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Peripheral Blood Smear Cell Morphology in COVID-19 Cases – A Cross Sectional Study

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Abstract

Background: Coronavirus disease 2019 (COVID-19) is a newly diagnosed viral disease first identified China in December 2019. The primary route of infection is by respiratory droplets and aerosols which enters into the cell. The lethal effects are due to the activation of renin angiotensin aldosterone pathway in the cell which further activates immune system and presents as lymphopenia in cases which have severe viral load. A few studies are available in English literature regarding quantitative parameters of peripheral blood, but very minimal data is available regarding morphological changes in blood smear. Hence this study was taken up to study morphological changes in the peripheral smears of patients with Covid-19. **Objectives:** To evaluate peripheral blood smears cell morphology in RT PCR confirmed cases of Covid19. **Materials and Methods:** All the cases were studied for a period of 3 months (May, June, July 2021) at Central Diagnostic Laboratory Services, RLJ Hospital, SDUMC, Kolar, Karnataka. Peripheral blood smears were made from all the blood samples which were collected in EDTA vacutainers, stained with Leishman stain and studied for morphological features of all three cell lines in the smear. Individual morphologies were noted. **Results:** Majority of the smears showed neutrophilia and lymphopenia with shift to left of neutrophils. The morphological features seen in WBC's in neutrophils are hypersegmentation, monolobulated neutrophils, band forms, pyknotic nucleus, ring, fetal forms, toxic granules and cytoplasmic vacuoles. **Conclusion:** Our study identifies and describes significant morphologic changes in the peripheral blood cells of COVID 19 patients. An understanding of these morphologic changes in addition to established hematologic parameters can aid in the diagnosis of COVID-19. Peripheral smear review may help with management decisions in COVID-19 patients.

Keywords: Covid-19; Peripheral blood smear; Morphological Changes

1 Introduction

Coronavirus disease 2019 (COVID-19) is a newly diagnosed viral disease first identified China in December 2019.^{1,2} This virus transmits primarily through respiratory droplets and aerosols which enters into the cell by its interaction with angiotensin converting enzyme 2 (AEC 2) which is seen on surface of many cells such as endothelial cells and epithelial cells which lines capillaries and respiratory tract respectively.^{2,3} The lethal effects are due to the activation of renin angiotensin aldosterone pathway in the cell which further activates immune system.⁴

As the immune system gets activated, it presents as lymphopenia especially in in severe cases. Many studies are done regarding the quantitative parameters of peripheral blood but very little literature is available regarding the morphologic abnormalities in peripheral blood cells.⁵⁻⁷ Identifying the various morphological patterns and changes in the blood can aid in diagnosis and treatment of patient.⁸

2 Materials and Methods

This study was done in hematology laboratory of Pathology department after obtaining ethical clearance to start the study. All the blood samples of RT-PCR confirmed cases of Covid 19 were considered for peripheral smear examination. The smears were made and stained with Leishman stain and studied under microscope for various morphological changes in all the three cell lines- erythrocytes, leukocytes and platelets. 89 blood samples were collected over a period of 3 months (May, June, July 2021). Individual morphologies were noted.

3 Results

Of the 89 patients, 30 were females and 59 males.

S.No	Parameter (WBC)	No of Cases (%)	Mean% +/- SD			
1	Neutrophils	Normal neutrophils	89 (100%)	30+/-7.8		
		Hyprsegmented (neutrophils)	68 (76.4%)	7.5+/-3.3		
		Band forms	79 (88.7%)	13.2+/-8.5		
		Monolobulated	33 (37%)	1.7+/-0.8		
		Pyknotic (neutrophils)	9 (10.1%)	2+/-0		
		Karyorrhexis (neutrophils)	5 (5.61%)	4+/-0		
		Ring (neutrophils)	5 (5.61%)	1+/-0		
		Fetal (neutrophils)	23 (25.8%)	3.5+/-1.1		
		Vacuoles (neutrophils)	56 (62.9%)	9.25+/-2.5		
		Toxic granules (neutrophils)	78 (87.6%)	9.7+/-3.3		
		2	Lymphocytes	Normal lymphocytes	89 (100%)	17.4+/-6.4
				Reactive lymphocytes	28 (31.4%)	1.8+/-0.3
Plasmacytoid	8 (8.98%)			3+/-0		
LGL	16 (17.9%)			2.2+/-0.4		
3	Eosinophils	Normal (eosinophils)	89 (100%)	6.7+/-3.1		
		Abnormal (eosinophils)	4(4.49%)	1+/-0		
		Mature (monocytes)	89 (100%)	7.4+/-3.9		
4	Monocytes	Cytoplasm with vacuoles (monocytes)	8 (8.98%)	2.5+/-1.6		
		Abnormal nucleus (monocytes)	29 (32.5%)	4.3+/-1.9		
5	Basophils	Normal	14 (15.7%)	1.2+/-0.4		

3.1 Neutrophils

Neutrophils predominantly showed toxic granules and cytoplasmic vacuoles. Nuclear morphology showed various forms

as hypersegmented forms, fetal shaped, monolobated, karyolysis, pyknotic nucleus. Neutrophils show immature forms with shift to left with band forms.

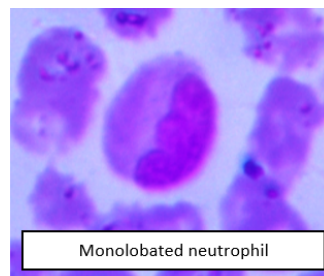


Fig 1.

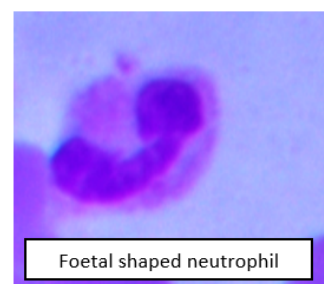


Fig 2.

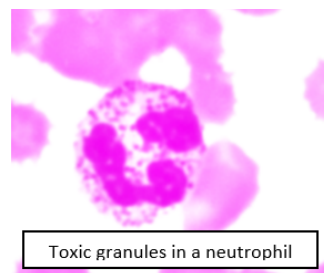


Fig 3.

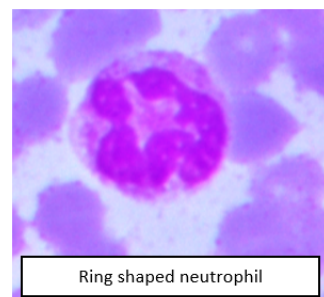


Fig 4.

3.2 Lymphocytes

Lymphocytes show large granular forms, reactive changes and plasmacytoid changes.

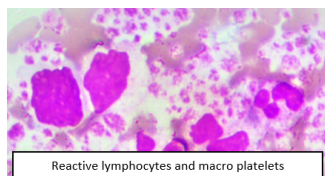


Fig 5.

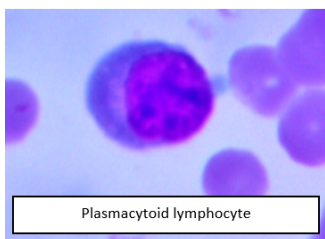


Fig 6.

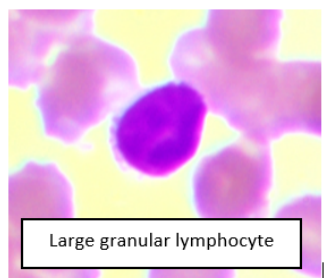


Fig 7.

3.3 Monocytes

Monocytes showed cytoplasmic vacuoles and abnormal nuclear forms.

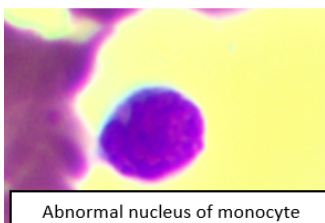


Fig 8.

3.4 Platelets

Majority of patients showed normal platelet counts and morphology. However, a few cases showed giant platelets, macroplatelets and large platelet clumps.

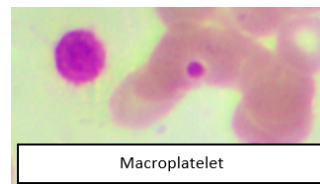


Fig 9.

4 Discussion

Covid-19 was initially found in China for the first time in 2019 which was later declared by the World Health Organization as a pandemic.^{1,3,9} This virus is a single stranded ribonucleic acid virus. The pathogenesis of this disease is still being constructed every day.^{10,11} So far, the research and literature available shows that the main mechanism by which the virus is infecting the host cell is by adhering its surface glycoprotein S with Angiotensin Converting enzyme 2 on epithelial cells and endothelial cells of the host.^{2,12,13} Cell injury and destruction are seen as consequences once the virus enters the host cell, which in turn stimulate innate and adaptive immune system.^{1,14,15}

Our study identified various morphological forms of all 3 cell lines in peripheral blood. Among 89 Covid – 19 patients, 66.2% showed normocytic normochromic blood picture, 22% showed normocytic normochromic anemia, very few cases showed microcytic hypochromic cells. All the patients showed normal platelets. However, 14.6% patients showed macro and 24.7% giant platelets. The abnormal forms in WBC's include band forms, toxic granules, hypersegmented neutrophils, monolobulated nucleus, ring forms and foetal forms. Reactive lymphocytes, plasmacytoid cells were seen along with normal lymphocytes. Similar morphological forms are also reported in other studies. But very few authors have completely described the morphological forms in the peripheral smear.

A study done by Singh A et al showed the various morphological forms of neutrophils such as fetal shaped cell, c shaped cell, ring forms.⁷ Singh S et al also stressed about the giant and macroplatelets, shift to left of neutrophils and band forms in a study.¹³ Another study done by Kaur G et al reported large granular lymphocytes, plasmacytoid lymphocytes and various morphological forms of neutrophils among COVID -19 infected patients.⁹

5 Conclusion

Our study identifies and describes significant morphologic changes in the peripheral blood cells of COVID 19 patients. An understanding of these morphologic changes in addition to established hematologic parameters can aid in the diagnosis of COVID-19 and peripheral smear review may help with management decisions in COVID-19 patients. Follow-up peripheral blood smears can be used to assess the resolution of the infection.

References

- 1) Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A Novel Coronavirus from Patients with Pneumonia in China, 2019. *New England Journal of Medicine*. 2020;382(8):727–733. Available from: <https://dx.doi.org/10.1056/nejmoa2001017>.
- 2) De Vries AAF. Renin-angiotensin system inhibition in COVID-19 patients. *Netherlands Heart Journal*. 2020;28(7-8):396–405. Available from: <https://doi.org/10.1007/s12471-020-01439-5>.
- 3) Vaideeswar P, Bal A, Agrawal R, Arava S, Jain A. COVID-19: An up-to-date review – from morphology to pathogenesis. *Indian Journal of Pathology and Microbiology*. 2020;63(3):358–366. Available from: https://dx.doi.org/10.4103/ijpm.ijpm_779_20.
- 4) Tay MZ, Poh CM, Rénia L, MacAry PA, Ng LFP. The trinity of COVID-19: immunity, inflammation and intervention. *Nature Reviews Immunology*. 2020;20(6):363–374. Available from: <https://dx.doi.org/10.1038/s41577-020-0311-8>.
- 5) Tan L, Wang Q, Zhang D, Ding J, Huang Q, Tang YQ, et al. Lymphopenia predicts disease severity of COVID-19: a descriptive and predictive study. *Sig Transduct Target Ther*. 2020;5(1). Available from: <https://doi.org/10.1038/s41392-020-0148-4>.
- 6) Berber I, Cagasar O, Sarıcı A, Berber NK, Aydogdu I, Yildirim A, et al. Simple peripheral blood smear findings of COVID-19 patients provide information about the severity of the disease and the duration of hospital stay. *Mediterranean Journal of Hematology and Infectious Diseases*. 2020;13(1):e2021009. Available from: <https://dx.doi.org/10.4084/mjhid.2021.009>.
- 7) Singh A, Sood N, Narang V, Goyal A. Morphology of COVID-19-affected cells in peripheral blood film. *BMJ Case Reports*. 2020;13(5):1–2. Available from: <https://dx.doi.org/10.1136/bcr-2020-236117>.
- 8) Nazarullah A, Liang C, Villarreal A, Higgins RA, Mais DD. Peripheral Blood Examination Findings in SARS-CoV-2 Infection. *American Journal of Clinical Pathology*. 2020;154(3):319–329. Available from: <https://dx.doi.org/10.1093/ajcp/aqaa108>.
- 9) Kaur G, Sandeep FNU, Olayinka O, Gupta G. Morphologic Changes in Circulating Blood Cells of COVID-19 Patients. *Cureus*. 2021;2021:1–8. Available from: <https://dx.doi.org/10.7759/cureus.13416>.
- 10) Liu YP, Liu Y, Huang QC, Chen M, Diao B. Morphological changes of lymphocytes in peripheral blood smears of patients with COVID-19. *Annals of Palliative Medicine*. 2020;9(6):4420–4422. Available from: <https://dx.doi.org/10.21037/apm-20-558>.
- 11) Sadigh S, Massoth LR, Christensen BB, Stefely JA, Keefe J, Sohani AR. Peripheral blood morphologic findings in patients with COVID-19. *International Journal of Laboratory Hematology*. 2020;42(6):248–251. Available from: <https://dx.doi.org/10.1111/ijlh.13300>.
- 12) Ahnach M, Ousti F, Nejari S, Houssaini MS, Dini N. Peripheral Blood Smear Findings in COVID-19. *Turkish Journal of Hematology*. 2020;37(4):301–302. Available from: <https://dx.doi.org/10.4274/tjh.galenos.2020.2020.0262>.
- 13) Singh S, Madan J, Nath D, Tiwari N. Peripheral Blood Smear Morphology- A Red Flag in COVID-19. *International Journal of TROPICAL DISEASE & Health*;2020:54–58. Available from: <https://doi.org/10.9734/ijtdh/2020/v4i1i830311>.
- 14) Granat LM, Singh AD, Cortese M, Velez V, Lichtin A. Severe thrombocytopenia in a patient with otherwise asymptomatic COVID-19. *Cleveland Clinic Journal of Medicine*. 2021;88(2):86–92. Available from: <https://dx.doi.org/10.3949/ccjm.88a.20154>.
- 15) A AA. Reactive lymphocytes in blood film of a covid-19 iraqi patient: a case report. *Hematology, Transfusion and Cell Therapy*. 2020;42:57–58. Available from: <https://doi.org/10.1016/j.htct.2020.09.104>.