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Value of Chest Computed Tomography in Diagnosis of COVID-19 Related Pneumonia and Its Severity in Relation to ABO Blood Grouping System

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ABSTRACT

Background: Most individuals inflicted with COVID-19 present with pneumonia. Chest computed tomography is such a promising and feasible technique of diagnosis. **Aim:** Evaluation of the diagnostic precision of chest CT in identification of COVID-19 related pneumonia and assessment of severity in relation with ABO blood grouping system. **Patients and methods:** This cross-sectional analytical research performed on 60 patients with symptoms suggestive of COVID-19 related pneumonia presented to Radiology Department in Al-Ahrar Teaching Hospital from August 2020 till February 2021.
Results: As regard ABO system, it was group A in 24 patients (40%), group B in twenty individuals (33.3%), group AB in 6 individuals (10%) and group O in 10 individuals (16.7%). As regard Rh system, there were 21 Rh positive patients (35%) and 39 Rh negative patients (65%) in all studied patients. The most common symptom was cough in 42 patients (70%). Regarding the diagnostic performance of chest CT for COVID-19, 48 individuals (80%) were true positive, 10 individuals (16.7%) true negative, 1 patient (1.7%) false positive and 1 patient (1.7%) was false negative. Thus, chest CT had the sensitivity of 98%, specificity of 90.9%, PPV of 98%, NPV of 90.9% and precision of 96.7%.
Conclusion: In the absence of negative nucleic acid test outcomes, clinical diagnosis of COVID-19 infection may be possible via CT characteristics. Clinical practice currently relies irreplaceably on CT for diagnosis, screening, and monitoring the efficacy of treatments, as it is exceptionally sensitive to COVID-19 lesions.
Keywords: COVID-19, ABO blood grouping system, Chest computed tomography

INTRODUCTION

The massive spread of COVID-19 mandates the presence of a rapid and practical diagnostic method. Although real-time reverse transcriptase polymerase chain reaction (rRT-PCR) is the only available gold standard test for confirmation of COVID-19 diagnosis, it is time consuming and expensive. Thus, a faster diagnostic modality is mandatory to decrease the risk of COVID-19 associated mortality and morbidities. There is currently no biological marker known to predict the susceptibility and severity of COVID 19 related pneumonia [(1)], so we investigated the linkage of ABO blood grouping and COVID 19 related pneumonia severity, for future prediction of the most susceptible persons. Nowadays, Corona virus disease (COVID-19) outbreak is the new pandemic that threatens the whole world. Since its detection in China late in 2019, its spread to all nations was inevitable. The World Health Organization reported 2,954,222 positive cases and 202,597 COVID-19-related mortalities internationally [(2)].

The majority of patients with COVID-19 present with pneumonia, which necessitates a radiological confirmation. Chest computed tomography (CT) is such a promising and feasible method of diagnosis. CT is rapid, cheaper in comparison to rRT-PCR, and relatively available [(3)]. Antigen determination of ABO blood groups has been related to the severity of specific viral infections. This is performed to demonstrate a correlation amongst SARS-CoV infection and ABO blood groups. [(4)].

The objective of this research was evaluation of the diagnostic accuracy of chest CT diagnostics of COVID-19 related pneumonia and assessment of severity in relation with ABO blood grouping system.

PATIENTS AND METHODS

This cross-sectional analytical research was performed on 60 patients with symptoms suggestive of COVID-19 related pneumonia presented to Radiology Department in Al-Ahrar Teaching Hospital from August 2020 till February 2021.

Inclusion criteria

Possession of a travel or residential history in communities where instances have been reported within the past 14 days, contact with individuals positive for viral ribonucleic acid (RNA) within the same time frame, interaction with a patient exhibiting fever or symptoms of breathing, or origin from a community where there have been confirmed cases reported within the last 14 days, along with the presence of a minimum of two of the subsequent clinical features: Imaging characteristics, fever, and/or respiratory signs. Although a computed tomography (CT) scan is favored, a chest x-ray or differential complete blood count (CBC) evaluation might suffice in cases where a decreased lymphocytic count and severe acute respiratory infection (SARI) with no apparent alternative cause are present.

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PSI scores are classified into groups I, II, III, IV, and V. Patients are stratified into two levels of risk: low risk (groups I–III) and high risk (groups IV–V).

Sample size:

$$n = \frac{Z^2\ P\ (1-P)}{d^2} \quad (5)$$

n: sample size. Z: statistic for level of confidence (for ninety-five% confidence level, z value is 1.96) P: prevalence (27.3%) [6]. d: precision (0.1)

According to the above formula, the sample size was 54 patients. A 10% dropout were added, so total sample size was 60.

Sampling technique: Convenience sampling method.

METHODS

Diagnosis of COVID-19: Individuals were regarded as confirmed instances of COVID-19 according with WHO technical guidance [7] when a nasopharyngeal swab specimen yielded positive results from reverse transcriptase-polymerase chain reaction testing.

CT scan was performed as follows:

- **Starting from** the apices of the lung to below costophrenic angles.
- **Slice thickness:** 0.625-1.25 mm
- **Scan time:** 0.5-1 second
- **KV:** 120
- **MAs:** 100-200
- **Collimation:** 1.5-3 mm
- **Matrix size:** 768 x 768; otherwise, the most extensive one available
- **FOV:** 35 cm
- **Reconstruction algorithm:** elevated spatial frequency
- **Window:** lung window, mediastinal window. Contrast media ± given in some selected cases (e.g., hilar lymphadenopathy).

Patient position: supine in cranio-caudal direction.

Level of inspiration: after full arrested inspiration.

Image analysis: performed by an autonomous radiologist, the report detailed the features of the lesion, including its distribution, lobe count, pattern, and the extent to which it affected neighboring structures.

Verification of pulmonary ground-glass opacity (GGO) was achieved in the presence of diffuse opacity that did not obstruct the underlying bronchial structures and pulmonary vessels. An opacity that obstructed bronchial structures and pulmonary vessels represented confirmation of consolidation. In the context of crazy paving, interlobular septal thickening is known as ground glass opacity. Reversed halo sign was aroused abnormality with peripheral consolidation and relatively less dense mild central GGO, it was potentially related to organizing pneumonia, presumably secondary to infection, mixed GGO and consolidation.

CT assessment and data analysis:

Utilizing a Somatom, Siemens 64-MDCT scanner (Somatom Sensation 64, Siemens Medical Solutions, Germany) and a Philips 256-MDCT scanner (Brilliance iCT; Philips Healthcare, Cleveland, OH), the scans were conducted. Supine patients underwent scans with the following parameters: 120 kV, 130-240 mAs, five millimeters beam collimation, 1.25 pitch, 0 gantry inclination, and the field of view (FOV) was determined based on the dimensions of the individuals. The scans reached lower the diaphragm and encompassing the entire thorax, from the base of the clavicle. Contrast was not administered intravenously. After obtaining the images, they were transmitted to a specialized post-processing workstation, where the multiplanar reformation function was utilized to get volumetric measures.

Ethical Considerations: For the purpose of taking part in the study, every patient gave written informed consent. Diagnostic Radiology Department, Faculty of Medicine, Suez Canal University, Egypt, and the Research Ethics Committee of the Faculty of Medicine, Suez Canal University, authorized the research's conduct. The purpose of this study was to perform research on humans in compliance with the Declaration of Helsinki, the code of ethics of the World Medical Association.

RESULTS

In relation to the individuals under investigation, the average age was 52.6 ± 11.5 years. In terms of gender, the samples for the study consisted of equal number of males and females (Table 1).

Table (1): Description of age and sex in the examined individuals.

		Studied patients (N = 60)	
Age (years)	**Mean ±SD**	52.6 ± 11.5	
	Min - Max	26 – 72	
Sex	**Male**	30	50%
	Female	30	50%

Table 2 demonstrates the description of symptoms in all studied individuals. Cough in 42 individuals (70%) was the most common symptom followed by fever in 36 individuals (60%).

Table (2): Description of symptoms in each examined. individuals:

	Studied patients (N = 60)	
Cough	42	70%
Fever	36	60%
Dyspnea	24	40%
Myalgia	17	28.3%
Nausea	8	13.3%
Diarrhea	10	16.7%
Headache	16	26.7%

Table 3 demonstrates the description of blood group in all the examined individuals. In regard to ABO system, it was group A in 24 individuals (40%) that was the most common followed by group B in 20 individuals (33.3%). As regard Rh system, there were 21 Rh positive patients (35%) and 39 Rh negative patients (65%) in all studied individuals.

Table (3): Description of blood group in each examined. individuals:

		Studied patients (N = 60)	
ABO	**A**	24	40%
	B	20	33.3%
	AB	6	10%
	O	10	16.7%
Rh	**Negative**	21	35%
	Positive	39	65%

Table 4 shows the diagnostic performance of chest CT in relation to PCR results for COVID-19 diagnosis. Chest CT had the sensitivity of 98% and specificity of 90.9%.

Table (4): Diagnostic performance of chest CT in relation to PCR results for COVID-19 diagnosis:

(n = 60)	**True positive**		**True negative**		**False positive**		**False negative**	
Chest CT	48	80%	10	16.7%	1	1.7%	1	1.7%
	Sensitivity		Specificity		PPV		NPV	Accuracy
Chest CT	98.0%		90.9%		98.0%		90.9%	96.7%

Table 5 shows the statistically significant variance amongst PSI collections regarding ABO while was noted no statistically significant variance amongst PSI collections as regard Rh.

Table (5): Relation between PSI group and blood group (ABO and Rh).

		PSI groups										X^2	p-value
		Group I (n = 12)		Group II (n = 22)		Group III (n = 13)		Group IV (n = 9)		Group V (n = 4)			
ABO	A	5	41.7%	6	27.3%	2	15.4%	8	88.9%	3	75%	21.3	0.046 S
	B	2	16.7%	10	45.5%	6	46.2%	1	11.1%	1	25%		
	AB	1	8.3%	2	9.1%	3	23.1%	0	0%	0	0%		
	O	4	33.3%	4	18.2%	2	15.4%	0	0%	0	0%		
Rh	Negative	5	41.7%	10	45.5%	5	38.5%	1	11.1%	0	0%	5.8	0.217 NS
	Positive	7	58.3%	12	54.5%	8	61.5%	8	88.9%	4	100%		

As regard pattern of lesion, there was GGO in 24 patients (40%), which was the most common finding followed by GGO with consolidation in 19 patients (31.7%) (Table 6)

Table (6): Description of CT findings in the examined individuals:

		Studied patients (N = 60)	
Lung affection	No affection	11	18.3%
	One lung	11	18.3%
	Two lungs	38	63.3%
Lobes affected	Non	11	18.3%
	All lobes	25	41.7%
	Upper lob	8	13.3%
	Middle lob	6	10%
	Lower lobe	22	36.7%
Side of affection	Non	11	18.3%
	Right side	9	15%
	Left side	2	3.3%
	Bilateral	38	63.3%
Lesion distribution	Non	11	18.3%
	Peripheral	21	35%
	Mixed	28	46.7%
COVID or not	COVID	49	81.7%
	Not COVID	11	18.3%
Pattern of lesions	None	11	18.3%
	GGO	24	40%
	GGO with consolidation	19	31.7%
	GGO with pleural effusion	1	1.7%
	Consolidation and Pleural effusion	3	5%
	Consolidation and lymphadenopathy	1	1.7%
	Consolidation	1	1.7%

CASES PRESENTATION

CASE (1)

A 72-year-old male individual with signs of nausea, dyspnea, and body aches for 5 days. CT image demonstrates faint multiple bilateral ground glass densities and septal thickening are seen involving different lung lobes, they are seen more peripherally and pleural based.

Right Lung affection:
Upper lobe: Posterior segment.
Middle lobe: Lateral segment.
Lower lobe: Superior, anterior, lateral, and posterior segment.
Left Lung affection:
Upper lobe: Apicoposterior segment.
Lower lobe: Superior, lateral, and posterior segment.

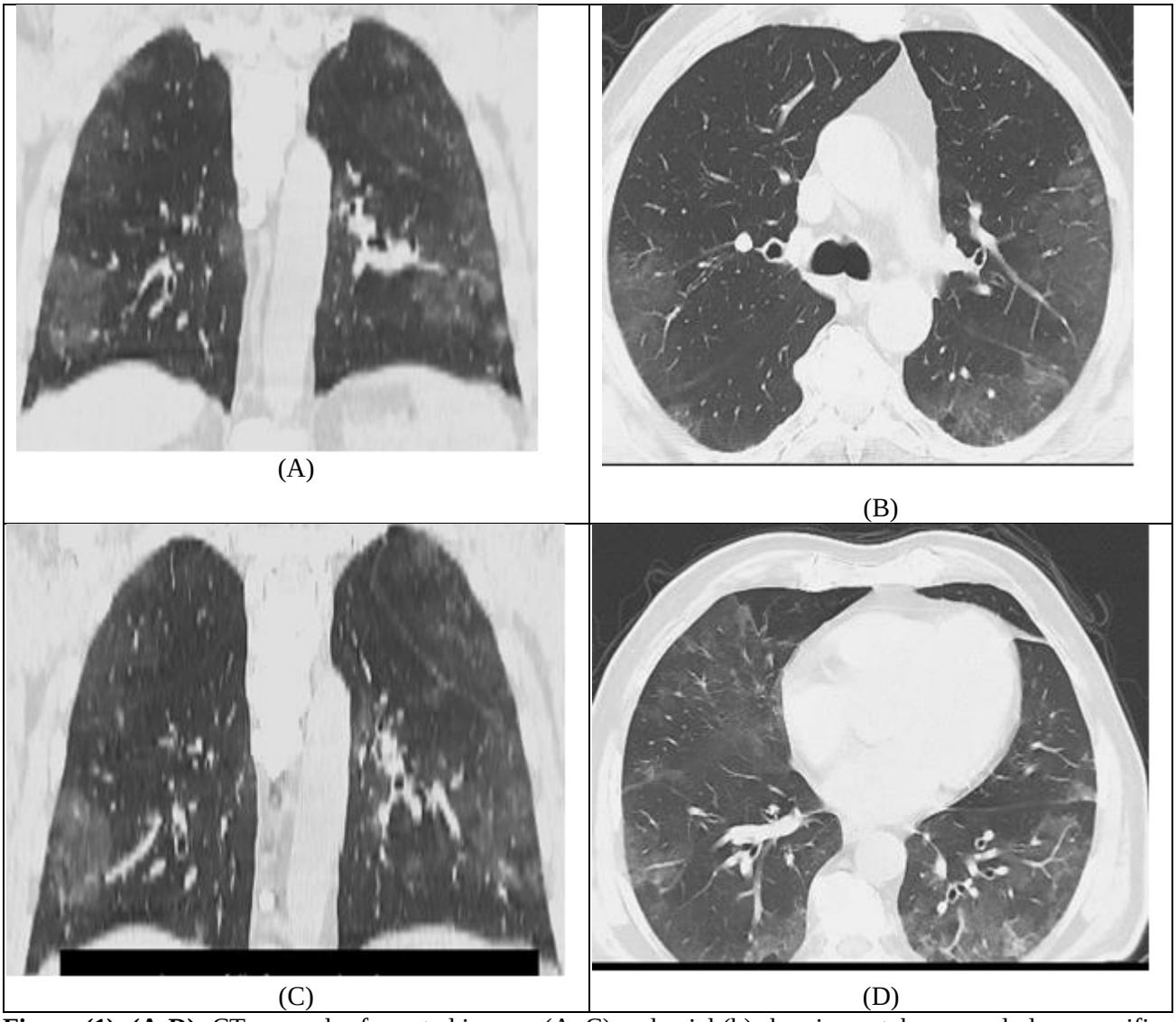

Figure (1): (A-D): CT coronal reformated images (A, C) and axial (b) showing patchy ground glass opacifications, which are more peripherally and pleural based, CT axial image (D) is showing characteristic of crazy paving appearance intralobular lines within GGOs.

CASE (2)

A thirty-eight-year-old male patient. CT images obtained after 3 days of symptoms onset of fever, fatigue and chest tightness. CT demonstrate multiple bilateral regions of ground glass densities, which are seen involving different lung lobes, they are seen more peripherally and pleural based. Some nodules are peribronchovascular.

Right Lung affection:
Upper lobe: Posterior segment.
Lower lobe: Superior, anterior, and posterior segment.
Left Lung affection:
Upper lobe: Anterior segment.
Lower lobe: superior, anterior, lateral, and posterior segment.

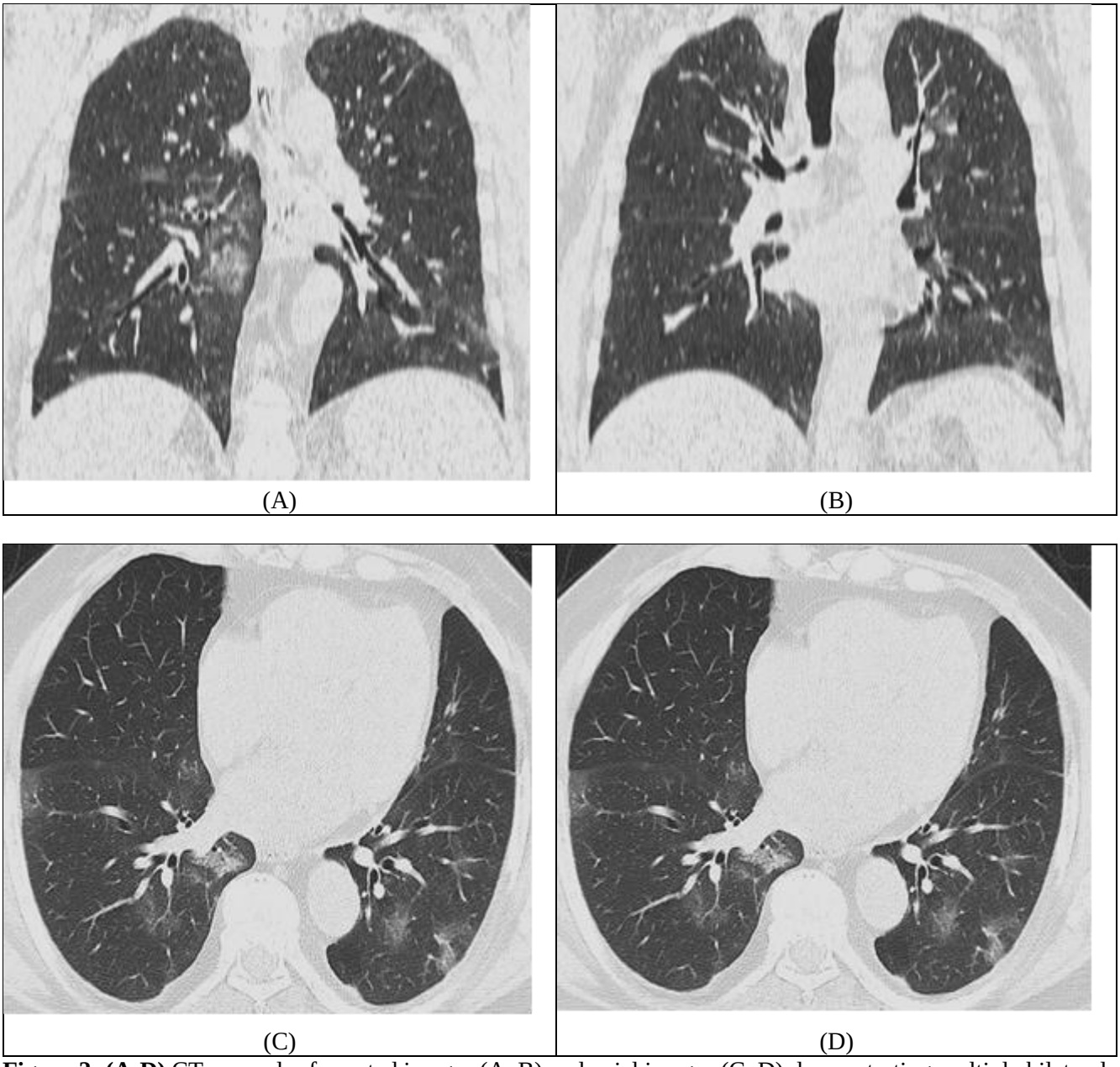

Figure 2: (A-D) CT coronal reformated images (A, B) and axial images (C, D) demonstrating multiple bilateral regions of ground glass densities, which are seen involving different lung lobes, they are mixed peripheral (arrow in image C) and peribronchovascular (arrow in image D) nodules.

DISCUSSION

COVID-19 is a highly contagious and severe illness that is causing widespread disruption on a global scale. The utilization of chest CT evaluation is crucial in the early and preliminary detection of COVID-19. A thoracic CT can be performed prior to the initial detection of a positive RT-PCR. to distinguish non-COVID-19 from COVID-19 during an individual's initial consultation at a general hospital. Amidst the varied isolation and treatment principles associated with suspected COVID-19 cases with a history of epidemics, it is vital that radiologists initially focus on baseline CT findings [8].

Sixty patients, age range 26-72 years, all had clinical symptoms varying between cough 70%, fever 60%, dyspnea 40%, myalgia 28.3%, nausea 13.3%, and diarrhea 16.7%; diagnosed as suspected suffering from COVID-19 related pneumonia were the participant of this study.

Regarding the diagnostic performance of chest CT in relation to PCR results for COVID-19 diagnosis. Total studied individuals were 60 individuals. Were noted 48 individuals (80%) true positive, 10 individuals (16.7%) true negative, 1 individual (1.7%) false positive and 1 individual (1.7%) false negative. Thus, chest CT had the sensitivity of 98%, specificity of 90.9%, PPV of 98%, NPV of 90.9 percent and precision of 96.7%.

Most cases showing areas in our work of GGO (ground-glass opacities), mixed GGO with consolidation, GGO with pleural effusion, consolidation and pleural effusion, consolidation and lymphadenopathy, and consolidation. Distribution was GGO in 24 patients (40%), GGO with consolidation in 19 patients (31.7%), GGO with pleural effusion in 1 patient (1.7%), consolidation and pleural effusion in 3 patients (5%), consolidation and lymphadenopathy in 1 patient (1.7%) and consolidation in 1 patient (1.7%).

This agrees with study by **Dai *et al.*** [8] that have documented the utility of CT in identifying the existence, distribution, scope, and characteristics of pneumonia connected to COVID-19.

Since the identification of the ABO blood group, the potential function of blood groups in infectious disease has been a subject of ongoing interest. Investigations into epidemiology frequently focus on blood groups due to the fact that they are genetically detected characteristics whose polymorphic expression is well understood across populations and persons.

Numerous blood groups function as receptors for pathogens, toxins, parasites, bacteria, and viruses, enabling these entities to colonize, invade, or circumvent host clearance mechanisms. In addition to functioning as false receptors, blood groups can impede binding to target tissue. Lastly, antibodies against blood group antigens, including ABO, can be stimulated by microorganisms. ABO antibodies are a component of the innate immune system that protects against enveloped viruses and certain bacterial pathogens carrying ABO-active antigens. [9].

The correlation that exists among the ABO blood group and the risk of multiple infectious illnesses has been established in a number of prior studies. The existence of blood group O may substantially reduce the risk of hepatitis B, according to **Mohammadali *et al.*** [10]; furthermore, among HBV-infected individuals, Rh was more prevalent among Rh-positive donors.

Elnady *et al.* [11] found that the incidence of rotavirus gastroenteritis was found to be substantially higher in persons with blood type A and considerably lower in persons with blood type B who tested positive for rotavirus.

Degarege *et al.* [12] found in a more recent investigation that individuals who have malaria with blood group A were at a greater risk of increasing anemia compared to those with blood group O and those without phenotype A.

In our study we tried to find a relation that link ABO blood grouping system and COVID-19 related pneumonia, but such studies need large numbers of participant to apply the results to population and this study is limited due to small numbers of cases.

In regard to ABO, our findings revealed a statistically significant distinction (p-value = 0.046) among the PSI groups. However, with respect to Rh, no statistically significant variance (p-value = 0.217) was observed among the PSI groups.

In our work we found that as regard ABO system, it was group A in 24 patients (40%), group B in twenty individuals (33.3%), group AB in 6 individuals (10%), and group O in 10 individuals (16.7%). As regard Rh system, there were 21 Rh positive patients (35%) and 39 Rh negative patients (65%) in all studied patients.

This agrees with studies by **Liu *et al.*** [13], **Bhandari *et al.*** [14] and **Golinelli *et al.*** [15], studies demonstrate a correlation between COVID–19 susceptibilities and ABO blood grouping, with group A being more susceptible. More research is necessary to determine how to implement these relationships in clinical practice.

This disagrees with studies by **Dzik *et al.*** [16] that found a potential rationale for the marginally higher proportion of people with blood group O in COVID-19 cases, given the disproportionate impact of the pandemic

on those of Latin or Hispanic heritage in Boston, where group O is more prevalent, is the higher prevalence of SARS-CoV-2 infection between this population.

CONCLUSION

In the absence of negative nucleic acid test results, clinical diagnosis of COVID-19 infection may be possible via CT characteristics. Clinical practice currently relies irreplaceably on CT for screening, diagnosis, and monitoring the efficacy of treatments, as it is exceptionally sensitive to COVID-19 lesions. The research demonstrates a correlation among COVID–19 susceptibilities and ABO blood classification, with group A being more susceptible. More research is necessary to determine how to implement these relationships in clinical practice.

DECLARATIONS

- **Consent for publication:** I certify that each author has granted permission for the work to be submitted.
- **Funding: No fund**
- **Availability of data and material:** Available
- **Conflicts of interest:** no conflicts of interest.
- **Competing interests:** None

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