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Differences in Prevalence of Haematological Abnormalities on Presentation to Hospital in COVID 19 Infected adult and Paediatric Patients: A Retrospective Multicenter Descriptive Study

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ABSTRACT

Background: It is well known that COVID 19 infection affects multiple systems in the body. Reports have documented many changes in the hematopoietic system in the pathophysiology of the disease.

Aim: The aim of the study was to find out the prevalence and any significant difference in routine haematological parameters on presentation in Paediatric and adult patients with COVID 19 infection.

Methodology: We conducted a multicenter retrospective descriptive observational study and investigated the prevalence of haematological abnormalities at presentation of 1000 PCR swab confirmed COVID 19 infected randomly selected adult and Paediatric patients admitted to 3 tertiary hospital in Dubai. Data was gathered through their electronic medical records and all analysis was done using the Statistical Package for the Social Sciences software (SPSS).

Results: The prevalence of at least one abnormal haematological parameter was 95.1% (794/835) on first presentation to the hospital. After adjusting of age and gender the prevalence of any white cell abnormality was 34.7% (290/835) (5.7% leukopenia, 9.6% leucocytosis, 25.4% lymphopenia, 5.5% neutropenia, 16.4% had neutrophilia, 7.3% monocytosis, and 1.2% eosinopenia). A prevalence of 15.3% (128/835) anaemia, 9.5% (79/835) thrombocytopenia and 4.3% (36/ 835) thrombocytosis was also observed. The prevalence of other abnormal blood parameters: C reactive protein 69.5%(573/835), D dimer 57.5% (280/835), high LDH 52%(383/835), high ferritin 72.1%(452/835), high INR 5.1%(38/835) , prolonged PT 32.2% (240/835) , and prolonged APTT 35.6%(264/835). A significant difference in prevalence of these abnormalities was evident between adult and Paediatric population, these abnormalities were much more prevalent in adults but interestingly paediatric population tended to have higher incidence of neutropenia, eosinophilia and monocytosis ($p<0.001$).

Conclusion: The effects of COVID 19 infection are different in adult and paediatric patients. Many mechanisms have been hypothesized for this observation. This study revealed another less studied and interesting variation in the manifestation among the two populations.

Key words: COVID 19 infection, Leukopenia, Leucocytosis, Anaemia, Thrombocytopenia thrombocytosis, Lymphopenia, Neutropenia, Neutrophilia, Monocytosis, Eosinopenia, Inflammatory markers, C reactive protein, Ferritin, Dimer

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INTRODUCTION

Following the emergence of the new coronavirus 2019 (2019-nCoV), the world has seen a spectrum

of presentations of the virus with different clinical outcomes. The clinical spectrum of COVID19 varies from asymptomatic or mild disease to respiratory failure that requires mechanical ventilation and to multiple organ dysfunction syndromes or failure leading to death. Cytokine storm and thromboembolism have been identified as the main pathological processes of SARS-CoV-2. The enormous cytokine release in COVID 19 patients is linked to decreased lymphocyte count. Lymphocytopenia was present in 83.2% of patients on admission in a report from China and with was linked to more severe cases. Coagulation abnormalities such as PT and aPTT prolongation, fibrin degradation products increase, with severe thrombocytopenia were also noted and were commonly seen in patients with worse outcomes. Moreover, elevated dimer was also a frequent finding and levels above (1 µg/mL) were a strong and independent risk factor for death [1-3].

Primary objectives

To study the prevalence of haematological manifestations in the full blood count of patients admitted to hospital with COVID 19 infection within first 24 hours of hospital admission.

Secondary objectives

To compare the difference in the prevalence of haematological manifestation of COVID 19 and their clinical significance in adult and paediatric patients.

METHODOLOGY

Retrospective descriptive multicenter study for which 1000 patients were randomly selected from COVID 19 infected patients with confirmed pharyngeal swab admitted at three Dubai Health Authority facilities; Rashid hospital, Dubai hospital and Latifah hospital infection from 15th March- 30th May 2020. After exclusion of patients as per study criteria the final population size was 835 patients. Of these patients 731 patients were adults (age 19 and above) and 104 patients were of paediatric age group (0-18 years). This study was approved by Dubai Scientific Research Ethics committee (DSREC). Patients below the age of 18 years were classified under the paediatric population [4]. The normal values for blood parameters were obtained from Phase II of the pathology Harmonization Project and Hematology of Infancy and Childhood [5-9].

Inclusion

Patients of all ages who tested positive for COVID 19 infection on nasopharyngeal PCR swab.

Exclusion

- ✓ Patients with pre-existing haematological disorders like haematological malignancies, hemoglobinopathy or immune thrombocytopenia.
- ✓ Patients on warfarin or pre-existing coagulopathy.
- ✓ Pregnant patients and those with missing basic investigations.

Data collection

All data was collected from patient's electronic medical records and tabulated on an Excel sheet. Two researchers independently reviewed data to confirm the accuracy of the collected data.

Statistical analysis

Data was analysed using the IBM SPSS version 27.0 (IBM Corp., Armonk, NY, USA) under the supervision of experienced statistician. All the categorical data groups were recorded as frequencies and compared using the Pearson Chi-Square test. P values less than 0.05 represented statistical significance and all reported P values were two-sided.

Patient population

A total of 835 patients were studied. 731 were studied in the adult group and 104 patients were studied in the paediatric group (Table 1).

RESULTS

The prevalence of at least one abnormal haematological parameter was 95.1% (794/835) on first presentation to the hospital. After adjusting of age and gender the prevalence of any white cell abnormality was 34.7% (290/835) (5.7% leukopenia, 9.6% leucocytosis, 25.4% lymphopenia, 5.5% neutropenia, 16.4% had neutrophilia, 7.3% monocytosis, and 1.2% eosinopenia). A prevalence of 15.3% (128/835) anaemia, 9.5% (79/835) thrombocytopenia and 4.3% (36/ 835) thrombocytosis was also observed. The prevalence of other abnormal blood parameters: C reactive protein 69.5%(573/835), D dimer 57.5%(280/835), high LDH 52%(383/835), high ferritin 72.1%(452/835), high INR 5.1%(38/835) , prolonged PT 32.2%(240/835) , and prolonged APTT 35.6%(264/835). A significant difference in prevalence of these abnormalities was evident between adult and paediatric population, these abnormalities were much more prevalent in adults but interestingly paediatric population tended to have higher incidence of neutropenia, eosinophilia and monocytosis ($p<0.001$).

DISCUSSION

Multiple prior studies have established the effect of SARS COV2 virus on the hematopoietic system [2]. The key goal of our study was to explore some of these haematological manifestations associated with COVID 19 infection and their prevalence in our population. The most common blood abnormalities at presentation were noted to be increased inflammatory makers including high ferritin (72.1%), high CRP (69.5%), high LDH

Table 1: patient characteristics.

	Adults	Paediatrics
Number (%)	731(87.5)	104(12.4)
Age in years (mean)	44.7	4.9
Male N (%)	639 (87.4)	55(52.8)
Female N (%)	92 (12.6)	49(47.2)
N: Number (%) percentage		

Table 2: CRP C reactive protein, LDH lactate dehydrogenase, INR international normalized ratio, PT prothrombin time, APTT Activated partial thromboplastin time.

Variable		Total patients	Adults	Paediatrics	Asymptotic Significance (2-sided) (chi- square test)
White blood cells	Within normal limits corrected for age	707(84.7%)	610 (83.4%)	97 (93.3%)	0.002
	Low for age	48 (5.7%)	41 (5.6%)	7 (6.7%)	
	High for age	80 (9.6%)	80 (10.9%)	0 (0%)	
Haemoglobin	Within normal limits corrected for age	707 (84.7%)	617 (84.4%)	90 (86.5%)	NS
	Low for age	128 (15.3%)	114 (15.6%)	14 (13.5%)	
	High for age	0 (0%)	0 (0%)	0 (0%)	
Platelets	Within normal limits corrected for age	720 (86.20%)	623 (85.2%)	97 (93.3%)	NS
	Low for age	79 (9.50%)	75 (10.3%)	4 (3.8%)	
	High for age	36 (4.30%)	33 (4.5%)	3 (2.90%)	
Lymphocytes	Within normal limits corrected for age	616 (73.80%)	516 (70.6%)	100 (96.2%)	Less than 0.001
	Low for age	212 (25.40%)	208 (28.5%)	4 (3.8%)	
	High for age	7 (0.80%)	7 (1.0%)	0 (0%)	
Neutrophils	Within normal limits corrected for age	652 (78.10%)	564 (77.2%)	88 (84.6%)	Less than 0.001
	Low for age	46 (5.50%)	33 (4.5%)	13 (12.5%)	
	High for age	137 (16.40%)	134 (18.3%)	3 (2.9%)	
Monocytes	Within normal limits corrected for age	770 (92.2%)	680 (93.0%)	90 (86.5%)	0.02
	Low for age	4 (0.5%)	4(0.5%)	0 (0.0%)	
	High for age	61(7.3%)	47 (6.4%)	14 (13.5%)	
Basophils	Within normal limits corrected for age	831 (99.50%)	729(99.7%)	102 (98.1%)	NS
	Low for age	0 (0%)	0 (0%)	0 (0%)	
	High for age	4(0.5%)	2 (0.3%)	2 (1.9%)	
Eosinophil's	Within normal limits corrected for age	818(98.0%)	728 (99.6%)	90 (86.5%)	Less than 0.001
	Low for age	10(1.2%)	0 (0%)	10 (9.6%)	
	High for age	7(0.8%)	3 (0.4%)	4(3.8%)	
CRP	Within normal limits	251(30.5%)	115 (21.5%)	96 (92.3%)	Less than 0.001
	High	573(69.5%)	565 (78.5%)	8(7.7%)	
D dimer	Within normal limits	207(42.5%)	169 (39.3%)	38(66.7%)	Less than 0.001
	High	280(57.5%)	261(60.7%)	19 (33.3%)	
LDH	Within normal limits corrected for age	353(48.0%)	264(41.4%)	89 (90.8%)	Less than 0.001
	High for age	383(52.0%)	374(58.6%)	9 (9.2%)	
INR	Within normal limits corrected for age	708(94.9%)	612(94.4%)	96(98%)	NS
	High for age	38(5.1%)	36 (5.6%)	2(2%)	
PT	Within normal limits	506(67.8%)	433(66.8%)	73(74.5%)	NS
	prolonged	240(32.2%)	215(33.2%)	25(25.5%)	
APTT	Within normal limits	470(63.4%)	414(64.4%)	56(57.1%)	NS
	Prolonged	264(35.6%)	6(0.9%)	1(1.0%)	
Ferritin	Within normal limits corrected for age	166(26.5%)	110 (19.5%)	56 (87.5%)	Less than 0.001
	Low for age	9(1.4%)	4(0.7%)	5(7.8%)	
	High for age	452(72.1%)	449 (79.8%)	3 (4.7%)	

(52%), followed by deranged coagulation high dimer (57.5.%) and prolonged PT (32.2%) and (aPTT 35.6%), other common findings were lymphopenia (25.4%), neutrophilia (16.4%), anaemia (15.3%), leucocytosis (9.6%), monocytosis (7.3%).

We noted a significant difference in prevalence of these findings in adults and paediatric population (Table 2). These abnormalities were much more common in adults compared to paediatric patients; but interestingly paediatric population tended to have higher incidence of neutropenia ($p<0.000$).

Moreover, leucocytosis was observed in 10.9% of adult population while leucopenia was more evident in paediatric population (6.7%) (p 0.002). Lymphopenia was observed in 28.5% of the adult population and only in 3.8% of paediatric group. The prevalence of lymphopenia was less in our studied group compared to previously reported 63% and 83.2% in a studies reported from different parts of China [5,10].

CONCLUSION

Like most viral infections SARS COV 2 infection affects the immune system of the body and generates an inflammatory response which can be detected on simple routine blood tests. These findings on blood cell counts and inflammatory markers are different in adult and paediatric population and could possibly be linked difference in pathophysiology and severity of COVID 19 infection. More studies are needed to compare the difference in hematological manifestations with different COVID 19 strains.

LIMITATIONS

- ✓ All the cases of COVID 19 infection in paediatric population were of mild severity so correlation of these haematological findings with severity and final outcome could not be done.
- ✓ Comparison of these findings with data in Middle East could not be done as data on this topic in this population was limited.
- ✓ The patient studied was infected with earlier variant of COVID 19 during early 2020. More studies are needed to know if the difference is maintained in the infection with other strains.

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