Recent Understanding of Pathogenesis, and Management Strategies of Asthma

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Abstract

Asthma is a chronic inflammatory disease of the airways triggered by an immune response involving Th22 cells and group 3 innate lymphoid cells (ILC2). This disease is divided into two main endotypes: type 2-high, characterized by eosinophilic inflammation and a good response to corticosteroids; and type 2-low, associated with neutrophilic inflammation and a response to non-type 2 cytokines. The aim of this literature review is to examine the literature focusing on the immunology of asthma, its pathogenesis, biomarkers, genetics, epigenetics, and management.

Methods. The literature used included searches in several databases such as Google Scholar and PubMed using keywords relevant to the topic. The results of the review indicate that type 2-high asthma responds well to corticosteroid therapy, whereas type 2-low asthma requires treatment approaches targeting non-type 2 cytokines. Biomarker-based approaches are becoming crucial in asthma management, with studies showing that plant-based diets and vitamin D intake may play a role in controlling asthma.

Conclusion. A deeper understanding of asthma endotypes and associated biomarkers is vital in developing more personalized and effective treatment strategies.

Keywords. asthma, endotype, immunology, biomarkers

Introduction

Asthma is a chronic inflammatory disease of the airways caused by a complex interaction between genetic, immunological, and environmental factors. This disease is characterized by symptoms such as shortness of breath, cough, and wheezing, which occur due to airway narrowing. The pathogenesis of asthma involves an immune response mediated by various immune cells and cytokines, including type 2 helper T cells (Th2) and group 2 innate lymphoid cells (ILC2) that produce cytokines such as IL-4, IL-5, and IL-13.[1] Eosinophilic inflammation can be divided into two main types: type 2-high and type 2-low. In type 2-high asthma, the predominant inflammation involves eosinophils, and the response to corticosteroid therapy is very good. Conversely, in type 2-low asthma, the inflammation involves neutrophils, and standard therapies such as corticosteroids are less effective.[2]

Recent research suggests that a deeper understanding of asthma endotypes can aid in the development of more personalized and effective therapies. Additionally, biomarkers such as blood eosinophils, IgE, and several other inflammatory mediators have been identified as important indicators in the diagnosis and management of asthma.[3] Therefore, studies on biomarkers and molecular mechanisms of asthma are crucial to improving the management of this disease.

Methods

The method used in this study is a literature review that involves searching for recent articles from various scientific journals published in the last five years. The search was conducted through several databases such as PubMed, Google Scholar, and ScienceDirect. Keywords used in the search include "immunology of asthma," "biomarkers of asthma," "genetics of asthma," "epigenetics of asthma," and "management of asthma." Articles that met the inclusion criteria, namely relevant journals regarding the research topic published in English or Indonesian, were selected for further review. Based on the search results, more than 13 articles were chosen and categorized into several main themes, including immunology, biomarkers, genetics, and asthma therapy.

Discussion

Immunology of Asthma

Asthma involves inflammation mediated by various immune cells, such as Th2 cells, eosinophils, and group 2 innate lymphoid cells (ILC2). This inflammation leads to increased mucus production and airway narrowing. As research has progressed, it has been found that

asthma is divided into two main endotypes based on the type of inflammation. In type 2-high asthma, the inflammation is dominated by eosinophils, while in type 2-low asthma, neutrophils play a more significant role.[4] Th2 cells produce cytokines such as IL-4, IL-5, and IL-13, which stimulate eosinophil activity and increase IgE production, playing a role in allergic reactions and airway hypersensitivity.[5]

Biomarkers and Diagnostics

Asthma biomarkers include several molecules and cells that can be measured in blood or sputum to diagnose and monitor disease progression. Commonly used biomarkers include blood eosinophils, specific IgE, and the important roles of interferon-gamma (IFN-γ) and IL-10 as anti-inflammatory mediators.[6] Recent studies show that these biomarkers can help differentiate between type 2-high and type 2-low asthma, which greatly influences the selection of appropriate therapy.[7]

Genetics and Epigenetics

Genetic factors play a critical role in susceptibility to asthma. Several genetic polymorphisms have been associated with an increased risk of developing asthma, including variations in genes encoding for interleukin receptors and other inflammatory mediators.[8] Additionally, epigenetics also plays a role in asthma development, with DNA modifications that can affect the expression of genes involved in immune response and inflammation.[9]

Management of Asthma

Current asthma management still involves the use of symptomatic medical therapies, such as bronchodilators and corticosteroids. However, biomarker-based approaches are gaining increasing attention. The use of biological therapies targeting specific cytokines, such as IL-5, IL-13, and IL-4, has shown positive results in managing type 2-high asthma.[10] In contrast, type 2-low asthma requires more targeted therapies, including anti-inflammatory treatments that do not focus on the Th2 pathway.[11]

In addition to pharmacological treatments, other approaches being developed include managing asthma through diet. Research indicates that consumption of foods rich in antioxidants and vitamin D can help reduce asthma exacerbations and improve the quality of life for patients.[12] Diets high in plant-based foods and low in fat have also been shown to have positive anti-inflammatory effects in managing asthma.[13]

Conclusion

Asthma is a complex inflammatory disease, with various endotypes requiring different treatment approaches. A deeper understanding of the immunology, biomarkers, and genetics of asthma is crucial in developing more personalized and effective therapies. Recent research suggests that biomarker-based therapies and dietary approaches may be promising strategies for managing this disease. Therefore, further research is needed to explore the underlying mechanisms of asthma and develop more efficient and safe therapies.

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