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RESEARCH ARTICLE
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FREQUENCY OF RAISED TOTAL SERUM IG E, SPUTUM EOSINOPHILIA AND BLOOD EOSINOPHIL COUNT IN PATIENTS WITH SEVERE PERSISTENT ASTHMA

Dr Mian Mufarih Shah[1], Dr Muhammad Abbas[2], Dr Momina Haq[3], Dr Sumira Abbas[4*], Dr Munaza Khattak[5], Dr Farhan Abbas Baloch[6]

[1]Assistant Professor, Department of Medicine, Khyber Girls Medical College, MTI-Hayatabad Medical Complex, Peshawar.
[2]Assistant Professor Medicine, Peshawar Medical College, Prime Teaching Hospital, Peshawar.
[3]Associate Professor, Department of Physiology, Peshawar Medical College, Riphah International University, Islamabad.
[4*]Assistant Professor Hematology, Department of Pathology, Peshawar Medical College, Kuwait Teaching Hospital, Peshawar.
[5]Associate professor, Department of Physiology, Peshawar Dental College, Riphah International University, Islamabad.
[6]Assistant Professor, Department of Pathology, College of Medicine, Qassim University.

***Correspondence Author:** Dr Sumira Abbas
*Assistant Professor Hematology, Department of Pathology,
Peshawar Medical College, Kuwait Teaching Hospital Peshawar
Email address: sumiraabbas11@gmail.com

ABSTRACT

Background: Asthma is a prolonged pulmonary illness and has many phenotypes of inflammation. Serum immunoglobulin E (IgE) and blood eosinophils are markers of pulmonary inflammation in asthma patients. This investigation evaluated the intensity of asthma with various markers of inflammation.

Objectives: To assess the occurrence of elevated total serum IgE, eosinophilia in sputum and levels of eosinophil in blood of asthmatic individuals.

Material & Methods: This cross sectional study involved 800 participants which participated in the study after achieving the inclusion criteria. The study took place in Hayatabad Medical Complex, Peshawar in time span of 1st July 2023 to 31st December, 2023. Aseptic measures were taken for collection of samples of blood to assess serum IgE and levels of blood eosinophils. Sterile jar was used for collection of sputum and the jars were submitted to histopathology laboratory.

Results: The present study involved 800 participants with the mean age of 48.39 ± 13.22 SD. The time duration of symptoms was 26.58 ± 8.43 SD. The study involved 47% males and 53% females. After analysis of the serum it was found that majority of the asthmatic participants (n= 612, 76.5%) had elevated IgE. Only 9.6% of the participants had elevated eosinophils in sputum. Majority of the participants (n=450, 56.2%) had elevated eosinophil count in the blood. After comparing age, gender and time duration of symptoms with serum IgE, blood eosinophilia and sputum eosinophilia through chi square test, it was found that there was a significant association between age of the asthmatic patient and elevated eosinophils count in sputum (p= 0.035) as indicted by p-value. There was no

significant association between gender of the asthmatic patient and duration of symptoms with elevated serum immunoglobulin E levels, eosinophilia in sputum and elevated eosinophilic count in blood.

Conclusion: Levels Serum IgE, eosinophils count in sputum as well as blood were elevated significantly in asthmatic patients. These biomarkers can be used in the diagnosis of asthma as their discovery is feasible, 'simple and non-invasive' and they have a direct correlation with inflammation.

Key words: Asthma, Serum, Sputum, Immunoglobulin E, Eosinophils

INTRODUCTION

The prevalence of asthma has increased globally over the past few years. The incidence of asthma has changed dramatically with specifically higher rates in the developing countries like USA, 'Canada', UK, 'Australia' and 'New Zealand'.[1] Its prevalence has in the US has increased in the time duration of 1980 to 2011. The total lifetime and the current prevalence of asthma in 2012 was 13.0% and 8.3 % respectively.[2] In Pakistan the prevalence of asthma was 19.36%.[3] Despite of rarity in mortality rate of asthma previously data by the World Health Organization showed 418,917 deaths globally.[4]

Many cells and their elements has a role in asthma pathophysiology including eosinophils, T lymphocytes, epithelial cells, mast cells, macrophages and neutrophils. In high risk individual's inflammation causes recurrent cough, difficulty in breathing, chest wheeze and tightening mostly in morning and rarely at night. They are associated with reversible obstruction to airflow which subsides by itself or after treatment. There is an elevated responsiveness of bronchi by inflammation to various stimuli.[5]

Asthma has various phenotypes of inflammation and Simpson has divided it on the components of granulocytes in the cells of sputum.[6] There are four categories of asthma based on sputum cytology i-e neutrophilic, eosinophilic, mixed neutrophilic and eosinophilic and pauci granulocytic asthma when there is absence of cells of inflammation.[7,8,9]

The extent of seriousness of asthma is evaluated by current guidelines by the severity of various symptoms i-e wakening at night, usage of inhalers, asthma exacerbations, and extent of airflow obstruction.[10,11] Recent investigation from India evaluated the association of serum IgE, eosinophils in 'sputum and blood' with asthma severity and has showed a significant relation between them.[12] The study involved seventy six participants out of which thirty four had severe asthma, all the participants who had severe asthma showed elevated levels of serum IgE and 19.7% had raised eosinophils in sputum.[12]

In the present investigation we assessed the frequency of elevated total serum IgE, eosinophilia in sputum and in blood of individuals with asthma. Numerous investigations are conducted on this 'topic in western countries' but there is lack of data on this in Pakistan.

MATERIALS AND METHODS

The study was conducted in Hayatabad Medical Complex, Peshawar in the time duration of 1st July 2023 to 31st December, 2023. The study involved 800 participants and they were recruited by 'non-probability consecutive sampling' technique.

Those patients who visited the 'Outpatient Department' or were admitted to 'Pulmonology Ward' of 'Hayatabad Medical Complex' were included in the study if they fulfilled inclusion criteria i-e having either sex with age range of 15-80 years and presenting to the Outdoor Department or admitted to the Pulmonology Ward of either sex having age 15 to 80 years and accomplishing the 'criteria of severe asthma' while exclusion criteria involved those patients who suffered from 'eosinophilic

pneumonia', 'Allergic Bronchopulmonary Aspergillosis', 'Churg Strauss syndrome' and with 'hematological malignancies'.
Blood samples were collected by following aseptic technique for measuring 'total serum immunoglobulin E' and levels of 'blood eosinophils count'. The informed consent was obtained from all the patients. Sputum was obtained in the sterile jar and allotted to the pathology lab. Eosinophils count was recorded in sputum. Patients data confidentiality was ensured.

SPSS version 23.0 was used for analysis of the data. Age and duration of symptoms were considered as quantitative variables and were presented as mean ± standard deviation. Elevated serum IgE, raised eosinophils in blood and sputum were presented as frequencies and percentages. Data was graded for age, gender, and duration of symptoms. P-value was obtained by applying Chi-square test and P-value less than or equal to 0.05 was taken as significant.

The study was approved by the Ethical Review Board of Hayatabad Medical Complex (HMC), Approval No:1834 dated: 18th May 2023.

RESULTS

The present study involved 800 participants with the mean age of 48.39 ± 13.22 SD. The time duration of symptoms was 26.58 ± 8.43 SD. The study involved 47% males and 53% females.
After analysis of the serum it was found that majority of the asthmatic participants (n= 612, 76.5%) had elevated IgE. (Figure 1) Only 9.6% of the participants had elevated eosinophils in sputum. (Figure 2) Majority of the participants (n=450, 56.2%) had elevated eosinophil count in the blood. (Figure 3) (Table-1)

After comparing age, gender and time duration of symptoms with serum IgE, blood eosinophilia and sputum eosinophilia through chi square test, it was found that there was a significant association between age of the asthmatic patient and elevated eosinophils count in sputum (p= 0.035) as indicted by p-value. P value ≤0.05 was considered significant. (Table-2)

There was no significant association between gender of the asthmatic patient and duration of symptoms with 'elevated serum immunoglobulin E levels', 'eosinophilia in sputum' and 'elevated eosinophilic count in blood'.

Table-1 Characteristics of patients	
Characteristics	**n= 800**
Age (years) Mean±SD	48.38±13.22
Gender	
Male	376 (47%)
Female	424 (53%)
Time duration of symptoms (years)	
Mean±SD	26.58±8.43
Elevated serum IgE	
Yes	612 (76.5%)
No	180 (22.5%)
Elevated eosinophils in sputum	
Yes	77 (9.6%)
No	723 (90.3%)
Elevated eosinophils in blood	
Yes	450 (56.2%)
No	350 (43.7%)

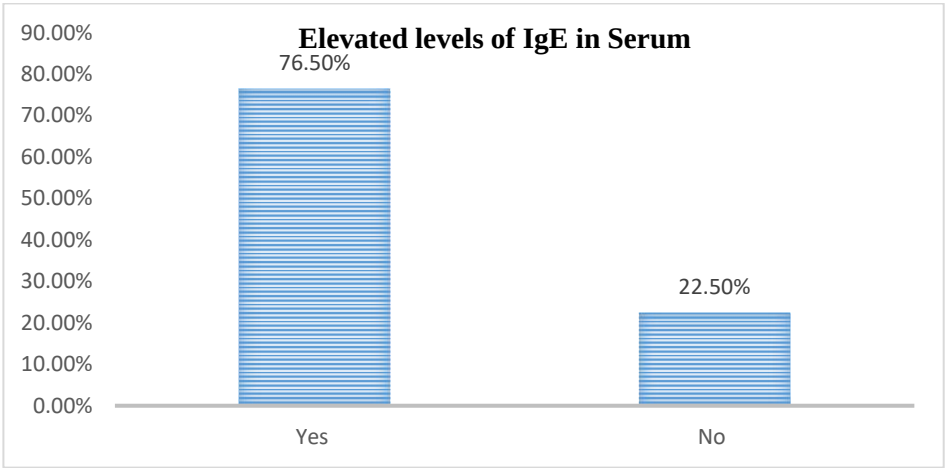

Figure 1: Clustered column chart showing elevated levels of Serum IgE in asthmatic patients

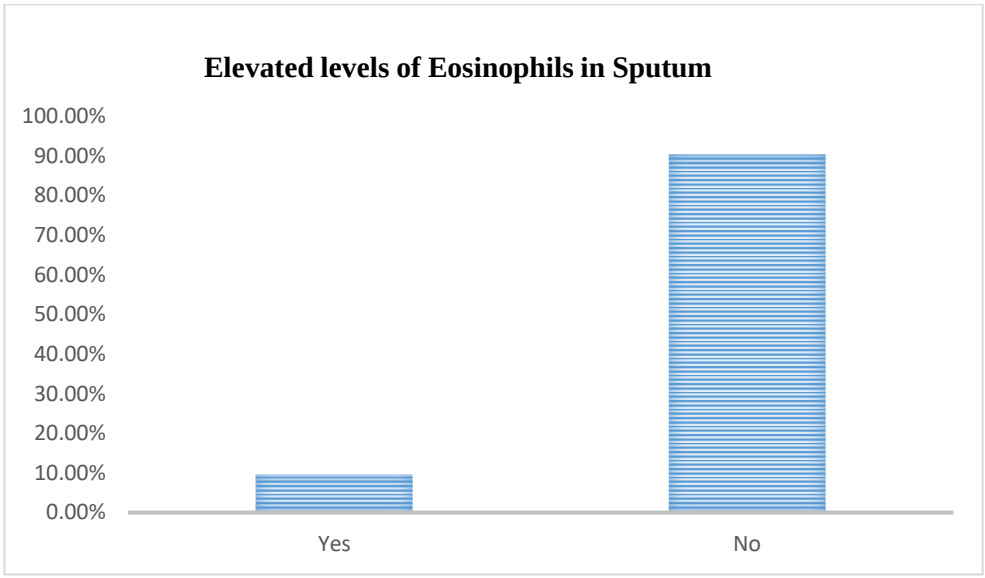

Figure 2: Clustered column chart showing elevated levels of Eosinophils in Sputum of asthmatic patients

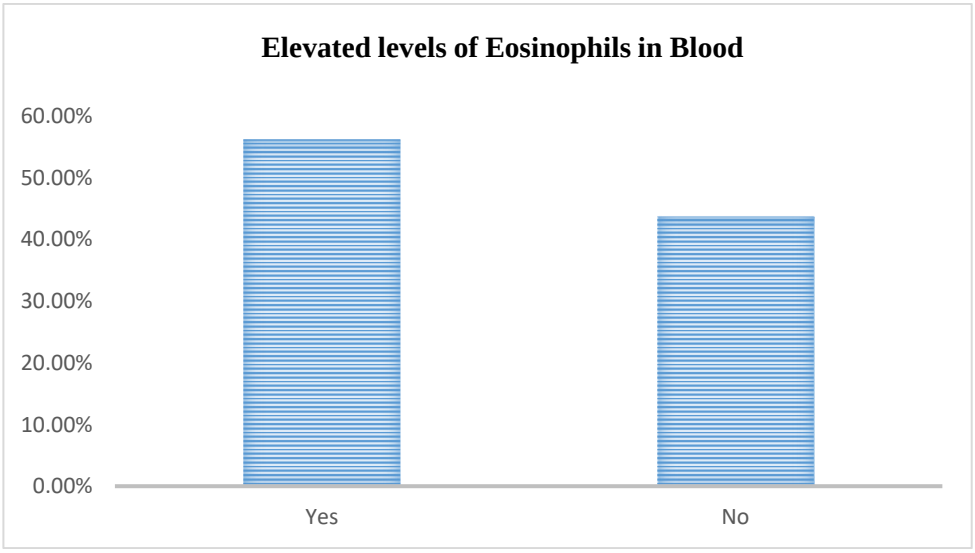

Figure 3: Clustered column chart showing elevated levels of Eosinophils in blood of asthmatic patients

Table-2: Correlation of Age with elevated levels of eosinophils in sputum				
	Elevated Levels of Eosinophils in Sputum			
Age Groups	**Yes**	**No**	**Total**	**P Value**
15-30 years	2 (2.24%)	87 (97.75%)	89 (11.12%)	
31-46 years	210 (33.7%)	413 (66.29%)	623 (77.8%)	
47-80 years	2 (2.27%)	86 (97.72%)	88 (11%)	
Total	214 (26.7%)	586 (73.3%)	800 (100%)	0.035

DISCUSSION

The airways in the asthmatic patient are very sensitive and there is hindrance to airflow of various intensities. Globally 339 million population had asthma in the year 2016.[13] it is known as hypersensitivity reaction Type I. Several methods were proposed by past studies to evaluate inflammation in the airways. In severe asthmatic patients those methods are preferred which are non-invasive, safe, and easy for patient investigation. The findings of the present study showed that patients with severe asthma had elevated serum IgE and levels of eosinophils in blood as compared to eosinophils levels in sputum. In addition to the above findings, it was also found that among these inflammatory markers, only levels of eosinophils in sputum had a significant association with age. There was no significant association between the rest of the factors. In accordance to our findings a study conducted by Fanny Wai-San Ko et al in China also found out that those patients who had high levels of serum IgE and increased eosinophil count in blood showed severe asthma than those without these features.[14] A study conducted by Herve Caspard et al., also found increased blood eosinophil count in asthmatic patients as compared to non-asthmatic or control group.[15]

An investigation conducted by Ankan Bandyopadhyay involved participants treated for bronchial asthma and observed a relation between levels of eosinophils in sputum and 'forced expiratory volume in one second (FEV1)'. The investigators also observed the treatment outcome and prognosis of patients of asthma from baseline sputum eosinophils count. There was no significant association between FEV1% and levels of eosinophils in sputum.[16] In accordance to our study this investigation also found out that levels of eosinophils in sputum as an exceptional biomarker of inflammatory airways and can be a valued biomarker to assess the disease severity, outcomes of treatment and prognosis of asthma.

A relationship between levels of IgE in serum and severity of allergic asthma was found in Spanish population through a study conducted by I Davila et al in 2015. They also found out different levels of IgE in serum noticeably.[17] In accordance to our study, I Davila et al also found that patients who suffered from severe asthma had elevated IgE levels in serum. They also found that younger age, sensitivity to allergic agents, gender and family history of asthma were significantly associated with elevated levels of IgE in serum. While our study assessed both age and gender and only found a significant association between age of asthmatic patients and levels of eosinophils in sputum while levels of IgE in serum and levels of eosinophils in blood had no significant association with age and gender.

Another retrospective research led by 'Akihiko Tanaka et al.' found an 'association between variations in levels of IgE and asthma control'. They evaluated variations in IgE levels and patient's clinical features i-e asthma control, scoring of asthma control test, IgE specific to allergens and 'pulmonary function test'. They found that those patients who had 'elevated levels of IgE had higher mean age', 'more exacerbations' of asthma yearly, 'lower asthma control test scores' and these patients often used corticosteroids drugs. Those patients who had uncontrollable asthma and allergen specific IgE had high levels of IgE.[18] Our study did not consider the above factors, so statement on the relationship cannot be made.

In accordance to our study 'a cross-sectional study by Roshan M. Kumar et al' assessed the association of levels of IgE in serum, raised levels of eosinophils in sputum and levels of eosinophils in blood with severity of asthma clinically. Their findings showed a contrary association between

levels of IgE in serum and levels of eosinophils in sputum with forced expiratory volume 1 (FEV1) and found out a significant association between raised levels eosinophil 'in patients with severe asthma'. There was a 'significant association between' serum IgE levels, raised eosinophils in sputum, elevated eosinophils in blood with asthma severity.[12] the present study also found elevated levels of IgE in serum and increased eosinophils count in blood in patients with severe asthma.

CONCLUSION

There is elevated levels of IgE in serum and eosinophil count in blood of severe asthmatic individuals. Therefore, these 'inflammatory markers' can be used easily along with other 'diagnostic tools for diagnosis', 'monitoring of treatment response' and 'giving an interpretation' regarding prognosis of severe asthma.

LIMITATIONS

It was a cross sectional study and involved a small sample size so results cannot be generalized. In the current study only patients who had severe asthma were evaluated for inflammatory markers while patients with mild and moderate asthma were not involved. Those patients who had elevated IgE levels in serum were not tested for allergic aspergillosis, and those with raised eosinophil levels were not evalated for parasitic infections.

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