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Studies on correlation between aquatic diseases and immunity

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Abstract

Aquatic diseases are mostly caused by waterborne pathogens. The animals and human beings residing on lands are prone to diseases caused by contaminated water. The pathogens generating the immune responses in the human body have the capability to destroy the host defence mechanisms. The defending strategies taken by the immune system cannot always have the ability to restrict the entry of pathogens. Hence, the immune memory cells get activated and defend to a limit. The death toll due to evolving aquatic diseases is rising and hence certain preventive measures are to be incorporated. Vaccination for diseases has been started as a result of developing disease-free areas. This article puts light on the correlation between aquatic diseases and the human immune response towards the disease.

Keywords: Aquatic Diseases; Contaminated Water; Human Immunity; Immune System; Vaccine

1. Introduction

Human beings and terrestrial animals residing on land can be affected by aquatic diseases predominantly caused by pathogens. Nevertheless, the diseases caused by these organisms possess some insights into developing certain immunological outcomes in animals [2]. The diseases are usually caused by bacteria, fungi, protozoa, and viruses which survive under different aquatic and terrestrial conditions [5]. Such microorganisms can cause the involvement of various diseases and generate host stress. In this article, we will study several aquatic diseases and their outcomes. Additionally, the involvement of immunity in fighting the disease will also be discussed. Overall, the correlation based on the host-pathogen interaction and their probable outcomes will be identified. This study will put light on the antimicrobial defences in the host body. Such a mechanism in defending the pathogen will target generating antiviral immunity [3]. The host immune defence mechanism will be analyzed holding the tolerance between microbial and viral infections. Lastly, the prevention and control mechanism of aquatic diseases will be discussed.

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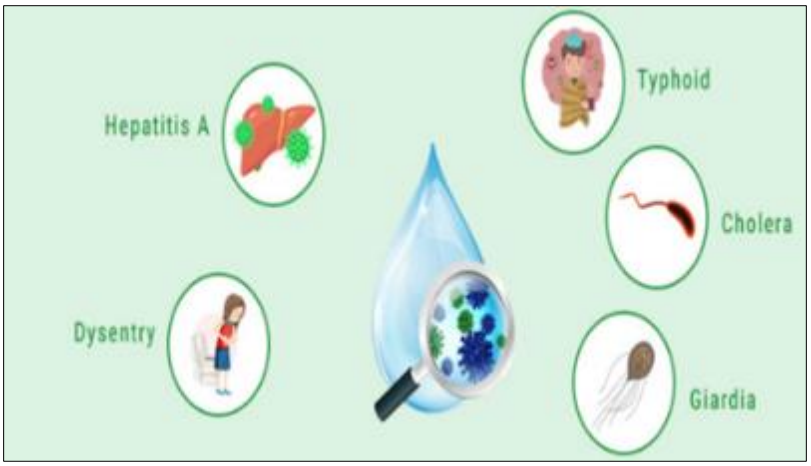

Figure 1 Aquatic Diseases

Objectives

The research article casts to establish the key objectives.

- To analyze the various aquatic diseases leading to severe consequences.
- To discuss the probable outcomes of the infections caused by the aquatic pathogens.
- To portray the role of immunity in defending the diseases caused by microorganisms.
- To research the correlation between the diseases and the host defence mechanisms.
- To assess the roles of anti-pathogenic immunity to prevent probable aquatic diseases.

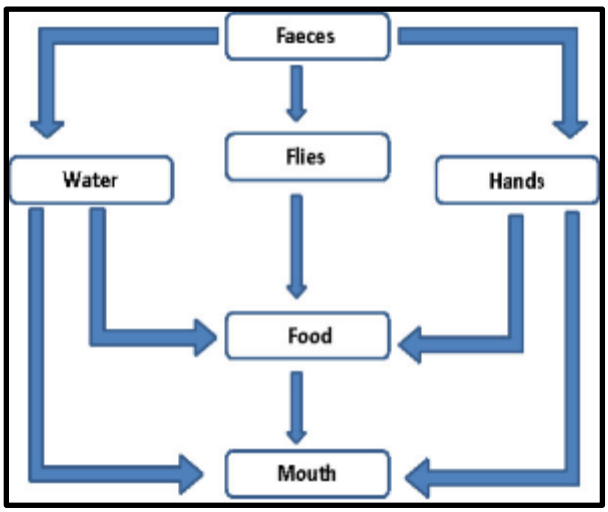

Figure 2 Mode of transmission of aquatic diseases

2. Methodology

Aquatic diseases or infections of the animals residing in water bodies can transmit the disease to humans. e crustaceans and mollusks culturing in huge productivity levels [8]. Waterborne- diseases caused by pathogens can lead to several health issues and human beings are susceptible to infections. The methods of developing immunity in relation to pathogens are emerging in the developing era [1]. Therefore, the initiatives to restrict the spread of communicable diseases will be portrayed. In this study, the techniques of evaluating water-borne diseases in humans are analyzed based on the targeted human beings for their source of growth.

2.1. Aquatic diseases

The diseases caused by the water borne-organisms include clean water and contaminated water diseases [4]. Let us have a view of the diseases caused by them.

2.2. Clean water

Clean water is generally free from any contaminants like materials, radioactive materials, toxins, gasses, or oils.

2.3. Contaminated water

The contaminated water usually involves human waste, sewage, animal waste, and other chemicals and pathogens [7]. This unclean water has the tendency to transmit diseases like Cholera, Dysentery, Typhoid, Polio, Diarrhea, and hepatitis A. These diseases if left untreated can lead to life risks. Globally, almost 15% of patients develop water-borne diseases during their hospital stay [9]. The diseases related to water are shown in Table 1.

Table 1 Diseases related to water

Water-borne diseases	Pathogens	Symptoms
Cholera	Vibrio cholerae	Rice-water stools Vomiting Thrust Leg cramps
Dysentery	Entamoeba histolytica	Loose motion Nausea vomiting
Typhoid	Salmonella typhi	Fever Headache Stomach pain
Diarrhea	Clostridium sp.	Bloody stools Fever and chills Vomiting
Food poisoning	E. coli sp.	Vomiting Loose motion Nausea
Hepatitis A	Hepatitis A Virus	Weakness Nausea vomiting Dark urine
Ascariasis	Roundworm	Abdominal pain Nausea vomiting
Polio	Poliovirus	Stiffness of neck and pain in limbs Paralysis Fatigue

The bacteria and virus are prone to causing diseases when ingested. The animal, feces are transmitted through the oral-fecal route of transmission. These diseases are transmitted through the process of water contamination.

3. Human immunity

The diseases caused by water-borne pathogens in the human body have the effect of generating human immunity in defence mechanisms [10]. Contaminated water and sanitation which are generally poor in some areas of the country are leading to the outcome of diseases in human beings. The complex system of immune mechanisms in humans has the criteria for developing new mechanisms of defending strategies against infectious attacks [6]. Generally, the immune system keeps a record of the diseases caused to the body in recent times and develops the memory cells in the body. These memory cells can therefore destroy the pathogens in the body if attacked in the future. The human immune system responds to pathogens with the general symptom causing fever. The parts of the immune system responding

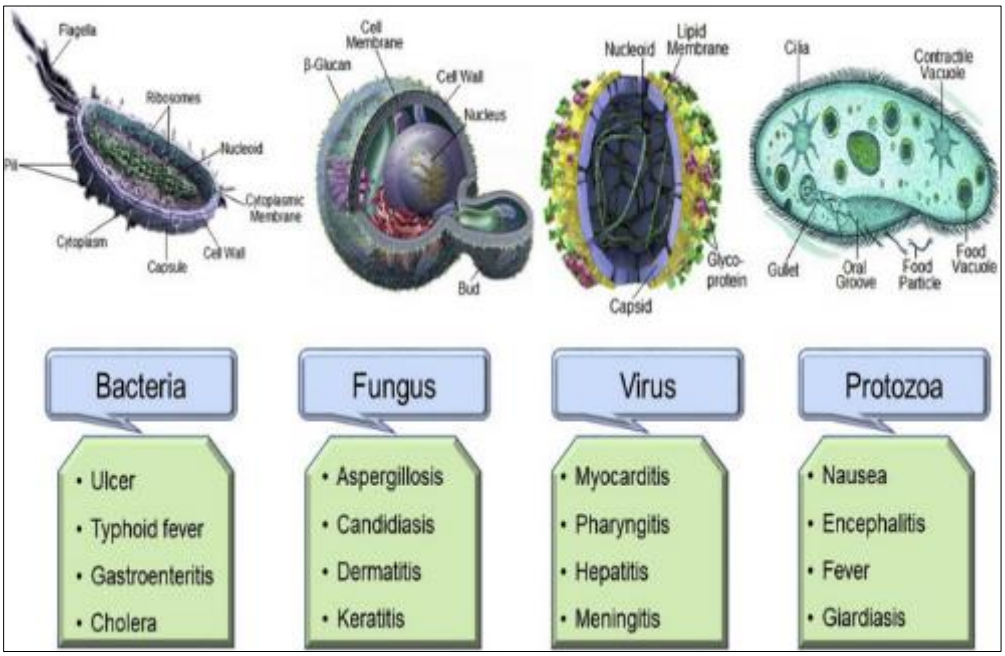

Figure 3 Water-borne pathogens

4. Diarrhea and human immunity

Diarrhea is a common disease caused in populated countries due to the ingestion of contaminated food. The colon and intestine of the affected person get triggered and process loose motion [13]. The symptoms arise within 1-2 days of the initial infection of the pathogen. Generally, the body gets dehydrated and the person experiences nausea and vomiting. The circular and humoral immune responses circulating in the body gets transmits the information and the probable symptoms of the diseases seen in the patient [11]. The host immune system imitates the cytokine response to the body and prevents further loss of body fluids from the body.

It is estimated that almost 829,000 people die due to diarrhea every year globally [21]. Children aged 5 years or above are prone to diarrheal diseases. Over 220 million people in the year 2017 needed treatment for the disease schistosomiasis [21]. In many parts of the world, diarrhea is prevalent due to the weak immune mechanism. Hence, building immunity to diarrheal diseases needs to be manifested as such.

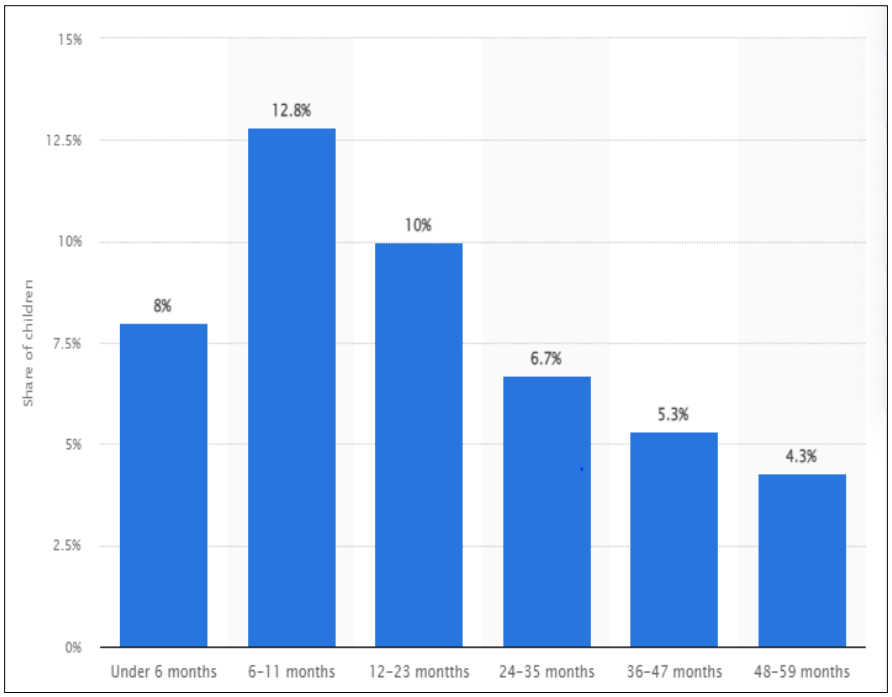

Figure 4 Children under 5 years with diarrheal symptoms

5. Typhoid and Human Immunity

Typhoid fever is caused due to the action of bacteria affecting the various organs of the body. It is highly contagious and can be transmitted through water [16]. The person suffering from typhoid fever releases the pathogens with their stools and urine. The contaminated water when coming in contact with a healthy person causes the transmission of typhoid fever. In general, the disease is less affecting until treated \under a certain time period and proper sanitation is accessed.

The immune mechanisms in eliminating the disease are generally responding to a high fever persisting for a week, nausea and vomiting are the initial symptoms of the disease [14]. Extreme tiredness and fatigue are caused due to the disease. The immune system in response to the detection of the pathogen generates the neutrophils and monocytes in the immune cells. Several defence strategies are developed by the pathogens in defending the macrophages [20]. This initiates the whole process of the infection leading toward more insidious development.

6. Defence mechanisms in the immune system

The human body reflects three primary lines of defence mechanisms which is the first line of defence mechanism to fight against foreign materials such as viruses, fungi, bacteria, and protozoans [12]. The other lines of defence mechanisms include physical and chemical barriers of the defence system. The other two lines of defence include non-specific innate responses and specific adaptive responses [15]. The physical barriers include the skin, mucosa, respiratory tract, and digestive tract of the human body. However, the components that are released from the various body parts trap the pathogens and restrict the entry of the pathogens into the body. The acidic fluids in the intestine of the human body have the capability of destroying most of the pathogens and provide the barrier against the first line of \defence in the chemical barriers.

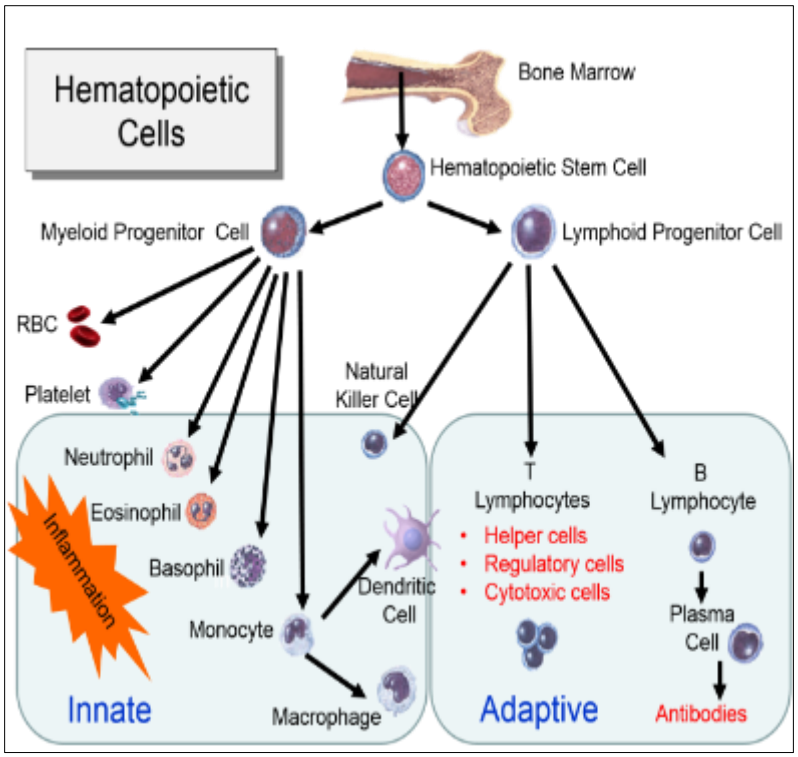

Figure 5 Defence mechanisms in the immune system

The second line of defence is triggered when the first line of defence fails on terminating the entry of the pathogen in the body [17]. Therefore, the defence mechanisms of the second line of defence are generally the involvement of the phagocytes which phagocytosis the pathogens. They are initially categorized as macrophages and neutrophils [19]. The digestive enzymes available in the second line of defence mechanism help the cells to digest the pathogen entering the body. Usually, the macrophages digest the pathogens and release the materials for out casting the pathogens and building memory cells in the body.

The adaptive responses in the immune system are the B lymphocytes and the T lymphocytes. Both cells have the access to generate the memory cells in the Immune system [18]. The B- cells are generated in response to the known pathogen in the human body. Additionally, the function of T- cells in the immune system is considered the greatest, as the antigen-antibody complex is built up in the bloodstream and the action of destroying the pathogens is carried out. Later on, the T-cells mature to form the memory T- cells and gain the ability to destroy the same pathogen if attacked a second time.

6.1. Vaccines and Immune response

The immune responses are triggered by the action of the vaccine development. It triggers the immune response in the body [26]. The macrophage which is the primary defence mechanisms of the immune cells are activated which engulfs the bacterial cells and eliminates the bacteria in response to the vaccine [4]. Furthermore, memory cells are generated which helps in the recognition of a similar pathogen in near future.

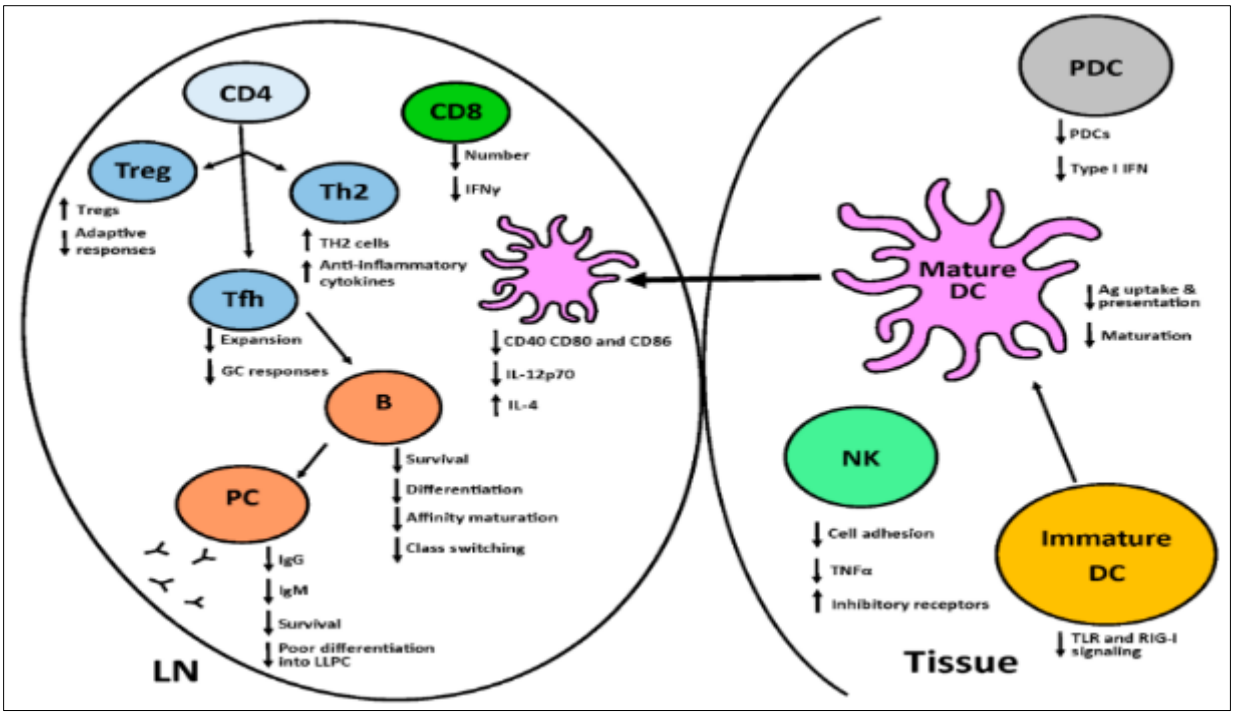

Figure 6 Vaccines and Immune response

7. Prevention and control

Water-borne diseases are generally complicating the immune system and developing various symptoms and complications in our day-to-day life [5]. The office of the chief medical officer of Health has incorporated some measures to prevent and eliminate waterborne diseases in the areas concerning health [22]. The following table 2 portrays the prevention strategies incorporated to facilitate the drive in eliminating the illness.

Table 2 Prevention strategies

Steps of prevention	Objectives
Practicing good personal hygiene	Washing hands thoroughly before and after using the toilet Washing hands before and after eating food [24] Washing hands after tending pets or animals
Possessing food safety precautions	Washing raw vegetables before eating Drinking pasteurized milk products Meat and poultry products are cooked before eating
Drinking treated water	Swallowing water from swimming pools and other water bodies should be avoided Drinking treated water and using water filters for clean water drinking
Providing Vaccination	

8. Problem statement

The diseases arising due to the evading pathogens in water bodies are an issue of concern for the public. Human beings have access to water and food available at these places [23]. The inadequate development of sanitation and purification facilities in public areas has led to emerging diseases in the context of the water transmitted. In general, the areas with industrialization and emerging industries releases contaminated water from the factories adds to the contamination of the water bodies and leads to the spread of various diseases [25]. The issue Therefore, this issue is of great consideration and has to be looked into.

9. Conclusion

The emerging aquatic diseases and their mechanisms of invading the human body is causing havoc in the human population. The strategies for eliminating diseases from entering the host body are developing. The diseases such as diarrheal, dysentery, typhoid, cholera, food poisoning, and hepatitis A are deteriorating the host mechanisms of defence against the disease. Therefore, the responses of the immune system generating the first line of defence in evading pathogens usually fail due to the evolution of viruses and bacteria. This method later on calls for the second line of defence mechanism which involves the macrophages in destroying the pathogens from entering the body further. The development of science and technology in developing strategies for preventing diseases is advancing. Hence, the cholera vaccine is 85% effective in preventing the disease during the first six months of injecting the vaccine. Therefore, various prevention and control mechanisms are incorporated by the government, and development in the production of vaccines is growing to prevent the spread of aquatic diseases.

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