THE EFFECT OF EOSINOPHIL AND BASOPHIL COUNTS ON MORTALITY IN PATIENTS WITH COVID-19 INFECTION

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Abstract

INTRODUCTION: The aim of this study investigated the effect of eosinophil and basophil counts on mortality in patients with COVID-19 infection. METHODS: Blood tests of 582 patients with RT-PCR test in an oropharyngeal swab sample who were admitted to Diyarbakır Gazi Yaşargil Training and Research Hospital between March 2020 and December 2020 were retrospectively analysed. The patients were divided into two groups: those who recovered and discharged and those who had a mortal course. Demographic data, comorbid diseases, routine blood tests, and haematological parameters were compared between both groups. RESULTS: An eosinophil count of 0.01 ± 0.04 and basophil count of 0.0261 ± 0.026 was observed in the patient group who had a mortal course at first admission to the hospital, while the eosinophil count was 0.06 ± 0.12 and basophil count was 0.020 ± 0.017 in the recovered patient group. On the fifth day after admission, the eosinophil count was 0.02 ± 0.07 and basophil count was 0.043 ± 0.042 in the patient group with a mortal course, while the count of eosinophils was 0.13 ± 0.14 and basophils was 0.023 ± 0.016 in the recovered patient group. In both groups, the eosinophil and basophil counts on the fifth day increased compared to the first day, and the eosinophil and basophil counts were lower in those who had a mortal course on both the first and fifth day ($p < 0.05$). CONCLUSIONS: In our study, a significant decrease was observed in the count of eosinophils and basophils in the mortal group of COVID-19 patients. Eosinopenia and basopenia may be parameters that can be used to facilitate the diagnosis of COVID-19, and the depth of both eosinopenia and basopenia is positively correlated with COVID-19 mortality.

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SUMMARY

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admission, the eosinophil count was 0.02 ± 0.07 and basophil count was 0.043 ± 0.042 in the patient group with a mortal course, while the count of eosinophils was 0.13 ± 0.14 and basophils was 0.023 ± 0.016 in the recovered patient group. In both groups, the eosinophil and basophil counts on the fifth day increased compared to the first day, and the eosinophil and basophil counts were lower in those who had a mortal course on both the first and fifth day ($p < 0.05$).

CONCLUSIONS: In our study, a significant decrease was observed in the count of eosinophils and basophils in the mortal group of COVID-19 patients. Eosinopenia and basopenia may be parameters that can be used to facilitate the diagnosis of COVID-19, and the depth of both eosinopenia and basopenia is positively correlated with COVID-19 mortality.

WHAT'S KNOWN

Although there are studies showing the importance of eosinophil count in COVID-19, it is still a controversial issue and the number of studies evaluating basophil and eosinophil count together is limited. Although there are studies indicating a decrease in the number of eosinophils and basophils during the infection process, there are studies that found no significant difference. There are studies reporting that improvement in eosinopenia and basopenia may be an indicator of recovery from COVID-19, but the data on this subject are also controversial.

WHAT'S NEW

It was determined that there was a significant decrease in the eosinophil and basophil counts in COVID-19 patients, and it was observed that eosinopenia and basopenia were deeper in patients with a mortal course. While improvement in eosinopenia and basopenia was observed in all patients, this increase was observed to be more pronounced in patients who recovered. We think that our study will contribute to the literature, as there are limited studies in which both basophils and eosinophil counts are evaluated in detail in COVID-19 infection.

INTRODUCTION

COVID-19, which started in Wuhan province, China, in November 2019 and quickly spread all over the world, was declared a pandemic by the World Health Organisation on March 11. Those patients infected with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) may progress as asymptomatic or with symptoms severe enough to be admitted to the intensive care unit. This virus can cause death in patients who develop acute respiratory distress syndrome, as well as symptoms such as fever, dry cough, shortness of breath, malaise, taste and smell disorders, and myalgia (1). In many studies, treatment options have been evaluated, and prognostic factors and important parameters that play a role in the course of the disease have been investigated. These parameters are associated with viral pathogenic mechanisms and the resulting cell or organ damage (2).

Eosinophils are peripheral blood elements that have strong pro-inflammatory effects and are involved in immunoregulation in many infections, including viral infections (3). In the case of acute infection, a dramatic decrease is observed in the count of circulating eosinophils (4). Studies have shown a decrease in the count of eosinophils in acute viral infection caused by SARS-CoV-2 (3, 5, 6), and since eosinophil count can be used as a low-cost inflammation parameter in this infection, it has attracted attention recently (7). Unfortunately, the effect of eosinophil count on the course and severity of the disease is still a controversial issue (5). Likewise, the role of eosinophils count in recovery has not yet been fully elucidated. There are studies reporting that improvement in eosinopenia may be an indicator of recovery from COVID-19, but there are insufficient data on this subject (8, 9).

Another peripheral blood element that plays an important role in immunoregulation is basophils. In previous studies, it has been demonstrated that basophils secrete IL-4 and IL-6 and strengthen the immune system (10). During acute COVID-19 infection, dramatic changes occur in the immune system (11). Basophils change the immune system and cause hypersensitivity reactions, endocrinopathies, and haematological disorders (12).

Although there have been studies indicating the importance of eosinophil count in COVID-19, it is still a subject under investigation, and the number of studies evaluating basophil and eosinophil counts together is limited. In our study, we aimed to evaluate the prognostic importance of both eosinophil and basophil counts in peripheral blood during COVID-19 infection and their relationship with mortality.

METHODS

Blood tests of 581 patients who were hospitalised in Diyarbakır Gazi Yaşargil Training and Research Hospital between March and December 2020 and whose oropharyngeal swab samples were positive using RT-PCR were retrospectively analysed. Ethics committee approval was obtained for this study, dated 12/02/2021 and numbered 678. Patients aged 18–90 years with a haemogram examination, no haematological disease, no infectious disease other than COVID-19, oxygen saturation below 92%, lung findings in Thorax computed tomography (Thorax CT), and hospitalised for at least 5 days were included in the study. Patients under the age of 18 and over 90, those with incomplete examinations or who did not complete the treatment process, patients with infections other than COVID-19, patients with oxygen saturation above 92%, or without pulmonary findings in Thorax CT were excluded from the study. Haemogram (Mindray BC 6800, China) tests were performed in all patients during routine blood tests at the time of first hospitalisation. Then, the second haemogram test was performed on the fifth day of admission. In addition, demographic data, comorbid diseases, length of stay, and mortality information of the patients were noted. The patients were divided into two groups: those who recovered and were discharged and those who had a mortal course. Demographic data, comorbid diseases, routine blood tests, and haematological parameters were compared between both groups. In addition, haematological parameters performed on both days 1 and 5 were compared.

Statistical analyses

The Statistical Package for the Social Sciences Version 21 Windows (SPSS Inc., Chicago IL, USA) was used for statistical analyses. The normality of data distribution was analysed using the Shapiro-Wilk test. Descriptive statistics were expressed as the mean ± standard deviation. The independent samples test was used to compare the data of the two groups. Repeated measurements were compared with the paired t-test. $P < 0.05$ was considered statistically significant. The frequency of the data was evaluated with frequency tables.

RESULTS

While 358 (61.6%) of 581 patients who were diagnosed with SARS-CoV-2 in the oropharyngeal swab sample and hospitalised with COVID-19 pneumonia recovered and were discharged, 223 (38.4%) patients were mortal. We found that the mean age of these patients was 56.86 ± 19.38 (16–90 age range). The mean age of the 358 patients who recovered and were discharged was 47.7 ± 16.7, and the mean age of the 223 patients who were mortal was 71.9 ± 12.9. The difference in age was significant ($p < 0.001$). There were 324 male (55.8%) and 257 female (44.2%) patients. Of these, 136 male and 87 female patients were mortal. Demographic characteristics and Co-Morbid conditions of patients is shown in Table 1. The most common accompanying comorbid diseases were diabetes mellitus (43.7%) and hypertension (40.2%), followed by coronary artery disease (35.4%), chronic kidney failure (15.3%), chronic obstructive pulmonary disease (12.7%), cerebrovascular disease (10.1%), and malignancy (3.7%). There was a significant difference in the number of patients with comorbidities ($p < 0.001$) between patient groups who recovered and those who had a mortal course. There was more mortal in COVID-19 patients with diabetes mellitus, hypertension, coronary artery disease, chronic renal failure, chronic obstructive pulmonary disease, and cerebrovascular disease ($p < 0.001$). In contrast, there was no significant difference between the mortality and recovery groups in terms of progression in COVID-19 patients with malignancy ($p > 0.05$). While 52.2% of the discharged patients were smokers, 44.3% of the mortal patients were smokers. As a result, there was no significant difference between the two groups in terms of smoking ($p > 0.05$).

Routine blood tests of patients on the first hospitalisation day are shown in Table 2. Glucose, creatinine, ferritin, procalcitonin, d dimer, troponin, ALT, and CRP values were higher in those with mortality than in those who recovered and were discharged ($p < 0.001$).

The haematological examinations performed on the first day of hospitalisation are shown in Table 3, and the haematological examinations performed on the fifth day are shown in Table 4. Eosinopenia was observed in 376 patients and basopenia in 252 patients, according to the haematological parameters performed on the first day of hospitalisation. Interestingly, the eosinophil count in 273 patients and the basophil count in 22 patients was 0. On the fifth day, eosinopenia was observed in 225 patients and basopenia in 149 patients. While the eosinophil count was 0.01 ± 0.04 and basophil count was 0.0261 ± 0.026 in the patient group with a mortal course on the first day, the eosinophil count was 0.06 ± 0.12 and basophil count was 0.020 ± 0.017 in the recovered patient group. On the fifth day, the eosinophil count was 0.02 ± 0.07 and basophil count was 0.043 ± 0.042 in the patient group with a mortal course, while the eosinophil count was 0.13 ± 0.14 and basophil count was 0.023 ± 0.016 in the recovered patient group. The eosinophil and basophil counts on the fifth day increased compared to the first day in both groups, and the eosinophil and basophil counts were lower in the patient group with a mortal course compared to the recovered patient group on both the first day and the fifth day ($p < 0.05$). No difference was observed in the neutrophil, white blood cell, lymphocyte, platelet count, and haematocrit levels ($p > 0.05$) between the two groups on the first day. Similarly, there was no difference between lymphocyte, platelet counts, and haematocrit levels performed on the fifth day ($p > 0.05$). In contrast, the white blood cell and neutrophil counts were higher in those with mortality on the fifth day ($p < 0.001$).

The change in eosinophil and basophil counts on the first and fifth days is shown in Table 5, and the corresponding graphs are shown in Figure 1. All patients during COVID-19 infection, the eosinophil count in the blood was determined as 0.042 ± 0.10 and 0.09 ± 0.13 on the first and fifth day, respectively, and it increased on the fifth day compared to the first day ($p < 0.001$). The basophil count was 0.022 ± 0.021 on the first day and 0.031 ± 0.030 on the fifth day, showing an increase on the fifth day compared to the first day ($p < 0.001$).

DISCUSSION

In our study, eosinopenia and basopenia developed on the first day of hospitalization in the vast majority of COVID-19 patients, but the count of eosinophils and basophils increased on the fifth day compared to the first day in those who recovered, but this increase was less in the mortal group.

It is known from previous studies that there is a decrease in the eosinophil count during COVID-19 infection. In some studies, the incidence of eosinopenia has been reported to be between 50.8 and 94% (13). However, while we detected 64.7% eosinopenia in the haematological tests performed on the first day in our hospitalised COVID-19 patients, 43.8% had eosinopenia in the tests performed on the fifth day. There is variability in eosinophil count, with some studies showing 0 in some patients at the onset of infection (3). Similarly, in our study, we found that the eosinophil count was 0 in approximately 47% of our patients upon initial admission to the hospital. At the same time, we found that basopenia, which was 43.3% on the first day of hospitalisation, decreased to 25.6% on the fifth day.

Zhang et al. emphasised that eosinopenia commonly develops during COVID-19 infection and that eosinopenia can be a parameter used in diagnosis. In their study, there was no significant difference in terms of eosinopenia between those who both recovered and had a mortal course (14). Similarly, Lippi et al. reported that there was no difference in eosinophil count between mortal and recovered patient groups. In addition, they emphasised that the increase in eosinophil count was similar in both groups throughout the course of the disease, and the improvement in eosinopenia was not a prognostic factor in terms of the course of the disease and mortality in COVID-19 infection (5). In contrast, Liu et al. reported that eosinopenia is common in COVID-19 patients, but there was an increase in eosinophil count before discharge, and this improvement in eosinophil count may be an indicator of clinical improvement (8). In addition, Chen et al. reported that eosinopenia seen at initial admission to the hospital improved in patients who recovered but was maintained in patients with a severe prognosis (15). At the same time, other studies have emphasised that persistent eosinopenia during hospitalisation is associated with low recovery rates, and improvement in eosinopenia may be an indicator of improvement in clinical status (6, 16, 17). There are also various studies emphasising that not only eosinophils but also basophil counts are lower in those with a mortal course compared

to recovered patients (18, 19). Similarly, Sun et al. reported that COVID-19 patients with a low basophil count and low basophil percentage in white blood cells may have a more mortal course. In addition, they emphasised that both the basophil count increased from the acute phase to the recovery phase and that this increase showed a similar correlation with anti-CoV-2 immunoglobulin G (IgG) (20). Rodriquez et al. also reported that both eosinophils and basophils play an effective role in immunopathology and viral defence during acute COVID-19 infection, and eosinopenia and basopenia developed in most patients. They emphasised that there was an increase in eosinophil and basophil counts when they passed from the acute period to the recovery period (11). It is similar to the findings in our study. In addition, as the depth of eosinopenia and basopenia increases, a significant deterioration is observed in the clinical course of the patients. Cazzaniga et al. reported that oxygen saturation was lower in patients with eosinopenia and basopenia, and these patients needed more intensive care. In addition, they demonstrated that 4-week mortality rates were high in these patients (21). Ajeneye et al. reported that eosinopenia, along with lymphopenia, was an important parameter in the diagnosis of COVID-19 and showed a strong correlation with mortality (7). These results were supported in our study; eosinopenia and basopenia had a similar relationship with mortality. In other words, a significant decrease in eosinophil and basophil count can be seen in COVID-19 patients due to the development of immune system disorders.

CONCLUSİON

In our study, a significant decrease was observed in the count of eosinophils and basophils in the mortal group of COVID-19 patients. Eosinopenia and basopenia may be parameters that can be used to facilitate the diagnosis of COVID-19, as the depth of both eosinopenia and basopenia was positively correlated with COVID-19 mortality.

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