices. Routine Chest X-ray parameters were in posterior-anterior projection with a film focus distance of 180 cm, 65 kV, 15 mAs.

**Thorax CT:** Thorax CT was performed with a 128-slice CT device (Ingenuity, Philips Medical Systems, Best, The Netherlands) without contrast administration. CT parameters were as follows: 120 kVp, 120 mAs, collimation: 128x0,625, pitch: 1.078, rotation time: 0.75ms, matrix: 521x521 pixel with a slice thickness of 1.0 mm. All CT images were evaluated using a lung window, with a window level of –500 HU and window width of 1500 HU.

**Real-time Reverse Transcription-Polymerase Chain Reaction (RT-PCR):** In order to research SARS CoV-2, the naso-/oropharyngeal swab, tracheal aspirate or bronchoalveolar lavage samples were taken into the transfer tube which contains viral transport medium (VTM) or into the Bio-Speedy® COVID-19 transfer tube (BS-NA-511) which contains the viral nucleic acid buffer (vNAT) which provides the viral nucleic acid extraction (Bioeksen, Istanbul, Turkey). These were sent to the Virology laboratories in 24 hours period of time, at 2-8°C in full compliance with the cold chain rules. The samples with VTM and also the mucus samples have been transferred into the tubes containing vNAT in accordance with the company suggestions in the laboratory. For the viral RNA extraction, the samples have been incubated for 5 minutes in the tubes containing vNAT and then vortexed for 15 seconds and made ready for the usage in the PCR reaction. The obtained extraction products have been subjected to the amplification process in the Qiagen Rotor-Gene (Qiagen, Germany) or Roche Light Cycler 480 (Roche, Germany) devices, by means of using the Bio-Speedy COVID-19RT-Q pcr Detection Kit (Bioeksen, Istanbul, Turkey). The results have been evaluated qualitatively in accordance with the related suggestions of the kit-producer company.

**Statistical Method:** We preferred to use SPSS15.0 for Windows for carrying out the statistical analysis. The definitive statistics are provided both in numbers and in percentages for the categorical variables. The responses of the assessors are compared via Cochran’s Q Test. The comparisons of the proportions among the results are performed with Mc Nemar Test. The compliance of the results is analyzed with Cohhen’ Kappa compliance test. As a result of the evaluation process, the capability of finding the test positive is given as sensitivity, the capability of finding the test negative is given as specificity, the real positive ones among the results where the test detected as positive are given as Positive Predictive Values, the real negative ones among the results where

the test detected as negative are given as Negative Predictive Values and all of the accurate results are given as the correct known ones. The alpha relevance level is accepted as  $p < 0,05$ .

## RESULTS

There was considerably weak compliance between the PCR result and the chest radiography (Kappa value=0.335). The negative predictive value is found as 78% and the sensitivity of the chest radiography is found 74.5% and the specificity is also found as 60.8% (Table 1). Also there was a statistically significant difference among physicians on the evaluation of Chest X-rays ( $p < 0,001$ ).

**Table 1.** Compliance of the PCR and the chest radiography

	PCR	Overall PA
N	250	250
Mc Nemarp	-	<0,001
Kappa Value	-	0,335
Sensitivity	-	74,50%
Specificity	-	60,80%
PPV	-	56,10%
NPV	-	78,00%
Correct Known	-	66,30%

**Table 2.** t-CT and chest radiography compliance

	CT	Overall PA
N	250	250
Mc Nemrp	-	0,004
Kappa Value	-	0,395
Sensitivity	-	73,00%
Specificity	-	66,50%
PPV	-	68,70%
NPV	-	71,00%
Correct Known	-	69,80%

**Table 3.** PCR and t-CT compliance

	PCR	Overall BT
N	250	250
Mc Nemarp	-	<0,001
Kappa Value	-	0,719
Sensitivity	-	95,00%
Specificity	-	79,90%
PPV	-	76,00%
NPV	-	96,00%
Correct Known	-	85,90%

## DISCUSSION

Because of the fact that the COVID-19 disease affects the lungs in particular and it is excessively contagious disease, lots of important preventive measures are being taken relating to the anesthesiology and preoperative evaluation in the healthcare centers in many countries [10]. It is also suggested to postpone the medical operations which are not considered urgent during the pandemic period as well [11]. However, it is further emphasized that it is deemed important to put the preoperative COVID-19 diagnosis for those which should be definitely operated [10,12]. The case detection in the incubation period continues to be compelling both before the operation and after the operation. Particularly for those that the medical operation is being planned due to the pathologies inside thorax, the certain similarities between the symptoms and radiological findings which are related to the thorax disease and the COVID-19 viral pneumonia symptoms may cause some delays. In the study of Shu Peng et al., the mortality rate is reported as 27.3% for the patients that did not take any diagnosis before the operation and then got the COVID-19 diagnosis just after the medical operation [12]. The risk of infection of the disease to the healthcare personnel taking part in the medical operation is additionally crucial [13,14].

In the preoperative evaluation, it is essential to perform the RT-PCR test in 24-72 hours before the medical operation [3,10,11,15,19]. There are various suggestions on the subject whether the Chest X-ray or Thorax CT should be performed for radiological evaluation. The Chest X-ray is considered as easy to access, with the affordable prices, with less risk of infection and radiation exposure [15,20,21]. Just like in Thorax-CT, there may not be any findings within 24-48 hours of the disease [22]. In a compilation from Turkey, the Chest X-ray was suggested in the preoperative imaging [15]. In 5 patients with the RT-PCR negative, Xie et al. reported presence of ground glass areas in Thorax CT and they recommended to perform repetitious RT-PCR and Thorax CT in order to attain the accurate diagnosis in case of high clinical suspicion [16]. The evaluation with Thorax CT was suggested by Amanda et al. for the patients with high risk and also whenever RT-PCR could not be performed [3]. Gökçe et al. evaluated the 473 patients in total from 5 different countries and 11 centers together with their preoperative data. While there was no preoperative finding in 268 of them, Thorax CT was performed and 250 of these patients have been already operated in China [10]. Besides, in Spain and Italy, small case groups have been reported rather than a national approach. While Thorax CT was suggested in the study of Albarello et al., the chest

radiography was suggested in the study of Borghesi *et al.* [23, 24].

The Chest X-ray sensitivity also differs. In the study of Castiglioni *et al.*, while the sensitivity and specificity were found as >80% whenever the Chest X-ray of the COVID-19 patients have been evaluated with the artificial intelligence, it was found as 60% whenever the same patient X-rays have been evaluated by the radiologists [25]. The sensitivity was detected 74.5% and the specificity was 60.8% in our study. In the study of Weinstock *et al.*, the Chest X-rays of the RT-PCR positive patients was evaluated by 11 different radiologists and then it was observed that the sensitivity scale varies around 10-40% [26]. On the other hand, in the study of Wong *et al.*, 2 radiologists evaluated the Chest X-rays and then the sensitivity was found 69% [27]. In our study, the chest X-rays have been evaluated by 10 physicians which are composed of the internal diseases specialists, family physicians and the lung diseases specialists and then the sensitivity was determined as 74.5% specificity. While there were significant differences among the branches in our study, the sensitivity was much higher in comparison with the literature as well.

We are in an opinion that our study is considered quite important in terms of showing the exact role of chest X-ray in the preoperative evaluation process. However, performing our study in a single hospital, the participation of the physicians only from the educational and research hospital and the limited number of patients could be taken as the limitations of our study.

## CONCLUSION

A weak level of compliance of the chest X-ray is found not only with RT-PCR but also with Thorax CT in our study. The interpretation differences among the physicians are also extremely significant. Because of this, we concluded that the chest X-ray is not sufficient alone in COVID-19 diagnosis in the patients for whom the surgical operations are planned.

## LIMITATION

Interpretation of Chest radiographs was done by many physicians of different specialties and experiences, which could directly affect the results (false+ and false- predictive values). In addition, the fact that our study was carried out in a single hospital and that a limited number of patients could be recruited are other limitations.

## ACKNOWLEDGEMENTS

Thank you to Evren Canel Karakaş, Nihal Yıldırım, Mehmet Yamak, Derya Kayaş, Zeynep Erturk, Sunduz Gorukmez, Mustafa Reşat Dabak and Tuba Selçuk Can for their contribution.

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