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The Eosinophil

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Abstract

Eosinophils along with neutrophils and basophils make up much of the acute phase immune response in humans and other animals. Like the other two mentioned cell types the physiology is not complex and it has a short half-life, especially following activation. While simple in structure and not long lived, eosinophils have a variety of complex functions which serve to modulate the immune response in both a positive or in some cases a negative way. These negative enhancements can lead to disease causing states, which may in some cases be considered life threatening.

Introduction

Eosinophils were discovered in the late 1800's and quickly became associated with different and diverse disease states [1]. Eosinophils were linked in terms of disease to everything from parasitic infections to allergic reactions. The eosinophil has the capability of causing extreme damage to certain tissues in the body. It has been suggested that eosinophil evolution dates back more than one hundred million years [2]. Eosinophil counts in the blood have a range of 350 – 600 per microliter. Disease states can occur if the blood count becomes excessive, or conversely is reduced below 350.

Structure

Eosinophils constitute about 1-3% of the total "white" cell count in humans. As with neutrophils they are produced in the bone marrow. They have bi-lobbed nuclei and are about 15 micrometers in diameter. Eosinophils reside primarily in various types of tissue, unlike many other cell types. In tissue they can survive for up to twelve days. They are found in the thymus and the lower gastrointestinal track, and other organs, such as the spleen, but not in the lungs or skin. Eosinophils are acid loving cells in the that they have acidophilic cytoplasmic granules, and have an affinity for coal dye tars, so they appear brick-red following staining. This staining is segregated to granules in the cytoplasm of the cell. Unstained eosinophils, like other cell types are clear or transparent when not stained. When circulating they can survive up to 12 hours. Once matured they circulate in the blood until a stimulus occurs usually involving a chemokine. When activated, they break apart and release granules found in DNA traps, thereby releasing toxins which can cause tissue damage.

The appearance of Interleukin-5 receptor on the surface of progenitor eosinophils is essential for eosinophil development [3]. What has also become known in recent years is the upstream requirement of IL-33 for enhancing differentiation.

Function

One of the most striking features of the role of eosinophil function is de-granulation. Cationic proteins may be released at this time. Major basic protein, eosinophil cationic protein, and eosinophil peroxidase all tissue destructive [4,5]. Some of the "side effects" of the presence of these molecules is that they can affect or induce the production of other tissue destructive substances such as reactive nitrogen species that may occur as the result of the presence of eosinophil peroxidase.

Eosinophils have the capability of producing or stimulating a variety of cytokines such as Interleukins 1, 2, 4, 5, 6 and TNF alpha [6]. They can produce growth factors such as vascular endothelial growth factor (VEGF) and enzymes such as elastase [7]. Eosinophils also have a role in resisting viral infections and worm (helminth) colonization. They may, in concert with mast cells mediate allergic responses such as allergic rhinitis. As shown there are extremely positive aspects of the presence of eosinophils.

Clinical significance

Eosinophil related syndromes are rare in humans. They are most prominent when associated with asthma. Eosinophilia is a condition where there are >500 cells/microliter of blood. There are a variety of disease states that occur when this number is exceeded but the most common has to do with asthma, where the number of eosinophils is directly related to the severity of the attack [8]. Further increased levels of eosinophils may cause damage to tissue in the lungs of asthma patients.

Eosinophil deficiency was first reported in the 50's associated with a patient that had thymoma [9]. There have been other reported cases of eosinophil deficiency associated with, or as a cause of thymoma, but there is not at this time enough evidence to firmly assign a clinical sign or diagnosis.

Another reported condition occurs when eosinophils and basophils are absent [10]. This condition has been reported in rare cases. Signs and symptoms include baldness, acquired hemolytic anemia and warts and other skin conditions, such as mumps and a generalized case of blisters. Other cases involve chronic urtcaria and vitiligo. Some but not all of the classes of immunoglobulins may be absent.

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