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ABSTRACT

As the global prevalence of allergic asthma continues to rise, there is growing interest in exploring the relationship between the gut microbiome of the host and the ability to regulate allergic inflammation. This was prompted by several studies that commonly demonstrated a correlation between the presence of microbial-rich environments and lower levels of childhood allergic asthma. With constant antigen exposure, the mucosal immune system of the gut must regulate environmental stimuli, such as bacteria and food antigens, to sustain immune homeostasis. This is achieved by maintaining immune tolerance to support the gut mucosa's commensal microbiota and mounting a simultaneous, controlled immune response to eliminate pathogenic species. The immune patterns of the gut microbiome are thought to shape allergic asthma progression through its shared immunomodulatory role with the airway microbiome. Currently, studies are examining the role regulatory B cells play in allergic asthma through immune regulation. This review will discuss the relationship between regulatory B cells and the gut microbiome in maintaining immune homeostasis within the allergic disease framework.

INTRODUCTION

Allergic Inflammation

In patients with allergic asthma, inhalation of seemingly harmless allergens can trigger IgE-mediated inflammatory processes, resulting in an aberrant expansion of Cluster of Differentiation (CD) 4+ T cells and eosinophilia. This allergic inflammatory response is facilitated by the release of type-2 (Th2) cytokines, such as Interleukin (IL)-4 and IL-13, which further induces the maturation of IgE-producing B cells. Currently, studies are exploring the effect of gut dysbiosis, the imbalance of the gut microbiota, on the homeostatic capacity of allergic asthmatics.^{1,2}

Microbial Exposure & Health

The concurrent evolution of the host and the commensal microbiota has resulted in a dynamic symbiotic relationship.³ However, individuals are reducing their exposure to microbial-rich environments, which can be attributed to lifestyle changes in the areas of increased hygiene, industrialized food supply, and excessive antibiotic use. These factors, along with the shift towards smaller families in which there is decreased exposure to infections, have accompanied an increase in allergic disease prevalence.^{4,5}

THE GUT MICROBIOTA

General Function

Currently, it is thought the microbiome of the gut influences the host immune response, particularly the mediators involved in adaptive immunity. As the gut is constantly exposed to antigens, the gastrointestinal tract is considered

to be the largest immune interface to the environment. With such a high antigen load, the mucosal immune system of the gut must coordinate an elaborate balance between intestinal inflammatory responses to harmful pathogens and tolerogenic responses to commensal

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flora.⁶ As the first line of defense against the invasion of resident microbiota, the intestinal epithelium forms a physical barrier consisting of mucus, antimicrobial proteins, and immunoglobulin A (IgA), and tight-junction complex. With bacterial stimulation, intestinal epithelial cells can provide a non-specific immune response to foreign invaders by secreting various pro-inflammatory and anti-inflammatory cytokines.⁷ As the gastrointestinal tract plays a large role in immune function, imbalances in gut microbiome composition have been proposed to cause numerous human health conditions, ranging from obesity to Crohn's disease.⁸