J. Dhaka National Med. Coll. Hos. 2024; 30 (02): 28-32

Original Article

Study of Biochemical and Radiological Findings among COVID-19 Patients in a Tertiary Care Hospital

Samira Ferdous[1*], Asma Khatun[2], Santwana Saha[3], Nusrat Jahan[4], Mahmuda Khandaker[5], Jannatul Nayim[6], Banaful Roy[7]

[1]Assistant Professor, Department of Biochemistry, ShaheedMonsur Ali Medical College, Dhaka, Bangladesh, [2]Associate Professor, Department of Physiology and Biochemistry, Dhaka Dental College, Dhaka, Bangladesh, [3]Assistant Professor (cc), Department of Biochemistry, Dhaka National Medical College, Dhaka, Bangladesh, [4]Assistant Professor, Department of Biochemistry, Kumudini Women's Medical College, Tangail, Bangladesh, [5]Associate Professor and Head, Department of Microbiology, ShaheedMonsur Ali Medical College Hospital, Dhaka, Bangladesh, [6]Medical Officer, Department of Surgery, Bangladesh Institute of Health Sciences General Hospital (BIHS), Dhaka, Banglaedsh, [7]Adjunct Faculty, Food science and Nutrition Program, Bangladesh Open University, Gazipur-1705, Banglaedsh.

Abstract

Background: The COVID-19 pandemic has resulted in severe illness for many patients globally.Leveraging biochemical and radiological data, the research seeks to optimize patient management, ultimately leading to fewer deaths and disease-related complications.

Methods: This observational study has been carried out among 50 patients suffering either from COVID-19 aged between 16-90 years.The place of study was East west Medical College and Hospital, Uttara, Dhaka. The duration of this study was 6 months and was conducted from July 01, 2020 to December 31, 2020. The data are collected from biochemical and radiological investigations with the help of medical equipment for obtaining blood samples and CT scan. Quality of data is strictly maintained and ethical issues are properly maintained in all the steps of this study.The data was then analyzed by SPSS software (version 26.0) and then presented in tables and charts.

Results: The cohort included 29 (58.0%) men and 21 (42.0%) women, and the mean age was 56.9 years (SD ±7.3). The biochemical profile revealed that 39 (78.0%) patients had lymphocytosis and 44 (88.0%) had increased D-Dimer levels. In the CT chest findings, 35 (70.0%) had ground-glass opacity and 32 (64.0%) were present with consolidation.

Conclusion: The study provides information by examining biomarkers and chest CT scans aiding in thedisease diagnosis, severity assessment, and outcome prediction.

Key words: COVID-19, Coronavirus, Pandemic, CRP, D-Dimer, CT scan.

Introduction

In late 2019, a novel coronavirus emerged in Wuhan, China, and rapidly spread across the globe,causing symptoms that included fever, difficulty in breathing, cough, and invasive lesions on both lungs of the patients, sparking the COVID-19 pandemic.[1] The culprit behind this respiratory illness is SARS-CoV-2, a virus that infiltrates human respiratory cells. This ability is facilitated by the interaction between the viral S protein and a human cell receptor.[2]

***Correspondence:** Dr. Samira Ferdous, Assistant Professor, Department Biochemistry, Shaheed Monsur Ali Medical College, Dhaka, Bangladesh, Mobile: +8801728136155, Email: samiramazhar12@gmail.com

Received: 02.04.2024 **Accepted:** 30.09.2024

The World Health Organization (WHO) recognized the severity of the outbreak, declaring it a Public Health Emergency of International Concern (PHEIC) in January 2020. Shortly after, in February, the disease was officially named Coronavirus Disease 2019 (COVID-19).[3,4] Bangladesh confirmed its first case in March 2020, experiencing a rapid initial rise in infections before a gradual slowdown.[5]

Diagnosing COVID-19 presents a challenge due to the diverse clinical picture. The disease can range from asymptomatic infection to severe pneumonia. RT-PCR, the current mainstay diagnostic test, offers high specificity but suffers from lower sensitivity, leading to potential false negatives. Additionally, the test results can take 24-72 hours.[6]

To address these limitations, healthcare professionals often utilize a multifaceted approach that incorporates biochemical investigations. These investigations analyze the blood and other bodily fluids to assess various parameters. The specific findings can vary depending on the severity of the illness, aiding in diagnosis, determining disease severity, and predicting potential outcomes.[7]

SARS-CoV-2 can infect various tissues, including the lining of blood vessels (endothelium), liver, and kidneys, potentially leading to multi-organ involvement. Biochemical markers that reflect damage to these organs become crucial diagnostic tools.[8]

Imaging techniques like chest CT scans also play a vital role in diagnosing and managing lung diseases. In the context of COVID-19, CT scans are particularly valuable. They can help assess disease severity, differentiate between COVID-19 and other illnesses, especially when PCR tests are inconclusive, and identify early signs of lung infection.[9]

Rapid diagnosis is essential in COVID-19 pneumonia patients, especially considering the potential for rapid progression to acute respiratory distress syndrome (ARDS). Early detection allows for timely intervention and improved patient outcomes.[6]

By combining biochemical investigations with chest CT scans, healthcare professionals gain a more comprehensive understanding of the disease in each patient. This multifaceted approach allows for better diagnosis, assessment of severity, and ultimately, improved patient management with the goal of reducing mortality.

Materials and Methods

This research explored the characteristics of patients admitted in the Covid Unit of East West Medical College&Hospital in Dhaka, Bangladesh. The study was an observational study which examined data from 50COVID patients between July 2020 and December 2020. The researchers analyzed the existing patient recordsdiligently during the study period.

Each patient was diagnosedbeforehand by a registered specialist physician. This involved a detailed medical history, including past illnesses, treatments, and potential risk factors.Patient autonomy and understanding was ensured and consent was obtainedin a written form.

The study meticulously collected and documented patients' sociodemographic characteristics, encompassing age, sex, occupation, as well as their investigation reports andmanagement plan. This comprehensive data was recorded in the department'smedical registry, forming the foundation for subsequent analysis.To ensure transparency and replicability, only patients with complete data entries were included in the final analysis.

The detailed compiled data in the registry was thoroughly analyzed using Microsoft Excel. This user-friendly software facilitated the exploration of trends and patterns by presenting the information in comprehensive tables and insightful charts.

Maintaining rigorous quality standards was paramount throughout the research process. Data collection, processing, entry, and analysis all adhered to conscientious protocols to ensure the veracity and reliability of the findings. Additionally, the researchers prioritized ethical considerations at every stage. This included obtaining informed consent, maintaining patient confidentiality, and adhering to established research guidelines.

Results

The 50 patients admitted in the hospital who were confirmed positive of having COVID-19 were included in this study. In this study, 29(58.0%) were males and 21 (42.0%) were females. (Figure -I).

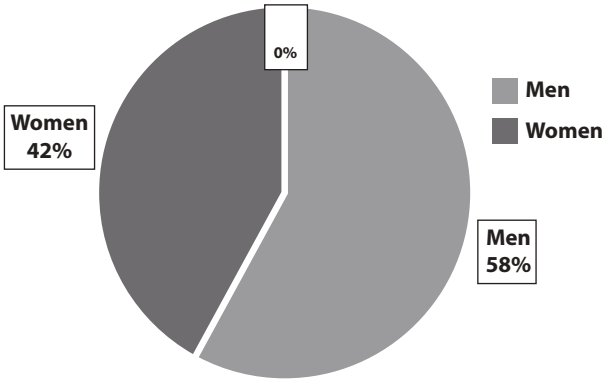

Figure I: Distribution of gender in COVID-19 patients

Among the patients, 8 (16.0%) were healthcare professionals mostly doctors who were in contact with patients having COVID-19. The mean age was 56.9 years (SD ±7.3; range 16–90 years) where the majority of the patients i.e. 23 (46.0%) belonged to the 51-70 years age group. 16 (32.0%) patients reported of having a BMI ≥ 25kg/m2. (Table -I).

Table-I: Medical record related characteristics of the patients

Attributes		Frequency (%) (n = 50)
Age	18-30	5 (10.0)
	31-50	12 (24.0)
	51-70	23 (46.0)
	>70	10 (20.0)
BMI	Underweight	6 (12.0)
	Normal	28 (56.0)
	Overweight	14 (28.0)
	Obese	2 (4.0)
Occupation	Health care professionals	8 (16.0)
	Service holder	29 (58.0)
	Homemaker	9 (18.0)
	Others	4 (8.0)

The laboratory investigations revealed that 39 (22.0%) patients had leukocytosis, 15 (30.0%) displayed decreased level of hemoglobin, 46 (92.0%) had raised C-reactive protein (CRP) levelsand 44 (88.0%) had raised D-dimer levels (Table -II).

Table-II: Biochemical profile of the patients

Attributes		Frequency (%) (n = 50)
Lymphocyte count	4,000-11,000/ mm^3 of blood	11 (22.0)
	> 11,000/ mm3 of blood	39 (78.0)
	Mean ± S.D. = 13048 ± 4651 (mm^3 of blood)	
Hb%	Normal Hb level	35 (70.0)
	Decreased Hb level	15 (30.0)
	Mean ± S.D. = 14.9 ± 2.3 (mg/dl)	
C-reactive protein	<5 mg/ ml	4 (8.0)
	> 5mg/ ml	46 (92.0)
	Mean ± S.D. = 29.2 ± 12.7 (mg/ml)	
D-dimer	< 0.5 µg/ml	6 (12.0)
	> 0.5 µg/ml	44 (88.0)
	Mean ± S.D. = 1.17 ± 0.78 (µg/ml)	

CT imaging revealed that 47 (94.0%) had abnormal findings and the remaining 3 (6.0%) were normal. Among the abnormal CT findings, 34 (68.0%) had ground-glass opacity,32 (64.0%) had consolidation and 42 (84.0%) had bilateral lung involvement (Figure -II).

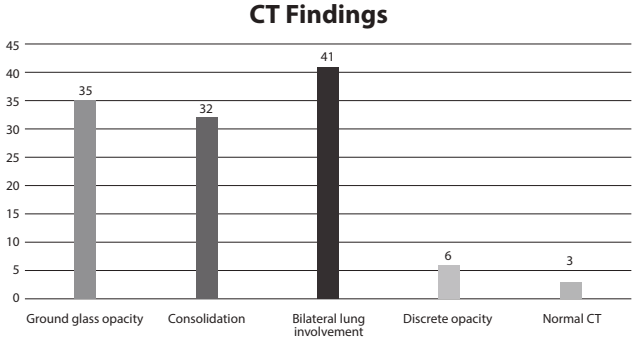

Figure-II: CT scan findings of chest in COVID-19 patients

Discussion

The culprit behind the COVID-19 pandemic is a novel coronavirus, SARS-CoV-2. This virus belongs to the Coronaviridae family, a group of RNA viruses known to infect humans. Notably, SARS-CoV-2 is the seventh member of this family identified to cause human illness.[10] While COVID-19 may have a lower mortality rate compared to its relatives, SARS and MERS, its rapid spread has made it a significant public health threat. By April 2nd, 2020, the number of confirmed cases worldwide had surpassed one million, affecting over 200 countries and territories.[11]

Males appear to be more susceptible to contracting the virus and experiencing severe illness compared to females. This aligns with findings from other respiratory illnesses, where men often exhibit worse outcomes.[12] Another trend identified is that the 51–70-year age group seems to be disproportionately affected compared to younger demographics. This may be due to the fact that this age group tends to have more underlying health conditions such as heart disease, diabetes, chronic lung disease, and high blood pressure.These conditions can worsen the severity of COVID-19 infection.[13]

Another factor influencing susceptibility and severity of COVID-19 is Body Mass Index (BMI). Individuals with a BMI exceeding 25, categorized as overweight or obese, appear to be at a higher risk for developing serious complications from COVID-19. This increased risk aligns with observations from other viral illnesses, where obesity is often linked to poorer outcomes. The reasons for this are complex but may involve chronic inflammation associated with obesity and potential alterations in immune function.[14]

Patients infected with COVID-19 often exhibit characteristic abnormalities in their blood work. The study found an elevated white blood cell count specifically of lymphocytes, which are essential for fighting infection in majority of the patients. However, in COVID-19, patients may present with a variety of abnormalities in their blood work. One finding is lymphocyte count dysregulation, which can manifest as either lymphopenia (low lymphocyte count) orlymphocytosis (elevated lymphocyte count).[15]

Additionally, C-reactive protein (CRP), a marker of inflammation, was found to be frequently elevated in COVID-19 patients, reflecting the body's response to the viral invasion. Similarly, D-dimer levels, a marker

for blood clotting, are also often raised in COVID-19 cases, potentially due to the virus's disruptive effect on the vascular system. These findings are supported by various studies. For example, a study conducted in Africa demonstrated that COVID-19 patients have significantly higher CRP levels compared to those without the infection.[16] Likewise, a review article established a correlation between elevated D-dimer levels and disease severity in COVID-19 patients.[17] These blood markers, while not specific to COVID-19, can serve as valuable clues for diagnosis, risk stratification, and guiding treatment decisions.

CT scan is one of the modern diagnostic tools which can play a major role both in diagnosis of patients with high suspicion of COVID-19 and in its management.[18] The most commonly observed opacification observed in patients with COVID-19 was ground glass opacification and consolidation. Consolidation was always accompanied by ground glass opacification. A Chinese study revealed a characteristic lung imaging pattern in COVID-19 patients. They found that more than three quarters of patients exhibited "pure ground glass opacity" in their lungs.[19] This opacity appeared predominantly in both lungs, affecting the back (posterior) and outer regions (peripheral) suggesting that that these ground glass opacities develop early in the course of the disease, primarily involving the lower portions (basal segments) of the lungs.

Although biochemical and radiological tests are essential for COVID-19 diagnosis and treatment, using data from just one center has drawbacks. These limitations include difficulty applying the findings to other populations, potential bias in patient selection, a restricted view of how the disease presents, and challenges with consistency across facilities. To address these issues and gain a more complete understanding of COVID-19's effects, multicenter studies with larger patient groups, standardized procedures, and consideration of other influencing factors are necessary.

Conclusion

The study has provided valuable insights into the biochemical and radiological profiles of COVID-19 patients. These investigations play a critical role in diagnosing the disease, assessing severity, and predicting potential outcomes. The findings on biochemical markers like CRP and D-dimer, alongside radiological features like ground-glass opacities on chest CT scans, contribute to a more comprehensive understanding of COVID-19's impact on the body.

References

1. Song F, Shi N, Shan F, et al. Emerging coronavirus 2019-nCoV pneumonia. Radiology. 2020:200274.
2. Tan W, Zhao X, Ma X, et al. Notes from the field: a novel coronavirus genome identified in a cluster of pneumonia cases—Wuhan, China 2019–2020. China CDC Weekly 2020; 2: 61–62.
3. World Health Organization. Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV. https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov) (Accessed March 20, 2024)
4. World Health Organization. WHO Director-General's remarks at the media briefing on 2019-nCoV on 11 February 2020. https://www.who.int/dg/speeches/detail/who-director-general-s-remarks-at-the-media-briefing-on-2019-ncov-on-11-february-2020. (Accessed March 20, 2024)
5. WHO Bangladesh COVID-19 Situation Reports: https://www.who.int/Bangladesh/emergencies/coronavirus-disease-(covid-19)-update/coronavirus-disease-(covid-2019)-bangladesh-situation-report (Accessed on March 20, 2024)
6. Parvin S, Arephen SS, Shakil SN, Rokonuzzaman SM, Pasha FM, Sarker RN, et al. CT Scan Findings of 400 COVID-19 Patients in Kuwait Bangladesh Friendship Government Hospital.Scholars Journal of Applied Medical Sciences. 2020 Oct19;8(10):2318-25.
7. Rasool G, Riaz M, Abbas M, et al. COVID-19: clinical laboratory diagnosis and monitoring of novel coronavirus infected patients using molecular, serological and biochemical markers: a review. Int J ImmunopatholPharmacol 2022; 36:3946320221115316
8. O'Sullivan JM, Gonagle DM, Ward SE, Preston RJS, O'Donnell JS. Endothelial cells orchestrate COVID-19 coagulopathy. Lancet Haematol 2020;7:e553-e555.

9. Shi H, Han X, Jiang N, Cao Y, Alwalid O, Gu J, Fan Y, Zheng C. Radiological findings from 81 patients with COVID-19 pneumonia in Wuhan, China: a descriptive study. The Lancet Infectious Diseases. 2020 Feb 24.

10. Dhama K, Khan S, Tiwari R, Sircar S, Bhat S, Malik YS, Singh KP, Chaicumpa W, Bonilla-Aldana DK, Rodriguez-Morales AJ. Coronavirus disease 2019–COVID-19. Clinical microbiology reviews. 2020 Sep 16;33(4):10-128.

11. World Health Organization. Clinical management of severe acute respiratory infection (SARI) when COVID-19 disease is suspected: interim guidance, World Health Organization; 2020

12. Groeneveld JM, Ballering AV, van Boven K, Akkermans RP, Olde Hartman TC, Uijen AA. Sex differences in incidence of respiratory symptoms and management by general practitioners. Family Practice. 2020 Oct;37(5):631-6.

13. Farshbafnadi M, Zonouzi SK, Sabahi M, Dolatshahi M, Aarabi MH. Aging & COVID-19 susceptibility, disease severity, and clinical outcomes: The role of entangled risk factors. Experimental gerontology. 2021 Oct 15;154:111507.

14. Chowdhury AI, Alam MR, Rabbi MF, Rahman T, Reza S. Does higher body mass index increase COVID-19 severity? A systematic review and meta-analysis. Obesity medicine. 2021 May 1;23:100340.

15. Wang Z, Yang L, Chen Y, Xu Z, Wang H, Zhang X. A longitudinal follow-up of COVID-19 patients in the convalescent phase showed recovery in radiological results, the dynamics of lymphocytes, and a decrease in the level of IgG antibody: a single-centre, observational study. Journal of Thoracic Disease. 2021 May;13(5):2986.

16. Gebrecherkos T, Challa F, Tasew G, Gessesse Z, Kiros Y, Gebreegziabxier A, Abdulkader M, Desta AA, Atsbaha AH, Tollera G, Abrahim S. Prognostic value of C-reactive protein in SARS-CoV-2 infection: A simplified biomarker of COVID-19 severity in Northern Ethiopia. Infection and Drug Resistance. 2023 Dec 31:3019-28.

17. Nasif WA, El-Moursy Ali AS, HasanMukhtar M, Alhuzali AM, YahyaAlnashri YA, Ahmed Gadah ZI, Edrees EA, Albarakati HA, MuhjiAloufi HS. Elucidating the correlation of D-dimer levels with COVID-19 severity: a scoping review. Anemia. 2022 Mar 8;2022.

18. Xiong Y, Sun D, Liu Y, Fan Y, Zhao L, Li X, Zhu W. Clinical and high-resolution CT features of the COVID-19 infection: comparison of the initial and follow-up changes. Investigative radiology. 2020.

19. Song F, Shi N, Shan F, Zhang Z, Shen J, Lu H, Ling Y, Jiang Y, Shi Y. Emerging 2019 novel coronavirus (2019-nCoV) pneumonia. Radiology. 2020 Apr;295(1):210-7.