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Pathogenic Bacteria and Medical Treatment

Mo. Ahamad Khan Khan*

Associate Professor Department of Biochemistry, Institute of SRGI and Social Medicine Bangladesh

Corresponding author:
Mo. Ahamad Khan Khan

sriw@murwani.in

Associate Professor Department of Biochemistry, Institute of SRGI and Social Medicine Bangladesh

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Abstract

Pathogenic bacteria are bacteria that can cause disease [1]. This article focuses on the bacteria that are pathogenic to humans. Most species of bacteria are harmless and are often beneficial but others can cause infectious diseases. The number of these pathogenic species in humans is estimated to be fewer than a hundred. By contrast, several thousand species are part of the gut flora present in the digestive tract.

The body is continually exposed to many species of bacteria, including beneficial commensals, which grow on the skin and mucous membranes, and saprophytes, which grow mainly in the soil and in decaying matter. The blood and tissue fluids contain nutrients sufficient to sustain the growth of many bacteria. The body has defence mechanisms that enable it to resist microbial invasion of its tissues and give it a natural immunity or innate resistance against many microorganisms [2].

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Introduction

Pathogenic bacteria are specially adapted and endowed with mechanisms for overcoming the normal body defences, and can invade parts of the body, such as the blood, where bacteria are not normally found. Some pathogens invade only the surface epithelium, skin or mucous membrane, but many travel more deeply, spreading through the tissues and disseminating by the lymphatic and blood streams. In some rare cases a pathogenic microbe can infect an entirely healthy person, but infection usually occurs only if the body's defence mechanisms are damaged by some local trauma or an underlying debilitating disease, such as wounding, intoxication, chilling, fatigue, and malnutrition. In many cases, it is important to differentiate infection and colonization, which is when the bacteria are causing little or no harm. Caused by Mycobacterium tuberculosis bacteria, one of the diseases with the highest disease burden is tuberculosis, which killed 1.4 million people in 2019, mostly in sub-Saharan Africa [3]. Pathogenic bacteria contribute to other globally important diseases, such as pneumonia, which can be caused by bacteria such as Streptococcus, Pneumococcus and Pseudomonas, and foodborne illnesses, which can be caused by bacteria such as Shigella, Campylobacter, and Salmonella. Pathogenic bacteria also cause infections such as tetanus, typhoid fever, diphtheria, syphilis, and leprosy. Pathogenic bacteria are also the cause of high infant mortality rates in developing countries. Most pathogenic bacteria can be grown in cultures and identified by Gram stain and other methods. Bacteria grown in this way are often tested to find which antibiotics will be an effective treatment for the infection. For hitherto unknown pathogens, Koch's postulates are the standard to establish a causative relationship between a microbe and a disease [4].

Each species has specific effect and causes symptoms in people who are infected. Some people who are infected with a pathogenic bacteria do not have symptoms. Immunocompromised individuals are more susceptible to pathogenic bacteria [5].

Some pathogenic bacteria cause disease under certain conditions, such as entry through the skin via a cut, through sexual activity or through a compromised immune function.[citation needed]An abscess caused by opportunistic S. aureus bacteria.

Some species of Streptococcus and Staphylococcus are part of the normal skin microbiota and typically reside on healthy skin or in the nasopharangeal region [6]. Yet these species can potentially initiate skin infections. Streptoccal infections include sepsis, pneumonia, and meningitis. These infections can become serious creating a systemic inflammatory response resulting in massive vasodilation, shock, and death. Other bacteria are opportunistic pathogens and cause disease mainly in people with immunosuppression or cystic fibrosis. Examples of these opportunistic pathogens include Pseudomonas aeruginosa, Burkholderia cenocepacia, and Mycobacterium avium [7].

Treatment

Bacterial infections may be treated with antibiotics, which are classified as bacteriocidal if they kill bacteria or bacteriostatic if they just prevent bacterial growth. There are many types of antibiotics and each class inhibits a process that is different in the pathogen from that found in the host. For example, the antibiotics chloramphenicol and tetracyclin inhibit the bacterial ribosome but not the structurally different eukaryotic ribosome, so they exhibit selective toxicity. Antibiotics are used both in treating human disease and in intensive farming to promote animal growth. Both uses may be contributing to the rapid development of antibiotic resistance in bacterial populations. Phage therapy, using bacteriophages can also be used to treat certain bacterial infections [8].

In summary, this Frontiers Research Topic includes 21 articles, and 146 authors from Austria, Canada, China, Denmark, Germany, Ireland, Japan, Portugal, South Korea, United Kingdom, and United States. It provides an overview of recent discoveries in resurgence, pathogenesis, and control strategies of the human serious foodborne pathogenic bacteria, and supports the urgent need for improving food safety and public health, particularly in globalization background [9]. The information presented in the articles not only underscores future research areas and needs for scientists, but also benefits governments, food producers, food suppliers, and food consumers to work together toward eliminating and controlling pathogen persistence in food and resistant infections in humans.

Medical solution

Endotoxin is omnipresent in the environment. It is found in most deionized-water lines in hospitals and laboratories, for example, and affects virtually every biologic assay system ever examined. It tends to be a scapegoat for all biologic problems encountered in the laboratory, and, many times, this reputation is deserved. Because of its pyrogenic and destructive properties, extreme care must be taken to avoid exposing patients to medical solutions containing endotoxin [10]. Even though all supplies should be sterile, solutions for intravenous administration can become contaminated with endotoxin-containing bacteria after sterilization as a result of improper handling. Furthermore, water used in the preparation of such solutions must be filtered through ion exchange resins to remove endotoxin, because it is not removed by either autoclave sterilization or filtration through bacterial membrane filters. If endotoxin-containing solutions were used in such medical procedures as renal dialysis, heart bypass machines, blood transfusions, or surgical lavage, the patient would suffer immediate fever accompanied by a rapid and possibly lethal alterations in blood pressure.

Conclusion

Both animals and bacteria require iron for metabolism and growth, and the control of this limited resource is often used as a tactic in the conflict between pathogen and host. Animals have evolved mechanisms of "withholding" iron from tissue fluids in an attempt to limit the growth of invading bacteria. Although blood is a rich source of iron, this iron is not readily available to bacteria since it is not free in solution. Most of the iron in blood is bound either to hemoglobin in erythrocytes or to transferrin in plasma. Similarly, the iron in milk and other secretions (e.g., tears, saliva, bronchial mucus, bile, and gastrointestinal fluid) is bound to lactoferrin. Some bacteria express receptors for eukoyotic iron-binding proteins (e.g., transferrin-binding outer membrane proteins on the surface of Neisserira spp.). Via these specialized receptors iron acquisition is facilitated, providing the esssential element for bacterial growth.

Other bacteria have evolved elaborate mechanisms to extract the iron from host proteins (**Figures 6 and 7**). Siderophores are substances produced by many bacteria (and some plants) to capture iron from the host. The absence of iron triggers transcription of the genes coding for the enzymes that synthesize siderophores, as well as for a set of surface protein receptors that recognize siderophores carrying bound iron. The binding constants of the siderophores for iron are so high that even iron bound to transferrin and lactoferrin is confiscated and taken up by the bacterial cells. An example of a bacterial siderophore is enterochelin, which is produced by Escherichia and Salmonella species. Classic experiments have demonstrated that Salmonella mutants that have lost the capacity to synthesize enterochelin lose virulence in an assay of lethality in mice. Injection of purified enterochelin along with the Salmonella mutants restores virulence to the bacteria. Therefore, siderophore production by many pathogenic bacteria is considered an important virulence mechanism.

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