Cross-sectional Study

Association between thrombocytopenia and the severity of Covid-19 infection among hospitalized Egyptian patients

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ARTICLE INFO

Keywords:
COVID-19
Severe acute respiratory syndrome
Disseminated intravascular coagulopathy
Thrombocytopenia

ABSTRACT

Background: COVID-19, which is caused by the corona virus 2 that causes severe acute respiratory syndrome, causes a respiratory and systemic illness that in 10–15% of patients escalates to a severe form of pneumonia. Thrombocytopenia is frequent in patients with COVID-19. We aimed to evaluate the association between thrombocytopenia and the severity of COVID-19 infection in hospitalized patients.

Methods: A cross-sectional study was done on 800 Egyptian patients with confirmed covid-19 infection. They were divided into Group I (Mild): 200 symptomatic patients meeting the case definition for COVID-19 without radiological evidence of pneumonia or hypoxia. Group II (Moderate): 200 patients with clinical signs of non-severe pneumonia and radiological evidence of pneumonia. Group III (Severe): 200 patients with clinical signs of pneumonia plus: respiratory or lung dysfunction. Group IV: 200 critically ill patient in ICU: Acute respiratory distress syndrome (ARDS).

Results: there was a highly statistically significant difference between the studied groups regarding thrombocytopenia (p < 0.001). Thrombocytopenia was statistically higher in severe and critically ill patients. In addition, a statistically significant difference found in outcome among the studied groups (p < 0.05) {critically ill (40%), severe (17.5%)}. The most common cause of death was respiratory failure, which occurred in 28 severe patients (80%) and 65 critically ill patients (81.25%), followed by hemorrhage due to thrombocytopenia, which occurred in 7 severe patients (20%) and 15 critically ill patients, respectively (18.75%).

Conclusion: The Platelet count is a straightforward, inexpensive, as well as easily available laboratory parameter that is frequently linked to severe covid-19 infection and a significant death risk.

1. Introduction

Corona virus disease (COVID-19), which iscaused by severe acute respiratory syndrome corona virus 2 (SARSCoV-2), can lead to respiratory and lead also to systemic diseases that progress to sever pneumonia in 10–15% of patients [1]. Severe COVID-19 can lead to serious illness, with acute respiratory distress syndrome (ARDS) can result with severe covid-19 and multiorgan failure (MOF) as the primary complications, eventually followed by disseminated intravascular coagulopathy [2].

Clinical manifestations in COIVD-19 patients have been widely reported since the outbreak. [3] COVID-19 infected patients can present with pulmonary symptoms, abdominal symptoms, acute heart injury, liver injury and kidney injury, coagulation abnormalities, and major changes in whole blood cells characterized by lymphopenia and thrombocytopenia [4].

Thrombocytopenia is a common manifestation of infection with COVID-19 which is also an indicator of a poor prognosis of severe acute respiratory syndrome (SARS), middle east respiratory syndrome...
was performed for the selected patients. and treatment in the intensive care unit. distress syndrome (ARDS) which met any of the following criteria as the severely critically ill patients in intensive care unit: acute respiratory logical examination including: pelvi-abdominal ultrasonography and TLC, lymphocytes, platelet count

The present study was conducted in compliance with the guidelines for cerned with COVID-19 management (Menoufia University Hospitals, DIC), acute liver failure, hypersplenism, heparin or other drug induced affecting platelets count such as immune thrombocytopenic purpura, chronic liver disease, sepsis, disseminated intravascular coagulation (DIC), acute liver failure, hypersplenism, heparin or other drug induced were excluded from the current study.

Patients with history of thrombocytopenia or any other cases affecting platelets count such as immune thrombocytopenic purpura, chronic liver disease, sepsis, disseminated intravascular coagulation (DIC), acute liver failure, hypersplenism, heparin or other drug included were excluded from the current study.

For all selected patients for this study, comprehensive history taking: a particular manifestation of respiratory symptoms (dyspnea, fever and cough) were recorded. A complete general examination (arterial blood pressure respiratory rate and body temperature), local chest examination was assessed. The laboratory research includes (full blood count) including: TLC, lymphocytes, platelet count & hemoglobin (HB) level, C-reactive protein (CRP), D-dimer, serum ferritin, Lactate Dehydrogenase (LDH); and arterial blood gases were done. Coagulation profile, Radio logical examination including: pelvi-abdominal ultrasonography and computed tomography. Chest, serology including: RT-PCR for covid-19 was performed for the selected patients.

3. Statistical analysis

Statistical Package for the Social Sciences (SPSS) version 23 was used to gather, tabulate, and statistically analyses data on an IBM compatible personal computer (Armonk, NY: IBM Corp, 2013). Percentage (percent), Median, Range, and IQR were descriptive statistics, whereas analytic statistics included the chi-square test, to compare different groups for categorical variables. Mann-Whitney test (U) to compare two studied groups for abnormally distributed quantitative variables. One-way ANOVA (F test), to compare more than two groups for normally distributed quantitative variables. Kruskal Wallis testto compare more than two studied groups for abnormally distributed quantitative variables, and Spearman’s correlation (r) for correlation between two quantitative variables. Correlation coefficient test (Person test) results may be positive (+) correlation (reverse) or negative (—) correlation (inverse). A statistically significant P value of 0.05 was used. P-value <0.05 was considered statistically significant, P-value<0.01 was considered statistically moderately significant and P-value<0.001 was considered statistically highly significant.

4. Results

This study had a total of 800 Egyptians patients. The ages of the patients ranged from 21 to 81 years with mean of 53.15 ± 11.82 years old. Most of them were males (n = 478, 59.75%) and (n = 322, 40.25%) were females. There were statistically significant differences among the studied groups in terms of smoking, diabetes, asthma, fever, cough, dyspnea, abdominal pain and diarrhea, and sore throat, with smoking being statistically significantly higher among severe patients’ group, whereas, DM, hypertension, and dyspnea being statistically significantly higher among critically ill patients’ group. While, abdominal pain, diarrhea, and sore throat were statistically significantly higher in mild patients’ group. In addition, moderate patients’ group had a statistically significant greater of asthma and fever than the other groups (p < 0.05). However, no significant differences reported in age, gender, hypertension (HTN), or CKD among the studied groups (p > 0.05), (Table 1). Regarding, conscious level, crepitation, air entry, and wheezes were statistically significant variations among the studied groups (p < 0.05), where both crepitation and decrease air entry were higher in critically ill patients group and DLC was the most common with critically ill patients group (51.5%). Moderate group had a significant increase in the temperatures than the other studied groups. DBP, RR, and pulse were statistically significantly higher in critically ill patients compared to other groups. So2 was also statistically higher in mild and moderate groups than other studied groups. As regards SBP there is no statistically significant difference between the studied groups (p > 0.05), (Table 2). As regard CT chest findings there was a significantly increase in critically ill groups (p < 0.05). In addition, as regard CT chest findings there was a highly statistically significant difference among the studied groups (p < 0.001) while CT findings increase in critically ill groups (Table 3).

There was a statistically significant positive correlation between platelet count with So2 where thrombocytopenia statistically significant related with hypoxia. While, we found a statistically significant negative correlation between platelet count with CRP, D-dimer, Serum ferritin, and LDH (p < 0.05) (Table 4).

As regards mortality rate, there was a statistically significant difference between the studied groups (p < 0.05), where the mortality rate in severely ill patients’ group was (80%) is (40%) Severe 35 (17.5%). Where the commonest cause of death was respiratory failure, which took place in 28 severe patients (80%) and 65 critical ill patients (81.25%),
in December 2019 [18]. Fever, dry cough, loss of taste or scent, weakness, shortness of breath, and acute respiratory manifestations are all common COVID-19 symptoms [19,20]. A total of 800 Egyptians patients were included in our study, the ages of the patients varied from 21 to 81 years with mean of 53.15 ± 11.82 years. Most of them were males (n = 478, 59.75%) and (n = 322, 40.25%) were females. Statistically, there were no significant differences among the studied groups as regard age and/or gender. These results agreed with the study by Yameny, performed on 504 patients their aged ranged from 20 years to 75 years with mean age 44.5 ± 30.5, male gender was more frequent than female gender with no statistically significant differences [21]. Also, the study by Zhu et al., performed on 167 COVID-19 patients, and their age ranged from 29 to 93, female was frequent in 67.07% [22]. No statistically significant differences in age and gender between the studied groups. These results agreed with Yang et al., who performed a study on 1476 patients, comprising of 1238 (83.9%) survivors and 238 (16.1%) non-survivors, were included. Their median (IQR) age was 57 (47–67) years and 776 (52.6%) patients were males [23]. According to our findings, fever was more frequent in moderate patients’ group, while abdominal pain, diarrhoea, and sore throat were more common in mild patients. Dyspnea was more common in critically ill patients. Cough was more common in severe patients’ group or critically ill. This result agreed with the study by Yameny, who found that, fever was higher among moderate patients group while dyspnea and cough were statistically higher among critically ill patients’ group [21]. Additionally, World Health Organization, [24] In severe cases, infection can cause pneumonia, severe acute respiratory syndrome and sometimes death, that were increased in critically ill patients.

Also, Kim et al., summarized symptoms of 172 patients who were in community isolation facilities in South Korea for mild illness; the most common symptom was cough in 40.2%, and fever was mentioned in only 11.6% [25]. By contrast, Blair et al., noted fever to be the most common initial symptom (reported by 55.8%) and cough a predominant symptom initially, increasing in the first and second weeks before decreasing to 37.4% and 15.1% in the third and fourth weeks of illness, respectively; these differences may reflect differences in the approach to referring for testing [26]. The present study showed that Hb was statistically significantly lower among critically ill patients group than in other groups.

The present study showed that, CRP, ferritin, D Dimer, LDH, TLC and creatinine levels were statistically significantly higher among critically ill patients’ group than mild, moderate and severe patients’ groups. While AST and ALT were statistically significantly increased among the severe group than in other groups (p < 0.05). The study agrees with Yameny, found a significant value with critically ill infection as ferritin level which increased in 71.4% LDH has a high level in 67.7% and D-dimer has positive results in 36.4% [21]. Also, the study by Wool and Miller, reported that, temporally increasing

| Table 1 | Demographic data, medical history, risk factors and complains & symptoms among the studied groups. |
|----------------|----------------------------------|
| Variables          | Mild N = 200  | Moderate N = 200  | Severe N = 200  | Critically ill N = 200  | K     | P-value |
| Age/years Mean ± SD | 49.55 ± 11.44 | 53.46 ± 13.32 | 53.5 ± 10.9 | 56.07 ± 11.66 | 1.260 | 0.839 |
| Gender Male %     | 116 (58)      | 118 (59)        | 123 (61.5) | 121 (60.5) | 0.523 |
| Gender Female %    | 84 (42.0)     | 82 (41.0)       | 77 (38.5) | 79 (39.5)  | 0.015* |
| Smoking Asthmatic | 121 (60.5)    | 108 (54.0)      | 91 (45.5) | 115 (57.5) | 10.46 |
| Non-smoker Smoker | 79 (39.5)     | 92 (46.0)       | 109 (54.5) | 85 (42.5)  | 0.007* |
| DM (mg/dL) Yes     | 147 (70.5)    | 132 (66.0)      | 125 (62.5) | 109 (54.5) | 12.25 |
| HTN (mg/dL) No     | 123 (61.5)    | 116 (58.0)      | 112 (56.0) | 98 (49.0)  | 0.071 |
| CKD Yes            | 187 (93.5)    | 182 (91.0)      | 184 (92.0) | 191 (95.5) | 0.286 |
| Asthmatic No       | 13 (6.5)      | 18 (9.0)        | 16 (8.0)  | 9 (4.5)    | 3.78  |
| Fever Yes          | 177 (88.5)    | 160 (80.0)      | 175 (87.5) | 182 (91.0) | 0.007* |
| Yes No             | 23 (11.5)     | 40 (20.0)       | 25 (12.5) | 18 (9.0)   | 12.07 |
| Cough Yes          | 4 (2.0)       | 0 (0.0)         | 64 (32.0) | 64 (32.0)  | 139.45 |
| No                 | 196 (98.0)    | 200 (100.0)     | 136 (68.0) | 136 (68.0) | 0.001* |
| Dyspnea Yes        | 110 (55.0)    | 131 (65.5)      | 91 (45.5) | 91 (45.5)  | 24.70 |
| No                 | 90 (45.0)     | 69 (34.5)       | 109 (54.5) | 109 (54.5) | 0.001* |
| Abdominal pain and diarrhoea Yes | 193 (96.5) | 193 (96.5) | 199 (99.5) | 200 (100.0) | 0.001* |
| No                 | 7 (3.5)       | 7 (3.5)         | 0 (0.0)   | 0 (0.0)    | 729.56 |
| Sore throat Yes     | 164 (82.0)    | 194 (97.0)      | 176 (88.0) | 178 (89.0) | 22.28 |
| No                 | 36 (18.0)     | 6 (3.0)         | 24 (12.0) | 22 (11.0)  | 0.001* |

K: Kruskal Wallis test, X²: Chi-square test, * statistically significant, Group I: Mild covid-19, Group II: Moderate covid-19, Group III: Severe covid-19, Group IV: Critically ill covid-19, DM: Diabetes mellitus HTN: Hypertension CKD: Chronic kidney disease.

followed by thrombocytopenia associated hemorrhage (Table 5).

5. Discussion

SARS-CoV-2, a highly transmissible, novel respiratory pathogen infecting humans, caused the latest COVID-19 pandemic, which began in December 2019 [18]. Fever, dry cough, loss of taste or scent, weakness, shortness of breath, and acute respiratory manifestations are all common COVID-19 symptoms [19,20]. A total of 800 Egyptians patients were included in our study, the ages of the patients varied from 21 to 81 years with mean of 53.15 ± 11.82 years. Most of them were males (n = 478, 59.75%) and (n = 322, 40.25%) were females. Statistically, there were no significant differences among the studied groups as regard age and/or gender. These results agreed with the study by Yameny, performed on 504 patients their aged ranged from 20 years to 75 years with mean age 44.5 ± 30.5, male gender was more frequent than female gender with no statistically significant differences [21]. Also, the study by Zhu et al., performed on 167 COVID-19 patients, and their age ranged from 29 to 93, female was frequent in 67.07% [22]. No statistically significant differences in age and gender between the studied groups. These results agreed with Yang et al., who performed a study on 1476 patients, comprising of 1238 (83.9%) survivors and 238 (16.1%) non-survivors, were included. Their median (IQR) age was 57 (47–67) years and 776 (52.6%) patients were males [23]. According to our findings, fever was more frequent in moderate patients’ group, while abdominal pain, diarrhoea, and sore throat were more common in mild patients. Dyspnea was more common in critically ill patients. Cough was more common in severe patients’ group or critically ill. This result agreed with the study by Yameny, who found that, fever was higher among moderate patients group while dyspnea and cough were statistically higher among critically ill patients’ group [21]. Additionally, World Health Organization, [24] In severe cases, infection can cause pneumonia, severe acute respiratory syndrome and sometimes death, that were increased in critically ill patients.

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D-dimer levels indicate the progressive severity of COVID-19 infection and can be used as a predictor that more aggressive critical care will be needed [27]. Also, the study by Yang et al., found that, CRP, ferritin, TLC and creatinine levels were statistically significantly increased among critically ill group than other groups [23]. Another study by Helms et al., revealed that, D-dimers are significantly increased in critically ill patients. These findings agree with Yang et al., findings that thrombocytopenia is prevalent in patients with severe COVID-19 and is linked to a higher risk of in-hospital mortality [31]. Also, Lippi et al., found that, the rate of thrombocytopenia, a platelet count below the lower limit of the locally defined reference range was associated with an over 5-fold enhanced risk of severe COVID-19 [31]. The decreasing platelet count in patients in the intensive care unit usually indicates the dysfunction of organs or systems and leads to a disorder of homeostasis. Also, low platelet in the ICU tended to increase the risk of death [32]. It has also been reported that 2019-nCoV infection might affect the blood coagulation mechanism resulting in a disorder of blood coagulation [33].

In the present study, there was statistically significant positive correlation between platelet counts with So2. While, there was statistically significant negative correlation between platelet with CRP, D-dimer, Serum ferritin, and LDH (p < 0.05). These results are in agreement with Draz et al, who found that platelets were statistically significant associated with TLC among critically ill patients (P < 0.05) [32]. Also, the study by Yang et al., that there is a statistically significant negative relationship between platelets with LDH among the studied critically ill patients (P < 0.05) [23]. Moreover, Libby et al., indicated that the relationship between leukocyte count and increased platelet reactivity was observed in total leukocyte count, total neutrophil count, and total lymphocyte count [27]. Both neutrophil count and lymphocyte count showed a strong positive correlation with total leukocyte count (p < 0.05).The study by Draz et al., found no significant correlations between platelet count and hemoglobin level and So2 [34].

In the present study, As regards mortality rate, there was a statistically significant difference between the studied groups (p < 0.05). Where the mortality rate in critically ill patients’ group was (80) is

| Variable                   | Studied groups (N = 800) | K  | P value |
|----------------------------|--------------------------|----|---------|
|                            | Group I                  |   |         |
|                            | Group II                 |   |         |
|                            | Group III                |   |         |
|                            | Group IV                 |   |         |
|                            | N = 200                  |   |         |
|                            | N = 200                  |   |         |
|                            | N = 200                  |   |         |
|                            | N = 200                  |   |         |
| Conscious level            | No. %                    |    |         |
| Conscious                  | 200 100.0                |    |         |
| DLC                       | 0 0.0                    |    |         |
| Crepituation               | 200 100.0                |    |         |
| No                        | 0 0.0                    |    |         |
| Air entry                  | 200 100.0                |    |         |
| Normal                     | 0 0.0                    |    |         |
| Decreased Wheezes          | 177 88.5                 |    |         |
| No                        | 23 11.5                  |    |         |
| Temperature (°C)           | Mean ± SD Range          |    |         |
| Post Hoc                  | p1 < 0.001, p2 < 0.018*, p3 < 0.036*, p4 < 0.001*, p5 < 0.001*p6 < 0.779 |   |         |
| SBP (mmHg)                 | 126.23 ± 78.63           |    |         |
| Mean ± SD Range           | 100–1220                 |    |         |
| DBP (mmHg)                 | 80.64 ± 10.13            |    |         |
| Mean ± SD Range           | 60.00–110.00             |    |         |
| Post Hoc                  | p1 < 0.001, p2 < 0.001, p3 < 0.001*, p4 < 0.911, p5 < 0.315, p6 < 0.372 |   |         |
| RR (BPM)                  | 20.16 ± 1.67             |    |         |
| Mean ± SD Range           | 16.00–24.00              |    |         |
| Pulse                     | 82.25 ± 5.83             |    |         |
| Mean ± SD Range           | 66.00–91.00              |    |         |
| Post Hoc                  | p1 < 0.697, p2 < 0.001*, p3 < 0.001*, p4 < 0.001*, p5 < 0.001*, p6 < 0.001* |   |         |
| SO2                       | 96.88 ± 1.12             |    |         |
| Mean ± SD Range           | 95.00±99.00              |    |         |

SBP: Systolic blood pressure, DBP: Diastolic blood pressure
RR: Respiratory rate
X²: Chi square test.
K: Kruskall Wallis test * statistically significant.
P1: mild compared moderate
P2: mild compared severe.
P3: mild compared critically ill
P4: moderate compared severe.
P5: moderate compared critically ill P6: severe compared critically ill.
Severe (35%) where the most common cause of death was Diabetes mellitus (40%).

Correlation between platelet count with studied parameters with laboratory investigations among the studied patients.

| Variables          | Studied groups (N = 800) | K    | P value |
|--------------------|--------------------------|------|---------|
|                    | Group I N = 200          | Group II N = 200 | Group III N = 200 | Group IV N = 200 |
| Hb (g/dL)          | 12.10 ± 1.15             | 11.89 ± 1.17    | 10.84 ± 1.13    | 9.62 ± 0.81     | 23.84 | <0.001* |
| Mean ± SD          | 9.50-15.00               | 10.00-14.10     | 8.00-14.00      | 6.00-12.00      |      |        |
| Range              | Post Hoc                 | Post Hoc       | Post Hoc        | Post Hoc        | Post Hoc | Post Hoc |
| TLC (10^9/µL)      | 7.47 ± 1.87              | 7.60 ± 1.75     | 7.99 ± 1.85     | 8.08 ± 1.97     | 7.47  | 0.002*  |
| Mean ± SD          | 3.30-12.00               | 4.00-12.00      | 4.00-13.00      | 3.00-15.00      |      |        |
| Range              | Post Hoc                 | Post Hoc       | Post Hoc        | Post Hoc        | Post Hoc | Post Hoc |
| Lymphocytes (10^9/µL) | 0.74 ± 1.27              | 0.48 ± 0.59     | 0.59 ± 0.95     | 0.58 ± 1.00     | 0.74  | 0.076   |
| Mean ± SD          | 0.10-6.00                | 0.10-3.80       | 0.10-6.00       | 0.10-5.50       |      |        |
| Range              | Platelet (10^9/L)        | 358.26 ± 37.11  | 315.8 ± 55.66   | 199.0 ± 48.2    | 185.9 ± 35.57  | 358.26 | <0.001* |
| Mean ± SD          | 250.0-440.0              | 166.0-428.0     | 100.0-315.0     | 99.00-295.00    |      |        |
| Range              | Post Hoc                 | Post Hoc       | Post Hoc        | Post Hoc        | Post Hoc | Post Hoc |
| Creatinine (µmol/L) | 0.96 ± 0.54              | 0.76 ± 0.28     | 1.07 ± 0.63     | 1.09 ± 0.55     | 0.96  | 0.001*  |
| Mean ± SD          | 0.20-3.50                | 0.30-1.60       | 0.30-4.00       | 0.40-3.80       |      |        |
| Range              | Post Hoc                 | Post Hoc       | Post Hoc        | Post Hoc        | Post Hoc | Post Hoc |
| CRP (mg/L)         | 17.30 ± 8.36             | 27.72 ± 17.91   | 83.17 ± 27.3    | 129.8 ± 32.78   | 17.30 | 0.001*  |
| Mean ± SD          | 6.00-48.00               | 10.00-84.00     | 48.0-194.0      | 69.00-198.00    |      |        |
| Range              | Post Hoc                 | Post Hoc       | Post Hoc        | Post Hoc        | Post Hoc | Post Hoc |
| Ferritin (µg/L)    | 190.28 ± 64.88           | 242.35 ± 55.8   | 344.2 ± 58.5    | 433.4 ± 48.34   | 190.28 | 0.001*  |
| Mean ± SD          | 52.00-270.00             | 110.0-310.0     | 170.0-520.0     | 280.0-546.0     |      |        |
| Range              | Post Hoc                 | Post Hoc       | Post Hoc        | Post Hoc        | Post Hoc | Post Hoc |
| LDH (U/L)          | 213.75 ± 40.15           | 228.04 ± 35.6   | 237.1 ± 40.1    | 276.3 ± 42.98   | 213.75 | 0.001*  |
| Mean ± SD          | 135.0-290.00             | 135.0-290.0     | 136.0-310.0     | 175.0-395.0     |      |        |
| Range              | Post Hoc                 | Post Hoc       | Post Hoc        | Post Hoc        | Post Hoc | Post Hoc |
| D Dimer            | 0.36 ± 0.12              | 0.64 ± 0.16     | 1.85 ± 0.84     | 1.98 ± 0.93     | 0.36  | 0.001*  |
| Mean ± SD          | 0.10-0.60                | 0.30-1.20       | 0.50-4.00       | 0.50-5.00       |      |        |
| Range              | Post Hoc                 | Post Hoc       | Post Hoc        | Post Hoc        | Post Hoc | Post Hoc |
| Scv2               | 0.124 ± 0.081            | 0.088 ± 0.213   | 0.200 ± 0.004*  | 0.210 ± 0.039*  | 0.124 | 0.005*  |
| Mean ± SD          |                         |                 |                  |                  |      |        |
| Range              | Post Hoc                 | Post Hoc       | Post Hoc        | Post Hoc        | Post Hoc | Post Hoc |

| CT chest           | No. % | No. % | No. % | No. % | No. % | X²   | P value |
|--------------------|-------|-------|-------|-------|-------|------|---------|
| Corađ.1            | 93    | 46.5% | 0     | 0     | 0     | 28.97| <0.001* |
| Corađ.2            | 107   | 53.5% | 0     | 0     | 0     |      |        |
| Corađ.3            | 0     | 0     | 176   | 88.0% | 8     |      |        |
| Corađ.4            | 0     | 0     | 24    | 12.0% | 42    |      |        |
| Corađ.5            | 0     | 0     | 0     | 0     | 150   | 75.0%|        |
|                   |       |       |       |       | 200   | 100.0|        |

Hb: Haemoglobin, TLC: Total Leukocyte Count, AST: Aspartate aminotransferase, ALT: Alanine transaminase, CRP: C-reactive protein test, LDH: lactate dehydrogenase.
K: Kruskal Wallis test X²: chi-square test *statistically significant.
P1: mild compared moderate, P2: mild compared severe P3: mild compared Critically ill, P4: moderate compared severe, P5: moderate compared Critically ill, P6: severe compared Critically ill.

Table 4
Correlation between platelet count with studied parameters with laboratory investigations among the studied patients.

| Variables | PLT | Mild | Moderate | Severe | Critically ill |
|-----------|-----|------|----------|--------|---------------|
|           | r   | p value | r    | p value | r    | p value | r   | p value |
| CRP       | -0.004 | 0.953 | -0.221 | 0.002* | -0.036 | 0.616 | -0.029 | 0.688 |
| Ferritin  | -0.029 | 0.681 | -0.016 | 0.825 | -0.168 | 0.018* | -0.006 | 0.933 |
| LDH       | -0.108 | 0.127 | -0.072 | 0.309 | -0.130 | 0.066 | -0.200 | 0.005* |
| D-dimer   | -0.150 | 0.206 | -0.298 | 0.001* | -0.019 | 0.785 | -0.103 | 0.825 |
| Scv2      | 0.124 | 0.081 | 0.088 | 0.213 | 0.200 | 0.004* | 0.210 | 0.039* |

DM: Diabetes mellitus HTN: Hypertension CKD: Chronic kidney disease RR: Respiratory rate Hb: hemoglobin, TLC: Total Leukocyte Count, CRP: C-reactive protein test, CT: Computed tomography, LDH: lactate dehydrogenase.
r: correlation coefficient *significant.

Severe (35%) where the most common cause of death was respiratory failure, which occurred in 28 severe patients (80%) and 60 critical ill patients (81.25%), followed by thrombocytopenia associated hemorrhage. These findings matched those of Zhu et al., [22] Yang et al., [23]; and Lippi et al., [31]. Also, Helms et al., found that, outcome of the COVID-19 was statistically significant difference among the studied patients and the rate of mortality was statistically significantly higher among severe and critically ill patients [28].

It was established that mortality increases when platelet count decreases. Abnormal platelet count is quite common in patients in the
6. Conclusion

Platelet count is a simple, inexpensive, and readily available laboratory parameter that is frequently linked to severe COVID-19 infection and a significant death risk. From this work, we recommended that special consideration should be given to platelet count as a simple indicator for severe COVID-19 infection. Also, close follow-up of critically ill patients with thrombocytopenia is required to avoid a bad outcome to occur. Wheeze, the Platelet count should be closely observed before and during anticoagulant therapy. Finally, further studies on a wide scale of patients should be done to confirm our results.

Ethical approval

The study methodology was reviewed and found to be compliant with the 1975 Declaration of Helsinki’s ethical principles, as evidenced by prior approval by the institution’s human research committee (Institutional Review Board of Faculty of Medicine, Menoufia University, Egypt).

Sources of funding

This study did not receive any specific fund.

Author contribution

• All authors contributed to the conceptualization, design, data curation, resource identification, formal analysis, and data interpretation. Validation and technique, as well as revision of new software used in the work. All authors shared writing of this work. All authors reviewed the Manuscript.

Registration of research studies

1. Name of the registry: the Academic Research Registry Department
2. Unique Identifying number or registration ID: 9/2020TROP22
3. Hyperlink to your specific registration (must be publicly accessible and will be checked):

Guarantor

• All data are available upon request from the last author: Dr Ahmed Abozaid Ahmed Teima.

Consent

A written informed consent was given by every participant prior to the initiation of study in routine clinical practice at three specialized treatment centers especially concerned with COVID-19 management (Menoufia University Hospitals, National Liver Institute Hospital and Shebin El-Kom Teaching Hospital).

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The following information is required for submission. Please note that failure to respond to these questions/statements will mean your submission will be returned. If you have nothing to declare in any of these categories then this should be stated.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Conflicts of interest

No conflict of interest.

Acknowledgements

A good variety of cases, instructive supervision, ongoing advice, useful feedback, and clear directions were among the forms of help obtained by each author for this study.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2022.103973.

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