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Analysis of eosinophil and lymphocyte concentrations on the incidence of mild and severe acute asthma exacerbations

Análisis de las concentraciones de eosinófilos y linfocitos sobre la incidencia de exacerbaciones agudas leves y graves del asma

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SUMMARY

Introduction: *Exacerbation of asthma is an episode characterized by an increase in symptoms of progressive shortness of breath, coughing, wheezing, chest tightness, and a progressive decrease in lung function. Among the cells involved and activated in acute exacerbations in asthma are eosinophils and lymphocytes. This study aims to analyze the relationship between eosinophils and lymphocytes' concentration with the severity of acute exacerbation of asthma.*
Methods: *The method used was a cross-sectional retrospective with a sample of 40 patients with a simple random sampling technique in patients with acute exacerbation of asthma who came to the Emergency Room at Haji General Hospital, Surabaya, Indonesia.*
Results: *Patients with acute exacerbation of asthma are more dominated by women (23/40). Concurrently, the patient's age was dominated by the 46-65 age group (16/40). The conditions for discharging patients were proportionately proportional to outpatients (20/20) and inpatients (20/20). Statistical test results show the relationship of the severity of acute exacerbation of asthma with eosinophils (p= 0.003) and lymphocytes (p= 0.000). Also, a decreased trend in eosinophil and lymphocyte concentrations in severe acute asthma exacerbation compared with mild acute asthma exacerbation.*
Conclusion: *The concentration of eosinophils and lymphocytes was associated with the severity of acute exacerbation of asthma.*

Keywords: *Asthma, acute exacerbation, eosinophils, lymphocytes.*

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RESUMEN

Introducción: *La exacerbación del asma es un episodio caracterizado por un aumento de los síntomas de disnea progresiva, tos, sibilancias, opresión torácica y disminución progresiva de la función pulmonar. Entre las células involucradas y activadas en las exacerbaciones agudas del asma se encuentran los eosinófilos y los linfocitos. Este estudio tiene como objetivo analizar la relación entre la concentración de eosinófilos y linfocitos con la gravedad de la exacerbación aguda del asma.*
Métodos: *El método utilizado fue una retrospectiva transversal con una muestra de 40 pacientes con una técnica de muestreo aleatorio simple en pacientes*

con exacerbación aguda de asma que acudieron a Urgencias del Hospital General Haji, Surabaya, Indonesia.

Resultados: *Los pacientes con exacerbación aguda del asma están más dominados por mujeres (23/40). Al mismo tiempo, la edad del paciente estuvo dominada por el grupo de edad de 46 a 65 años (16/40). Las condiciones para dar de alta a los pacientes fueron proporcionalmente proporcionales a los pacientes ambulatorios (20/20) y los pacientes hospitalizados (20/20). Los resultados de las pruebas estadísticas muestran la relación de la gravedad de la exacerbación aguda del asma con eosinófilos (p= 0,003) y linfocitos (p= 0,000). Además, una tendencia disminuida en las concentraciones de eosinófilos y linfocitos en la exacerbación aguda grave del asma en comparación con la exacerbación aguda leve del asma.*

Conclusión: *La concentración de eosinófilos y linfocitos se asoció con la gravedad de la exacerbación aguda del asma.*

Palabras clave: *Asma, exacerbación aguda, eosinófilos, linfocitos.*

INTRODUCTION

Asthma is a chronic inflammatory process of the respiratory tract that involves many cells and their elements. This chronic inflammatory process causes the respiratory tract to become hyperresponsive, thereby facilitating bronchoconstriction, edema, and glandular hypersecretion, which results in restriction of airflow in the respiratory tract and is reversible (1-3). Asthma exacerbations are episodes characterized by a progressive increase in symptoms of shortness of breath, coughing, wheezing, chest tightness, and a progressive decrease in lung function, indicating a change from the patient's normal status sufficient to require a change in (1,4). According to data from GINA (2011), asthma is a heterogeneous disease. It is estimated that around 300 million people worldwide have asthma, and in 2025, it is estimated that the number of asthma patients will increase to 400 million (5,6). Risk factors for asthma that often cause the appearance of asthma symptoms according to their intensity including changes in temperature related to geographic conditions, allergens, physical activity, cigarette smoke, excessive emotional expression, and air pollution (7). As similar to other infections such as *Helicobacter pylor* (8), asthma is also associated with the environmental factors.

Eosinophil cells are a type of leukocyte cells involved in various disease pathogenesis (9). Eosinophils can phagocyte. Eosinophils are active, especially in the late stages of inflammation, when antigen-antibody complexes are formed and play an active role in allergic reactions or parasitic infections to increase the value of eosinophils can be used to diagnose or monitor disease. The normal value of eosinophils is 0-6 % (10). Lymphocytes are responsible for the control of the adaptive immune system. Based on their function and surface markers, lymphocytes are divided into two classes, namely B lymphocytes, which play a role in humoral immunity, and T lymphocytes which play a role in cellular immunity (11). The average concentration of lymphocytes in the blood is 15 %-45 % (10).

Asthma symptoms are varied, multifactorial, and potentially associated with inflammation of the bronchi. The primary inflammatory cells that play a role in asthma are eosinophils and mast cells. Besides, neutrophils and T lymphocytes also play a role in the inflammatory process (12). Many eosinophils accumulate in the bronchial mucosa in chronic asthma, excessive secretion of mucus in the airways, and the smooth muscle becomes hypertrophied and hyperactive to various stimuli. Inflammation and tissue damage in asthma, caused by slow-phase reactions (6-24 hours after re-exposure to allergens), wherein the slow-phase reactions are characterized by inflammation and infiltration of many eosinophils, neutrophils, and T cell lymphocytes (13,14).

The pathophysiology of asthma occurs based on the inflammatory process of the airway triggered by T lymphocytes, which is associated with increased production of cytokines by Th2 relative to the production of cytokines by Th1. The Th2 hypothesis in asthma suggests that a shift in the balance of a Th1-to a Th2-type response modulates eosinophilia, IgE production, airway hyperresponsiveness, and chronic inflammation (15). Several other studies have been conducted to determine how eosinophils and lymphocytes relate to asthma, but they have had different results. A study in 2013 stated that

there was an increase in eosinophil concentration as a characteristic feature of inflammation in asthma and an increase in the concentration of T lymphocytes in the mucosal lumen of the respiratory tract (16). However, in another study, it was found that no increase in eosinophil concentration was found in the complete blood count of asthma patients (17). This study aims to determine the relationship between eosinophil and lymphocyte concentrations and the severity of acute asthma exacerbation.

METHODS

The design of this study was quantitative, analyzing with an observational approach with a cross-sectional retrospective method where this design seeks to determine the relationship between eosinophils and lymphocytes with the severity of acute exacerbation of asthma. The population in this study was taken from acute exacerbation of asthma patients who came to the Emergency Room (ER) at Haji General Hospital, Surabaya, from 2017 to 2019. This research was conducted from December 2019 to March 2020. The sampling technique in this study used a simple random sampling technique, which is to take randomly from the population. The criteria used to select the sample were patients who had been diagnosed with asthma, acute exacerbation of asthma patients who came to the emergency room of General Hospital Haji Surabaya for the period 2017-2019, patients were over 15 years old, and had performed a complete blood count. The instrument used in this study used patient medical record data. In this study, samples of patients with acute asthma exacerbation who had their complete blood checked were then seen the eosinophil and lymphocyte concentrations. After visiting the ER, the patient's discharge condition indicates the severity of the patient's acute exacerbation of asthma. Patients with mild exacerbation of asthma are known if the patient's discharge condition is outpatient, while patients with severe exacerbation of asthma are known if the patient's condition is hospitalized. The data obtained from data collection will be processed and analyzed using a computer program, namely the 25th edition of the Statistical Package for the Social Sciences (SPSS). The non-parametric Mann-Whitney test was used for eosinophils because the data were not normally distributed and had different variants. In comparison, lymphocytes used the Independent T-test because the data were normally distributed and had different variants.

RESULTS

Patient characteristics can be determined based on sex, age, discharge condition, and the number of patient visits. Of the 575 patients, 40 patients met the inclusion criteria. Table 1 displays patients with acute asthma exacerbation in the ER at Haji General Hospital, Surabaya, Indonesia, are more dominated by women. Meanwhile, the patient's age was dominated by the 46-65 age group. In addition, the conditions for discharging patients were proportionately proportional to outpatients and inpatients.

Table 1

Acute exacerbation of asthma patient characteristics in the emergency room of Haji General Hospital, Surabaya, for the 2017-2019 Period

Characteristics	Total	Percentage
Sex		
Male	17	42.5
Female	23	57.5
Age		
15 - 25 years	3	7.5
26 - 45 years	11	27.5
46 - 65 years	16	40.0
>65 years	10	25.0
Returning Conditions		
Outpatient	20	50.0
Inpatients	20	50.0

The statistical analysis shows significant differences in eosinophil (p= 0.003) and lymphocyte (p= 0.000) concentration between mild acute asthma exacerbation and severe acute asthma exacerbation. Figure 1 shows differences in eosinophil and lymphocyte concentrations in two groups of different degrees of asthma

severity, including the mild and severe groups. The mean data of eosinophil concentration in patients with mild acute asthma exacerbation was 2.36 %. There was a decrease in severe acute asthma exacerbation with an average eosinophil concentration of 0.305 %. Meanwhile, the mean data of lymphocyte concentration in patients with mild acute asthma exacerbation was 17.19 %. There was a decrease in severe acute asthma exacerbation with an average lymphocyte concentration of 5.425 %.

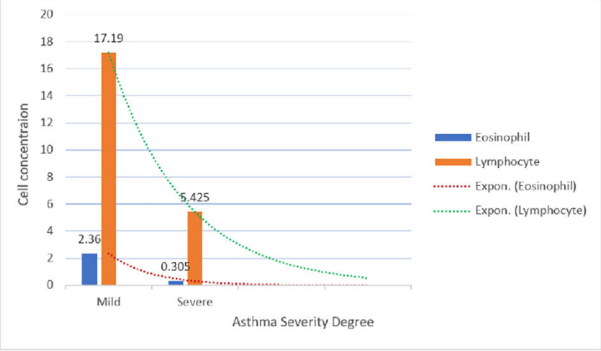

Figure 1. Relationship between the concentration of inflammatory cells and the severity of acute asthma exacerbation.

DISCUSSION

There was a significant difference in the mean values of eosinophil and lymphocyte concentrations with mild acute asthma exacerbation and severe acute asthma exacerbation. The eosinophil concentration in this study tended to decrease with increasing asthma severity. The average eosinophil concentration in mild acute asthma exacerbation was 2.36 %, with the highest value of eosinophil concentration in mild acute asthma exacerbation patients of 10.1 %, indicating the occurrence of eosinophilia process or an increase in eosinophil concentration from the normal range of around 0 %-6 % (10). This is consistent with the theory that a slow-phase reaction causes inflammation and tissue damage in asthma (6-24 hours after re-exposure to an allergen), wherein the slow-phase reaction is characterized by inflammation and infiltration of many eosinophils that accumulate in the bronchial mucosa (13).

In patients with severe acute asthma exacerbation, the mean eosinophil concentration was 0.305 %, with the highest value of eosinophil concentration in severe acute asthma exacerbation patients of 1.2 %. Although the concept of inflammatory eosinophils has long been considered a cause of asthma, there is now a new theory that says that eosinophils' role will be reduced in severe asthma, neutrophils will have a more significant role in respiratory damage in severe asthma (16). Drugs that suppress airway eosinophils, including corticosteroids, anti-IgE, and anti-IL-5, are generally effective in reducing the rate of exacerbation of asthma (12). Furthermore, it can be estimated that the results of eosinophil concentration in patients with severe acute exacerbation of asthma at Haji General Hospital, Surabaya, Indonesia, did not experience an increase in the concentration value because the patients had received previous corticosteroid therapy which had the effect of suppressing airway eosinophils.

The lymphocyte concentration in this study also tended to decrease with increasing asthma severity. The average lymphocyte concentration in mild acute asthma exacerbation was 17.19 %, with the highest value of eosinophil concentration in mild acute asthma exacerbation patients of 42.5 %, which indicates that no patient experienced an increase in lymphocyte concentration from its normal range, namely around 15-45 % (10). It is estimated that the cause of lymphocyte concentration in mild acute asthma exacerbation tends to show normal results because lymphocyte cells arise in slow phase asthma reactions. The slow-phase asthma reaction occurs between 6-9 hours after allergen provocation and involves the recruitment and activation of eosinophils, CD4 + T cells, neutrophils and macrophages. In patients with severe acute asthma exacerbation, the mean lymphocyte concentration was 5.425 % with the highest value of lymphocyte concentration in severe acute asthma exacerbation patients of 11.4 %. The decrease in lymphocyte concentration is due to the administration of corticosteroid therapy in patients with severe acute asthma exacerbation (18). Corticosteroids are effective drugs in inflammation because they cytokines production from both mast cells and

lymphocytes (19). Also, the increasing severity of asthma decreased the patient's lymphocyte concentration because the patient with severe acute exacerbation of asthma at Haji General Hospital, Surabaya, Indonesia, had received corticosteroid therapy treatment. So that when the patient performs a complete blood test, the lymphocyte concentration results obtained will decrease.

The patients with acute exacerbation of asthma are more dominated by women. After puberty, the prevalence of asthma increases at risk in women, with the highest incidence experienced by women with a history of early menarche and multiple pregnancies. This is thought to be due to sex hormonal factors in women (20). The condition of discharge of the patients was proportionally proportional to outpatients and inpatients (21). Patients with mild attacks may be discharged immediately if the asthma symptoms have been relieved and show a positive response by giving nebulization 1x and the symptoms have disappeared. While for patients with severe attacks, if the patient has been nebulized three times, but the response is still inadequate and the symptoms do not disappear, the patient should be hospitalized (22).

CONCLUSION

There was a significant difference in the concentration of eosinophils and lymphocytes with the severity of acute asthma exacerbation, both mild and severe. The concentration of eosinophils and lymphocytes tends to decrease with increasing severity of acute exacerbation of asthma.

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