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The Role of Innate and Adaptive Immunity in Staphylococcal Scalded Skin Syndrome: A Systematic Literature Review

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A B S T R A C T

The innate immune system provides immediate protection in the event of an infection, while the adapted immune system provides a more specific response and has the ability to remember specific pathogens, thereby protecting the body from similar infections in the future. This study aimed to present the role of innate and adaptive immunity in staphylococcal scalded skin syndrome (SSSS). The literature search process was carried out on various databases (PubMed, Web of Sciences, EMBASE, Cochrane Libraries, and Google Scholar) regarding the role of innate and adaptive immunity in staphylococcal scalded skin syndrome. This study follows the preferred reporting items for systematic reviews and meta-analysis (PRISMA) recommendations. In conclusion, a combination of innate and adapted immune systems work together to overcome SSSS infections. The innate immune system provides a rapid initial defense, while the adapted immune system provides a more specific response and the ability to form immune memory.

1. Introduction

Staphylococcal scalded skin syndrome (SSSS) is a skin disease caused by infection with the *Staphylococcus aureus* bacteria. This infection generally occurs in children, especially babies and toddlers, as well as in adults with weak immune systems. It is characterized by serious skin symptoms, including redness, blistering, and peeling, similar to burnt skin. The main cause of SSSS is the production of exfoliatin toxin by *Staphylococcus aureus*. This toxin causes damage to the bonds of the top layer of skin, which causes the skin to peel. Staphylococcal scalded skin syndrome (SSSS) has unique characteristics that involve the role of the immune system, including innate immunity and adaptive immunity. It is an interesting example of how the complex interaction between the innate immune system and the adapted immune system plays a role in the development, spread, and recovery from this serious skin disease. When the interaction between these two systems goes well, the body can deal with *Staphylococcus aureus* infections more effectively and speed up recovery. However, if there is an imbalance or disturbance in any of these immune systems, for example, a disturbance in the adapted immune response, SSSS infections can become more severe.[1-3]

The innate immune system is the body's initial defense system against pathogens that functions in a general, nonspecific manner. This involves components such as phagocytic cells (such as neutrophils and macrophages) which are tasked with absorbing and destroying pathogens. Additionally, the

innate immune system also involves antimicrobial proteins that help fight infections and inflammatory responses, which include inflammatory reactions such as redness, swelling, and increased blood flow to the infected area. This system is the body's first defense against infection and works quickly after exposure to pathogens. The adapted immune system is a more specific system involving T and B cells that are able to detect and respond to specific antigens with precision. T cells recognize antigens presented by other cells, such as dendritic cells, and can respond in ways such as killing infected cells directly or stimulating a cellular immune response. B cells produce antibodies that can bind to antigens and help in fighting pathogens. Antibodies can also inactivate pathogens and help activate the innate immune system to clear infections. The combination of these two systems provides powerful protection against a variety of pathogens. The innate immune system provides immediate protection in the event of an infection, while the adapted immune system provides a more specific response and has the ability to remember specific pathogens, thereby protecting the body from similar infections in the future.[4-6] This study aimed to present the role of innate and adaptive immunity in staphylococcal scalded skin syndrome (SSSS).

2. Methods

The literature search process was carried out on various databases (PubMed, Web of Sciences, EMBASE, Cochrane Libraries, and Google Scholar) regarding the role of innate and adaptive immunity in staphylococcal scalded skin syndrome. The search was performed using the terms: (1) "innate" OR "adaptive" OR "immunity" OR "staphylococcal scalded skin syndrome" AND (2) "staphylococcal scalded skin syndrome" OR "immunity." The literature is limited to preclinical studies and published in English. The literature selection criteria are articles published in the form of original articles, an experimental study about the role of innate and adaptive immunity in staphylococcal scalded skin syndrome, studies were conducted in a timeframe from 2013-2023, and the main outcome was the role innate and adaptive immunity in staphylococcal scalded skin syndrome. Meanwhile, the exclusion criteria of the study were not related to the role of innate and adaptive immunity in staphylococcal scalded skin syndrome and duplication of publications. This study follows the preferred reporting items for systematic reviews and meta-analysis (PRISMA) recommendations.

3. Results and Discussion

Innate immunity

The skin and mucous membranes are an important part of the innate immune system because they serve as the first physical barriers that prevent pathogens from entering the body. This is what is often referred to as the "first line of defense" in the immune system. The skin is the largest organ in the human body and functions as the main physical barrier that protects the body from external threats, including pathogens such as bacteria, viruses, and fungi. The outer layer of skin, known as the epidermis, has cells that are tightly packed together and produce special proteins such as keratin. This creates a strong, waterproof layer that is difficult for pathogens to penetrate. Immune cells in the skin, such as Langerhans cells, also play a role in detecting and responding to pathogens that try to penetrate the skin layers. Mucous membranes are layers of wet tissue that line areas such as the nose, mouth, throat, intestines, and urinary tract. It is included in the first physical barrier in the body. The mucous membrane produces mucus, which functions to capture and eliminate pathogens that may enter through the oral cavity, nose, or other organs. Mucous membranes also have cells that produce antimicrobial proteins and IgA (special antibodies that help protect mucous surfaces from infection). The combination of skin and mucous membranes helps protect the body from pathogen invasion. They work together with other innate immune systems, such as phagocytic cells and antimicrobial proteins, to prevent pathogens from entering the body. If the pathogen manages to get past these defenses, the innate immune system will become more active to fight the infection.[7-9]

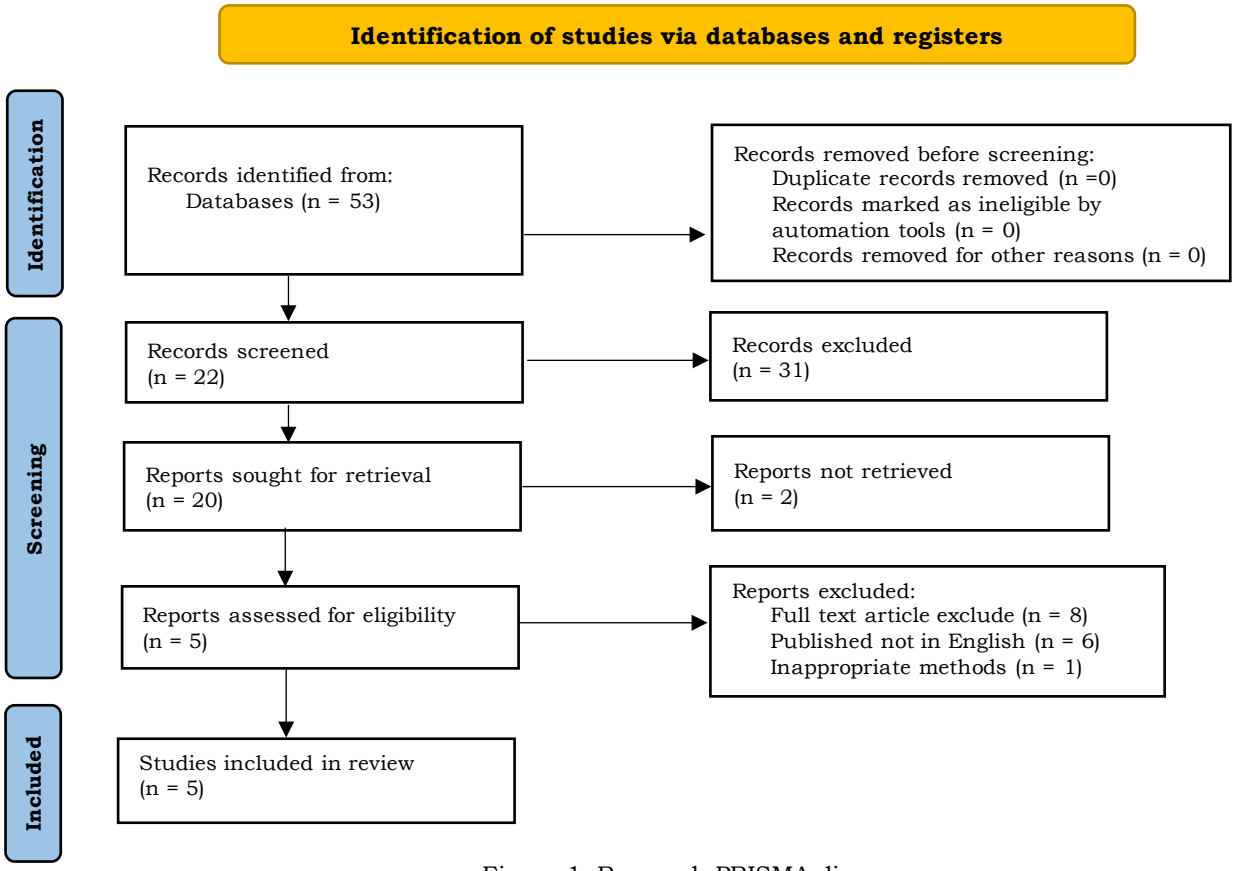

Figure 1. Research PRISMA diagram.

Phagocytic cells are an important component in the body's initial defense against pathogens. Neutrophils are the most abundant type of white blood cell in the human body and are a major component of the innate immune system. They have the ability to move towards infected or injured areas of the body. Neutrophils engulf (phagocytose) bacteria, viruses, and other particles that the body considers foreign. After ingesting a pathogen, neutrophils respond by secreting digestive enzymes and chemicals that help destroy and digest the pathogen. Macrophages are larger and more specialized phagocytic cells found in various body tissues. They have an important role in clearing dead cell debris, pathogens, and other foreign materials from body tissues. Macrophages also play a role in stimulating more specific immune responses by presenting pathogen fragments to T cells in the adapted immune system. The ability of phagocytic cells to engulf, digest, and destroy pathogens is an important part of the innate immune response referred to as "phagocytosis." This is one of the initial defense mechanisms that helps protect the body from infection. In addition, phagocytic cells also play a role in regulating inflammatory responses and contribute to the healing process after infection or injury.[10-12]

The innate immune system also involves the production of antimicrobial proteins, such as defensins and lysozyme, which have the ability to kill or inhibit the growth of pathogens. This is one of the additional defense mechanisms used by the body to fight the invasion of foreign microorganisms. Defensins are a group of antimicrobial proteins found in various tissues and body fluids, including saliva, tears, and mucus. This protein works by disrupting the integrity of the cell membranes of microorganisms, including bacteria, fungi, and viruses. They can create tiny holes in the pathogen's cell membrane, resulting in leakage and death of the pathogen. Defensins may also play a role in regulating inflammatory responses and stimulating other immune cells to respond to

infections. Lysozyme is an enzyme found in tears, saliva, mucus, and other body secretions. This enzyme plays a role in destroying bacterial cell walls by breaking down peptidoglycan, which is the main component of bacterial cell walls. Lysozyme helps inhibit bacterial growth and plays an important role in maintaining healthy mucous membranes and mucous membranes.[13,14]

The inflammatory response is an important mechanism used by the body to fight infections and respond to injury or tissue damage. Inflammatory responses can be triggered by a variety of factors, including infection by pathogens such as bacteria or viruses, physical injury, allergies, or even autoimmune reactions in which the immune system attacks the body's own cells for no apparent reason. Redness (rubor) occurs due to increased blood flow to the infected or injured area. Increased blood flow leads to an increase in local temperature and redness of the skin. Swelling (tumor) caused by immune cells and inflammatory mediators such as histamine can cause increased permeability of blood vessels in the affected area, resulting in fluid and blood cells moving into the tissue. This causes swelling and edema formation. Heat (calor) occurs due to increased blood flow, and the infected or injured area can feel warmer or hotter than the surrounding area. Pain (dolor) occurs because inflammation stimulates the nerves in the infected or injured area. This aims to avoid overusing the area, thereby allowing healing. The inflammatory response is an important mechanism in protecting the body from infection, and in many cases, it is a sign that the immune system is working to respond to a threat.[15]

Adaptive immunity

The adapted immune system is an important component of the immune system that has the ability to respond to antigens with precision and effectiveness. T cells are a type of immune cell that recognizes antigens presented by other cells, such as dendritic cells or macrophage cells. There are two main categories of T cells: cytotoxic T cells (CD8+) and helper T cells (CD4+). Cytotoxic T cells have the ability to kill cells infected by pathogens, including body cells that have been replicated by viruses or cells infected with bacteria. Helper T cells help coordinate the immune response by stimulating other cells, such as B cells and cytotoxic T cells. They can also stimulate cellular and humoral immune responses.[16,17]

B cells are immune cells that have an important role in fighting infections and producing antibodies. When B cells recognize the appropriate antigen, they develop into plasma cells that produce antibodies specific to that antigen. Antibodies, also known as immunoglobulins (Ig), are proteins that can bind strongly to antigens and help inactivate pathogens. They can inhibit the growth and movement of pathogens, making it easier for the innate immune system to clear infections. Activated B cells can also form immune memory, which allows the body to respond more quickly if exposed to the same antigen in the future. T and B cells work together in an adapted immune response to protect the body from pathogens and trigger highly specific responses to certain antigens. Their role in the formation of immune memory is also important as it allows the body to maintain long-term immunity against previously identified pathogens. This is what makes the adapted immune system so efficient in protecting the body from various infections.[18-20]

4. Conclusion

A combination of innate and adapted immune systems work together to overcome SSSS infections. The innate immune system provides a rapid initial defense, while the adapted immune system provides a more specific response and the ability to form immune memory.

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