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Radiological Role in the Detection, Diagnosis and Monitoring for the Coronavirus Disease 2019

Utkarsh Saxena, Mehaksha Batra*

Department of Community Medicine, Jawaharlal Nehru Medical College, Datta Meghe Institute of Medical Sciences, Sawangi, Wardha, Maharashtra, India

ABSTRACT

Background: COVID-19 is the continuously evolving disease which is here to stay for considerable amount of time. Hence the testing methodologies must be varied in order to detect the virus at any cost. Radiological examination of the COVID-19 patients offers some solution in such case. Various methods can be employed at one single time as no single methods can prove effective especially in new disease like COVID-19. Radiological examinations have lot to offer when it comes to screening for novel Coronavirus and its hazardous impact on the body.

Summary: Chest CT along with x-rays is some of the common methods of examination of lung injuries which can be easily employed in the fight against COVID-19. Various studies have proven the efficacy of the radiological intervention over the RT-PCR test which has given the boost for the usage of the former. Although the concerns attached to it are genuine in nature and are existing prior to the initiation of the pandemic. It must be addressed to ensure the long term wellbeing of the patient.

Conclusion: Coronavirus disease 2019 or COVID-19 is still evolving and is presenting new challenges by each passing days. Now the terminology is changed to COVID-19 era indicating its long and painful stay which will affect and change the future course of the life of the humans. More study needs to be done in order to prove efficacy of the radiological interventions like chest CT ad x-rays among COVID-19 patients. The patterns must be studied thoroughly to have deep understanding of the subjects. Artificial intelligence can aid and fast track the process and must be considered while strategizing the action plan.

Key words: COVID-19, CT scan, X-ray, Radiology, Cancer, Radiation

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Corresponding author: Dr. Mehaksha Batra
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INTRODUCTION

Coronavirus disease 2019 or COVID-19 is caused by the novel Coronavirus or SARS-CoV-2 which was first detected in Wuhan city of the Hubei province in China. Initially the disease spread through china ad termed as outbreak. But the all-encompassing nature of the outbreak after it spread to all parts of the world made World Health Organization (WHO) to term it as pandemic by upgrading the statue of Public Health Emergency of International Concern (PHEIC) on March 11, 2020. Till now on December 12, 2021, it has registered 269,525,358 infection cases from worldwide and 5,300,321 people lost their lives to the COVID-19 [1]. The high transmission rate and complications making ability makes it even more lethal. Various vaccination candidates have been approved all across the world giving impetus to the fight against COVID-19. Till now 8,411,062,617 jabs has been administered showing the desperation to control the pandemic anyhow [2]. The latest variant of concern termed as omicron after Greek alphabet has created flutters across the world as it is supposedly more transmissible than its previous highly infectious version which was known as delta version. The detection and diagnosis are two of the most crucial steps in curbing the spread of the disease like COVID-19. Various methods can be employed at one single time as no single methods can prove effective especially in new disease like COVID-19. Radiological examinations have lot to offer when it comes to screening for novel Coronavirus and its hazardous impact on the body. Computes tomography scans along with chest x-rays are popular among health care professionals as they are sometime given more efficient than standardized RTPCR tests [3]. Especially patients having pneumonia in COVID-19 have been successfully

identified and their future course of treatment changed after seeing the onset of severe symptoms. Concerns such as high radiation levels which are not considered good especially in the case of children and pregnant women have merit and must be minimized and addressed [4].

LITERATURE REVIEW

Epidemiology of COVID-19: The novel Coronavirus is the descendants of the severe acute respiratory syndrome Coronavirus-1 or SARS-CoV-1 which is also known as SARS-CoV-2 [5]. The novel Coronavirus is the latest entrants in the Coronaviridae family and is causing the Coronavirus disease 2019 or COVID-19. It is a beta Coronavirus and is among the 7 human Coronaviruses that has caused widespread destruction. Several other human Coronaviruses are also present in surrounding but they are quite dormant and harmless. What makes the novel Coronavirus different from its predecessor is that it is way more contagious than others and its ability to make medical complications among infected persons is huge. The COVID-19 has left other outbreaks and epidemics happened in the near past of the human history way back in terms of all the devastation that has been caused due to the infection [6]. The single stranded RNA of the virus is making so much devastation, that no one has seen such drastic adverse change in past many years. The transmissibility of the virus is extremely high and stopping the infection from contacting is a huge challenge. The bodily openings of the human beings are the entry points for the virus such as nose and mouth and respiratory system is the first affected organs system in the human body. The bodily discharges of the infected person and droplets contain viral load and upon sneezing or coughing, it can be transmitted to other person surrounding the infected person. The virus can also remain airborne for several hours and on surfaces like mobile phones and door knobs which have high touch quotient. This causes more challenge to arise as lot of people uses such things in daily life [7]. To control a population of more than seven billion is a herculean task and if one percent of them get infected then the clinical management of the disease becomes difficult as the health care sector is already crumbling under pressure prior to the arrival of the COVID-19. Initially there was no establish course of treatment available among various medicine department and hence various governmental and health care authorities relied upon the Non-Pharmacological Interventions (NPI) such as lockdown and movement prohibitions in public places to ensure less contact of the population to each other. Meanwhile identification of the infected persons got traction and persons experiencing symptoms such as cold, cough and fever were tested for the disease. Dedicated COVID-19 care facilities cropped up all over the world as it needs separate isolated wards due to its highly contagious nature. Diagnostic facilities were not available worldwide and this too rapidly proliferated so as to cater the huge influx of samples to be tested [4]. Ad hoc administration of medications according to the local condition and clinical history of patient has started and people were responsive to the treatment [8]. While some section of the population known as vulnerable section showed more varied and severe symptoms which needed sophisticated medical care such as intensive care unit mobilization, oxygen support, mechanical ventilation and so on. The management of such patient was extremely difficult as more and more patient were experiencing such severe symptoms and needed high end medical care which was already in limited in number. There was no divide among the countries having resourcing and those who had not as the health care facilities among developed countries was also overburdened as no on anticipated that pandemic of such scale would arrive [9]. Virus is the quasi living organism which cannot be activated and do its job if it does not get any host. Novel Coronavirus and various other viruses need hosts to multiply and proliferate. Also viruses are notorious for the mutation. Mutation I she change in their structure which can be either small scale or drastic and which can alter the behaviour of the virus. The novel Coronavirus is mutating from the start and therefore for the ease of media reporting and layman understands WHO has come up with giving names of Greek alphabets to the new variants of viruses which are mutated. Currently the omicron version of the novel Coronavirus is making headlines all over the world as it is supposed to be several times more infectious than the previous highly infectious delta version [10]. Some of the Greek alphabets pronounced nu and Xi are skipped and omicron is the fifteenth in the list. Although not all the variant are major in nature, some of them can prove extremely nuisance causing as the detection and treatment of the same is extremely difficult. Virus basically makes changes in their spike protein which helps them to get into the host cell *via* Angiotensin Converting Enzyme 2 (ACE 2) receptors which are prominently expressed on various organs of the human body and hence novel Coronavirus can directly infect all these organs systems.

Detection and prognosis of the COVID-19: COVID-19 spread at extremely high rate and reached to the remotest part of the globe. It not only infects the person concerned but also exploits the weakness in the infected person's body if any. Also some of the weaknesses are induced by the COVID-19 which can be seen among the survivors of the disease. Therefore it becomes important to curb the spread of the virus. Detection and identification is one of the primary steps which are being taken in order to identify and isolate the infected individuals as they can transfer the infection to the others [11]. Early identification is extremely necessary as it can save the patient's life as well as safeguard others who might have been infected if the patient was not identified early enough. Several methods are employed in order to detect the COVID-19 infected patients. It consists of taking swabs which are checked through Reverse Transcription Polymerase Chain Reaction (RTPCR) test, blood samples can reveal antibodies through antibody test, rapid antigen test. Some expression of the virus has also been seen on the lungs which are early indicators and hence radiology is also taken in to diagnostic system [12]. Computed Tomography (CT) scan, x-ray can reveal some patterns which are unique to the COVID-19 and can

indicated the worsening of the situation. Also RTPCR, antibody tests etc. have flaws in them such as improper swab collection, low viral load in nose and upper respiratory tract, fewer antibodies which can give false negative test results. Hence section of patients which are considered as highly vulnerable to obtain severe symptoms on the course of infection must be cross checked with the radiological methods in order to clear the picture. Ground glass opacity test is conducted on the patient's radiological findings and the damage done to the lungs by the viral behavior. The more opaque the graphs are the more is the lung injury happened to the patient. Therefore various inferences can be drawn from the radiological findings of the patients and can be one of the alternative methods for detection of onset of the severity of the disease.

DISCUSSION

COVID-19 and role of radiology: RTPCR is considered as established standard for the identification of the COVID-19. It examines the nasal and oral swabs taken from the suspected persons and method of reverse transcription applies on it. If the RNA strand of the virus is present in the collected swab then the chain reaction will amplify the strand will compare it to the available assay. But several concerns are attached to the efficacy of the method. Firstly the requirement of the trained person is the major hindrance as the collection of swab with proper technique is important. Otherwise the swab may not be showing any viral strain but the patient can have enough viral loads to sicken him. Next the exchange or mishandling of swab samples may interchange the result and infected person might be shown negative for COVID-19. Therefore alternate mechanism to cross check the result should be in place in order to fast track the process of identification of COVID-19 infected persons [13]. Radiological interventions like CT scan and x-rays are one of the common methods which are used in the field of medicine and detection to take stock of the inner functioning of the organs. In COVID-19, novel Coronavirus primarily enters the body through bodily openings such as nose and mouth and the viral load then spreads to the respiratory tract and lungs. Hence the most initial effects of the novel Coronavirus causing COVID-19 can be seen on the lungs before any other organs system is affected. Hence CT scan of the chest can guide the health acre professionals on which course of treatment should they prefer in order to optimize the treatment methods. Several marked pattern was seen on the lungs such as abnormal lining, spots and patterns which otherwise would not have been seen. CT has been found to have been playing an important role in curbing the spread of COVID-19 by detecting several types of infection. Chest CT scan can easily reveal the lung injuries and indicate the condition of the COVID-19 infected person [14]. Various studies have shown that the efficacy of the chest CT scan in showing the damage done by the COVID-19 way greater than RTPCR test. As lungs is one of the vital organs that provides an essential element without which the survival of any animal is impossible and that is oxygen. Oxygen is extremely necessary for the proper function of the organs as energy production and breakdown of glucose happens in cell with the help of oxygen. Therefore any kind of damage to lungs can be detrimental to all other parts of the body resulting in the cascading effect. CT is recommended in the patient of COVID-19 having pneumonia as health care professionals need to know about the damage done to the lungs to decide further course of treatment [15]. A review of the CT scan in a hospital facility of 51 patients revealed that 77 percent of them had ground glass opaque patterns on their scans, interlobular septal thickening along with ground glass opacity was observed among 75 percent of the patient. Consolidation in chest CT was seen among 59 percent of the patients observed in the study. Ground glass opacity is the prominent feature which is often used by the health care professionals while analyzing the radiological scans of the patients suffering from pneumonia. In the initial days of the pandemic, when hospitals in China introduced the CT scans of chest to identify the patients of COVID-19, The number of patients rose and delays due to RTPCR test was somewhat negated. Low viral load and improper swab collection are two of the most cited lacunas in RTPCR test which is covered by the chest CT scan. Serious lesions can be detected by the computed tomography which would otherwise be neglected as the viral load changes their location from upper thoracic region to the lower one. A test done on the detection methods on 1014 patients which proved that chest CT has high degree of efficacy in detecting more accurately than RT PCR test. NO one methods can be said to be sacrosanct as every methods has its limitations. Chest CT scan can aid the efforts of detection and over all efforts against COVID-19. Radiological manifestation of the COVID-19 includes the opaque nature of the chest CT which indicates lesions in the lungs, faded bronchial and vascular margins in CT. Apart from ground glass opacification interlobular septal thickening, crazy paving pattern, halo and reverse halo sign, pleural and pericardial effusion, pulmonary emphysema and so on are some of the other radiological findings which are occurring less frequently [16]. The pediatric age group was thought to have been immune from severe manifestation of the novel Coronavirus disease 2019 but later through examinations of the chest CT of the pediatric age group patients, it was found that there were lesions present on the lungs which indicated the injury to the lungs. In another study in China, 20 pediatric age group patient of COVID-19 were considered for the study. Although the group was small, it offered some beneficial inferences from the study. 50 percent of the studied patients were having consolidation with halo sign, 60 percent of them were having ground glass opacification. Fine mesh shadow and tiny nodules were observed among 20 and 15 percentage of the patients respectively [17].

Concerns regarding the radiation: Although the role of the radiology in deciding the course of fight against COVID-19 is crucial, several concerns are also has been raised regarding the usage of radiology in COVID-19. Computed tomography and x-ray have mechanism in which the stream of radiation of invisible spectrum of

waves bombarded on the patients skin. The target size which is the peripheral part above the target organ is hit by the radiation. This radiation can be harmful to the cells and tissues of the organs ad these radiation have high penetration power which can disturb the function of the body at cellular levels. The high exposure to the radiation can cause defect that would only be seen in future. Especially young adults, infants and pregnant women must be extremely cautious about the levels of radiation to which they are exposed. As the effects of radiation includes deformed cells, growth of cancerous cells, tumors which are chronic diseases and does not leave the back of the patient for many years. Also the medical interventions for such ailments is time consuming and costly. That is why, radiation levels must be controlled and the frequency of radiological examinations must be as low as possible in order to minimize the exposure of radiation to the patient. The effects of radiation can be seen after couple of decade therefore geriatric care must include such aspects so that they can be better equipped to deal with any kid of eventualities. In non COVID-19 patients, radiological examinations are done only when there is inevitability such as emergency care and casualties. In old age patients, the radiological scans are considered less dangerous as they have enough time for medical intervention and it will take much more time to form any kind of disorder but the identification of any disorder *via* such scans is important. The exposure of the CT must be kept as least as possible in case of children and pregnant women as they can develop abnormalities in future. Ultrasound can be an alternative in case of CT which was also found to be effective in detection certain abnormalities. Lowest possible mode of the radiation must be used to optimize the use of the radiological examinations.

CONCLUSION

Coronavirus disease 2019 or COVID-19 is still evolving and is presenting new challenges by each passing days. Now the terminology is changed to COVID-19 era indicating its long and painful stay which will affect and change the future course of the life of the humans. The fight against COVID-19 should be continues and each and every aspect of this fight must be checked and updated as virus is also keeping itself updated *via* mutation. Diagnostic methodologies in COVID-19 must need regular revision and updating in order to keep it more effective. RTPCR is considered as gold standard but it lacunas and loopholes must be closed to make it more effective. Radiological detection methods can be act as alternative methods as no method can be fool proof. This methods has its own advantage and this should be taken into account while suggesting detecting and diagnosing techniques. The chest CT has become quite popular among the health care professionals has it gave accurate stock of the pneumonia patient suffering form COVID-19. In some cases the accuracy of the radiological examination methods of COVID-19 were found to have been more than the standardized reverse transcriptase polymerase chain reaction test. Therefore it can be used as alternative testing methodology. Various patterns should be understood by the radiologist for quick detection. An algorithm along with use of artificial intelligence can be employed in order to fasten the detection procedure. The diagnosis with CT and other methods must be standard in any region of the world. The harmful impact of the radiation is the main concern and it should be anyhow minimize so as to safeguard the long term health and wellbeing of the patient.

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