

MUCOSA-ASSOCIATED LYMPHOID TISSUE IN BIRDS: AN INTEGRAL COMPONENT OF AVIAN IMMUNE DEFENSE

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ABSTRACT

The mucosa-associated lymphoid tissue (MALT) in birds plays a crucial role in maintaining their overall health and survival by serving as a frontline defense against pathogens that attempt to break the body's various mucosal surfaces. This article explores the structure, function and significance of MALT in avian species along with the unique adaptations that make birds resilient to a wide range of infectious agents. By understanding MALT's mechanisms of action in birds, it may prove very beneficial to enhance the avian health.



KEY WORDS: Mucosa, Lymphoid, Birds, Gut, Tissue

INTRODUCTION

Mucosa-associated lymphoid tissue (MALT) is a specialized part of the immune system that exists along the mucosal surfaces of various organs such as the respiratory, gastrointestinal and urogenital tracts. In birds, MALT holds prime importance because of the airborne nature of many pathogens and their susceptibility to causing countless infections. Thus, this article aims to provide a comprehensive analysis of MALT in birds, explaining its structural components, functional aspects and significance in avian health.

STRUCTURE OF MALT IN BIRDS

MALT in birds comprises several lymphoid structures that serve as the immune response in primary sites. The most prominent components of avian MALT are the bursa of Fabricius, gut-associated lymphoid tissue (GALT), and bronchus-associated lymphoid tissue (BALT). The bursa of Fabricius, located near the cloaca, plays a crucial role in B-cell development and maturation. GALT encompasses various lymphoid nodules, Peyer's patches, and ceacal tonsils along the intestinal tract, while BALT exists in the respiratory system to fight with airborne pathogens. Other type of MALT's distribution in different mucosal organs also ensures comprehensive protection against a wide range of pathogens.

TYPES OF MALT IN BIRDS

The mucosa-associated lymphoid tissue (MALT) constitutes as an essential part of the avian immune system serving as the first line of defense against pathogens that enter the body through mucosal surfaces. In birds, MALT is distributed in various regions of the respiratory, gastrointestinal, and urogenital tracts. Different types of MALT present in birds have different structures, organization and immune functions.

1. Gut-Associated Lymphoid Tissue (GALT):

GALT is the most extensively studied type of MALT in birds. It includes the various structures such as the tonsils, ceecal and colonic patches and the bursa of Fabricius. The bursa of Fabricius, is a unique avian organ which plays a critical role in B cell development and antibody production. Additionally, the ceecal and colonic patches contribute to the regulation of gut micro flora and immune responses.

2. Bronchus-Associated Lymphoid Tissue (BALT):

BALT is a crucial component of the avian respiratory defense system. It is primarily located in the bronchial walls and facilitates immune responses against airborne pathogens. BALT plays a key role in generating local and systemic immune responses to respiratory infections, including viral and bacterial agents.

3. Conjunctiva-Associated Lymphoid Tissue (CALT):

CALT is found in the conjunctival mucosa of the avian eye. It serves as a defense barrier against ocular pathogens and its organization allows for efficient immune surveillance of the eye and its surrounding tissues.

4. Cloacal-Associated Lymphoid Tissue (Cloacal MALT):

The cloacal MALT is present in the avian urogenital tract mainly in the cloaca region. Its role in immune defense against urogenital infections is crucial for maintaining reproductive health and overall well-being in birds.

5. Nasal-Associated Lymphoid Tissue (NALT):

NALT is located in the nasal cavity of birds and participates in the protection against inhaled pathogens. It shares functional similarities with mammalian nasal-associated lymphoid tissue and contributes to respiratory immune responses.

6. Other MALT-Related Structures:

This section covers additional avian MALT-related structures and their roles in the immune system. It includes the Harderian gland, specialized ceecal tissues and other lesser known MALT structures.

FUNCTIONS OF MALT IN BIRDS

The main function of MALT in birds is to detect and neutralize pathogens that attempt to break the mucosal barriers. MALT achieves this through a combination of innate and adaptive immune responses. The innate immune response involves the presence of specialized immune cells like macrophages, dendritic cells and natural killer cells. These cells serve as the first line of defense which rapidly identify and eliminate invading pathogens. The adaptive immune response is primarily mediated by B and T lymphocyte which provides long-lasting immunity upon exposure to specific antigens.

MALT ADAPTATIONS IN BIRDS

Avian MALT exhibits several unique adaptations that contribute to its effectiveness in fighting with the infections. One remarkable adaptation is the diversification of avian immunoglobulins. Birds possess five classes of immunoglobulins - IgM, IgY, IgA, IgD, and IgE. Out of these, IgY being the predominant antibody isotype in circulation. IgY serves as a functional analog of mammalian IgG and plays a crucial role in passive immunity transfer from mother to offspring through egg yolk.

Additionally, birds lack a true lymph node structure but have organized lymphoid aggregates known as lymphoid nodules, dispersed along the mucosal surfaces. This arrangement ensures rapid and effective immune responses to pathogens encountered at various entry points.

SIGNIFICANCE OF MALT IN AVIAN HEALTH

The significance of MALT in bird is of great importance as it directly impacts their survival and reproductive success. Pathogen exposure is unavoidable especially in the wild birds and MALT's ability to recognize and neutralize these threats reduces the risk of infections which could be harmful to individual bird or entire population. Furthermore MALT's role in the development of oral tolerance prevents harmful immune reactions also and thereby maintaining gut health and nutrient absorption.

CHALLENGES AND FUTURE PERSPECTIVES

Despite its importance, avian MALT can face challenges that compromise immune defenses. Environmental factors, stress, and changes in habitat can impact MALT function and consequently, the overall health of birds. Understanding these factors and their influence on MALT is crucial for conservation efforts and disease management especially in wild bird populations.

CONCLUSION

The mucosa-associated lymphoid tissue (MALT) in birds is an essential component of their immune defense system. Its unique adaptations and strategic distribution along mucosal surfaces equip the birds with the ability to fight with the diverse range of pathogens effectively. The study of MALT in birds

provides valuable insights into avian health, disease prevention and conservation strategies that can benefit both captive and wild avian populations.

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