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Emerging Infectious Diseases

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Abstract

A gram-positive, facultatively anaerobic bacteria called Streptococcus pneumoniae is capable of inflicting serious illnesses such pneumonia, meningitis, septicemia, and middle ear infections. It is also one of the main pathogens causing bacterial conjunctivitis and keratitis. Although there are two pneumococcal vaccines available, they only partially protect against eye infections and non-ocular illnesses. Numerous virulence factors present in this infection cause havoc on the conjunctiva, cornea, and intraocular system. Evading the host complement system is made easier by polysaccharide capsules. A cytolysin that depends on cholesterol and functions as a pore-forming toxin is called pneumolysin (PLY). Neuraminidases make the pneumococcus visible to cell surface receptors, which aids in colonisation and adhesion. The severity of the disease and immune system evasion are both influenced by zinc metalloproteinases. The burden of infectious illnesses on global public health and societal economic stability is considerable. They have long been among the main causes of death and disability and have posed increasing problems for both human advancement and health security. The threat posed by infectious diseases is further deepened by the continued emergence of new, unrecognized, and old infectious disease epidemics of global impact. At least 30 new infectious diseases that harm people have evolved in the past 35 years; the majority of these diseases are zoonotic, and research has revealed that the origins of these diseases strongly connect with socioeconomic, environmental, and ecological factors. There is concern that infectious diseases may spread as a result of these factors continuing to rise and bringing more people into touch with disease-causing bacteria.

Keywords: Environmental; Pneumococcus

Introduction

Several serious infections in various body sites are brought on by the gram-positive, facultatively anaerobic pathogen streptococcus pneumoniae. Healthy adults frequently have pneumoniae populate their nasopharynx. Despite the fact that many healthy adults carry this bacteria without showing any symptoms, it is a major contributor to serious illnesses such meningitis, pneumonia, septicemia, and middle ear infections [1]. Together with coagulase-negative Staphylococcus, Staphylococcus aureus, and Pseudomonas aeruginosa, pneumoniae continues to be one of the major causes of infectious disorders of the ocular surface such as keratitis and conjunctivitis. The review that follows will discuss (A) the three pneumococcal infectious illnesses of the eye-conjunctivitis, keratitis, and endophthalmitis-as well as (B) the part that particular pneumococcal virulence factors play in the pathogenesis of each infection. S. Pneumolysin, neuraminidases, zinc metalloproteinases, a polysaccharide capsule, and other virulence factors all contribute to the severity of ocular infections in pneumoniae [2]. By lowering IgG and C-reactive protein binding, the pneumococcal capsule helps the infection evade the host complement system. Since S. pneumoniae doesn't trigger the complement system, neutrophil phagocytosis is less likely. By focusing on the capsule, both of the pneumococcal vaccines that are currently licenced for use protect against the most prevalent pneumococcal serotypes involved in pneumonia and invasive illnesses, except for nonencapsulated S. Most cases of conjunctivitis are brought on by pneumoniae. NESp is divided into two categories. Group I possesses the capsule polysaccharide biosynthetic (cps) gene, but due to a mutation or deletion, does not synthesise capsule. The putative adhesin pspK and/or novel oligopeptide binding proteins aliC and aliD are present in Group II in place of the cps genes. It has been determined that conjunctivitis strains are part of a subset branch of Group II that lacks pspK but harbours aliC and aliD [3].

S. was in vitro cultured to stationary phase. Self-lysis occurs naturally in pneumoniae. The primary autolysin of S is LytA. Pneumoniae has been identified as a significant virulence factor in a number of illness models. Three theories have been put out as to how LytA contributes to pneumococcal pathogenicity. Any ailment with distinct indications and symptoms that affects the proper operation of a body organ and system, of the psyche, or of the organism as a whole is referred to as a "disease [4]." Impairment of organ or system function can be caused by intrinsic or external factors. Intrinsic factors originate from inside the host and may be brought on by the genetic make-up of an organism or by any affliction that prevents an organ or system from functioning normally. One such instance is the genetic disorder known as sickle cell anaemia, which is characterised by pain that progresses to organ damage due to a defect in the red blood cells haemoglobin [5]. This defect results from the change of a single base, thymine, to adenine in a gene those codes for one of the protein chains of haemoglobin. When a host contacts an agent from outside, extrinsic factors can access the host's system. As an illustration, consider the bite of a mosquito of the Anopheles species that spreads the parasite Plasmodium falciparum, which causes malaria. An infectious disease is one that develops when a foreign agent invades a host and causes injury to or impairs the normal operation of the host's organs or systems. Microorganisms typically cause infectious disorders [6]. The kind and severity of harm their causal agents cause to organs and systems when they infiltrate a host is what gives them their significance. Most entry points into the host are through the nose, mouth, eyes, genital openings, and skin. The synthesis and release of toxins or

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enzymes that impair the normal operation of organs and/or systems, as well as the intracellular growth and metabolic processes of infectious organisms, are the main causes of tissue damage [7]. These products may be dispersed, harm other organs and/or systems, or perform in a way that allows the pathogen to infiltrate other organs and systems as consequences. Infection-causing pathogens are naturally fought off and destroyed by the host's complex immune system. When the immune system fails to eradicate harmful infectious agents, infectious illness occurs or arises [8]. Consequently, all infectious diseases develop over time in a certain population and within a specific setting or environment. Methods for battling, preventing, and managing diseases are established by comprehending their dynamics and how they are spread [9]. Nevertheless, certain pathogens are able to develop the necessary skills to re-infect their original or new hosts, typically in progressively dangerous quantities, even after they appear to have been eliminated and have gone into slumber. Pneumococcus must be able to colonise the nasopharynx before it can result in systemic illness. S. Three neuraminidases (Nan), NanA, NanB, and NanC are produced by pneumoniae and aid in colonisation and adhesion. Pneumococcus is made available to cell surface receptors by the sialidases NanA and NanB. Without the proper cell surface receptors being exposed by the neuraminidases, adhesion and colonisation are less likely to occur, which makes the establishment of disease states less likely as well. Once an infection has spread throughout the body, S. Hyaluronate lyase has a role in pneumoniae's ability to spread [10].

Infectious Diseases [11]

Conjunctivitis

While viruses and allergens are the more frequent culprits, bacteria only account for about 1.35% of conjunctival infections. The direct and indirect expenses of treating bacterial conjunctivitis in the United States are expected to be over $500,000,000 despite the fact that they are less frequent. As well as redness, edoema, purulent discharge, and occasionally light sensitivity, typical infections are also characterised by these symptoms. The staphylococcal species are the most frequent bacterial pathogens isolated from conjunctival infections in adults; however, Haemophilus influenzae S. is more frequently the culprit in conjunctivitis in children. Moraxella catarrhalis with Pneumocystis pneumoniae. Hyperacute bacterial conjunctivitis, which manifests as eyelid swelling, discomfort, and purulent discharge, is frequently caused by Neisseria gonorrhoeae. Contact lens misuse and tainted cosmetics can result in pneumococcal conjunctival infections. Despite not being required, pneumococcal neuraminidase activity increases during conjunctivitis when capsule is not present. A capsule-deficient mutant really displayed noticeably greater neuraminidase activity than the original strain in a rabbit conjunctivitis model at 3 and 12 hours after infection. Additionally, after 6 hours of contact to ocular epithelial cells that express more mucin, nonencapsulated pneumococcal conjunctivitis isolates produce noticeably increased neuraminidase activity.

Additionally, NESp conjunctivitis strains and encapsulated strains release a zinc metalloproteinase (ZmpC) that increases bacterial internalisation by removing certain mucins from the epithelium.

Keratitis

The scarring of the cornea brought on by pneumococcus keratitis may result in a permanent loss of vision. Infections are frequently brought on by incorrect contact lens use, trauma, or prior ocular surgery. S. Along with Pseudomonas aeruginosa and Staphylococcus aureus, pneumoniae has been identified as one of the main causes of bacterial keratitis. A 5-year review of bacterial keratitis cases in one institution revealed S. P. pneumoniae caused 38% of infections, followed by P. aeruginosa at 29% and S. aureus for 4%. Similar pathogen distribution is revealed by other assessments of the etiologic factors causing bacterial keratitis. Corneal ulcers may result from improper keratitis therapy. Endophthalmitis can develop as a result of this corneal ulceration, which may also cause a penetrating wound. Inflammation seen with pneumococcal keratitis is largely brought on by the host's response to PLY. When compared to the parent strain in studies using strains lacking PLY, pathogenicity in the rabbit keratitis model was found to be reduced. During keratitis, pneumolysin appears to play both of its dual roles—cytolytic action and inciting inflammation. Before causing subunit oligomerization and hole development and causing host cell lysis, PLY first attaches to lipid rafts in the corneal epithelial cell membrane. As shown by the histology of corneas infected with wild type bacteria as opposed to PLY-deficient bacteria, PLY causes an enhanced infiltration of neutrophils into the cornea.

Emerging Infectious Diseases [12]

Scientists have long had an understanding of the phenomenon of illness emergence. In a discussion he gave in 1920 titled "Life and Death of Infectious Diseases," Charles Nicolle, then the director of the Institute Pasteur de Tunis, effectively highlighted this to underline the potential threat that infectious diseases represent. The idea of emerging diseases developed gradually but gained popularity in the late 1960s to early 1970s when viral hemorrhagic fevers such the Crimean-Congo hemorrhagic fever, Lassa fever, and Ebola fever suddenly arose. In the 1980s, when exceptionally large epidemics like HIV/AIDS arose, EID attracted more attention along with the emergence of other severe disorders. In 1987, Robert B. Shope, Mary Wilson, and Joshua Lederberg coined the phrase "emerging and reemerging diseases." The phrase is used to describe infectious diseases with an increase in human incidence during the past 20 years or a potential increase in the near future. The Institute of Medicine's 1992 study on emerging infections, which highlighted the microbiological dangers to American health, served as the catalyst for the present, widespread focus on emerging and reemerging infectious illnesses. The topic of emerging illnesses has been elevated on the agenda of national and international health programmes as a result of this formal classification and has become an important component of numerous organisational and institutional structures.

Important Factors that Influenza Diseases Emerge

Infectious diseases periodically emerge and reappear. Infectious disease pathogens undergo several steps of adaptation before spreading to a new host in order to access or acquire harmful features. Infectious agents have the potential to evolve, adapt to new hosts in novel ecological niches, and spread rapidly as a result of specific mechanisms such gene mutation, genetic recombination, or re assortment as well as circumstances that force microbial organisms to change reservoir hosts. This adaptability and the subsequent genesis of diseases are the results of numerous processes. The intricate relationships that exist between infectious agents, hosts, and the environment are crucial. Deforestation, the expansion and modernisation of agricultural methods, and natural catastrophes like floods are specifically variables that have an impact on the ecosystem. Increased host-microbe contact facilitates infections in humans due to sociodemographic factors such rising population density, declining living conditions, deteriorating infrastructure, human travel, wars, and societal instability. Some pathogens have also emerged as a result of deliberate human activity. These are the biological agents used as destructive weapons, making their emergence

"deliberate." Along with host and environmental factors, exposure to chemicals and antimicrobial agents (like antibiotics) can cause changes or mutations in a pathogen's genome, which can result in gene damage and the emergence of drug-resistant pathogen variants that may result in the development of new diseases.

The Impact of Developing Infectious Diseases

Since they pose such a substantial threat to human survival and progress, infectious diseases (IDs) have taken centre stage in world history. They make up a large fraction of all human diseases that are now understood. According to estimates, infectious diseases are responsible for at least 25% of the 60 million deaths that occur annually over the world. More than 500,000 people lose their lives each year as a result of neglected IDs, and at least 1 billion individuals are now chronically infected. Since the beginning of time, people have been aware of the dangers of developing IDs. Another serious infectious disease that has affected people around the world is influenza. The Spanish Influenza epidemic of 1918–1919, which killed up to 40 million people globally, was the deadliest outbreak of an infectious disease ever. The 1918–19 influenza pandemic claimed more lives than World War I did. It killed more people in a single year than the Black Death Bubonic Plague, which struck Europe in 1347–1351, did in four years, and more people than the HIV/AIDS epidemic, which claimed 35 million lives at the end of 2015. Infectious diseases have a variety of psychological, emotional, and mental side effects that make it harder for people to cope with their illness. Some contagious illnesses, like leprosy, make persons who have them ashamed and subject them to abuse or social exclusion. The freedom and value of those who suffer are frequently lost. Additionally, a contagious disease's effect on a person's ability to work increases adult poverty, which in turn may have an impact on children's schooling. Children's cognitive growth is also affected by infectious diseases, which can result in a variety of social vices that ultimately contribute to the disease's burden and exacerbate poverty [13].

Public Health Intervention

Human, environmental, and ecological variables play a significant role in the development of both EIDs and neglected infectious illnesses. However, NTDs are more resilient and thrive in poorer environments. The priorities of public health are frequently low for those affected by neglected tropical illnesses, and they frequently have little political clout. Therefore, a sensible public health response to the issue of infectious diseases in general focuses on addressing the fundamental causes that encourage the development and persistence of these diseases, while also implementing effective control measures. In order to assist the development and implementation of diagnostic tools, therapeutic medications, and vaccinations as the foundation of public health response, WHO supports advocacy, awareness, pathogenesis studies, and all of the aforementioned activities. The WHO uses a variety of public health strategies to control, eliminate, and eradicate NTDs, including veterinary public health services. These strategies include disease management, preventive chemotherapy, vector control, pesticide management, provision of safe drinking water, basic sanitation and hygiene, and education. Particularly in developing nations, preventive chemotherapy is primarily administered via mass medication administration. By using this method, helminthic illnesses such schistosomiasis, ascariasis, lymphatic filariasis, trichuriasis, onchocerciasis, and trachoma can be fought off. To lessen the worm burden, which in turn lowers morbidity and enhances the quality of life for affected populations, preventative anthelmintic treatment is periodically administered to all at-risk residents living in endemic areas. Although a long-term commitment is required, this is producing considerable benefits.

Major Changes have occurred in the Infectious Diseases Disease

Environmental studies, epidemiology, immunology, public health, social and cultural studies, pharmacology, medicine, molecular biology, chemistry, veterinary science, sociology, and anthropology are just a few of the disciplines that have contributed to the advancements made in the past century in the fight against emerging infectious diseases. Advances in basic science research and the development of molecular technology and diagnostics have improved understanding of disease aetiology, pathogenesis, and molecular epidemiology, which provide the basis for appropriate detection, prevention, and control measures as well as the logical design of vaccines, through which some diseases have been successfully eradicated. The study of infectious diseases, particularly their pathogenesis, diagnosis, and treatment, as well as the provision of the best possible patient care and management, has undergone a significant revolution since the development of nucleic acid detection and genome sequencing technology in the nineteenth century. Several molecular assays have been created to detect, characterise, and quantify the growing number of infectious diseases more quickly and with higher sensitivity and specificity than using conventional techniques [14]. The development of effective vaccines and medications against the majority of infectious disease pathogens has been aided by the accumulation of genomic and protein data. Through genomic and proteomic investigations, a better knowledge of recognised pathogens and the discovery of new or previously unidentified infectious diseases have been made possible. The development of the malaria vaccine was aided by a better understanding of the pathogenesis of the malaria parasite Plasmodium falciparum and the susceptibility or resistance of an individual to the disease. Along with pathogen and human variables, significant advancements in the field of global sociopolitical response to infectious disease issues have been made. In order to combat infectious diseases, there have been coordinated efforts made on a worldwide scale since the turn of the century by international organisations, governments, foundations, other cooperating agencies. The sixth of the eight Millennium Development Goals (MDGs) set by the United Nations, "fight HIV/AIDS, malaria, and other related diseases," has helped turn HIV from a fatal disease to a chronic, treatable condition. The Global Fund to Fight AIDS, Tuberculosis, and Malaria (GFATM), the World Health Organization's (WHO) "3 by 5" initiative, and the United States President's Emergency Program for AIDS Relief are additional international programmes in the fight against HIV. These organisations are all supported by the United Nations [15].

Discussion

In addition to IgA1, ZmpB, and ZmpD, pneumoniae possesses three other zinc metalloproteinases, but as of the writing of this review, none had been investigated in relation to ocular disorders. In the same way as PLY does, ZmpB causes a TNF-inflammatory response when S. Mice with pneumoniae have reduced respiratory tract infections. TNF-a not only alters the shape of rabbit corneal cells, but also harms their cytoplasm. Significantly lower levels of cytokines were found in mice infected intranasally with a strain lacking ZmpB than in animals infected with the wild type strain. ZmpB may therefore contribute significantly to both keratitis and endophthalmitis by triggering the host inflammatory cascade. The idea that neuraminidase activity and capsule expression are coordinatedly regulated and that deleting one or the other will have different pathogenic effects is one explanation for these findings. Increased neuraminidase production is brought on by capsule deletion in conjunctivitis. The decrease in capsule expression that results from the deletion of neuraminidase in endophthalmitis may be regulated by a different mechanism and have a different

outcome from the total deletion of the capsule locus. In order to better understand the unpredictable and devastating nature of IDs, there are a lot of lessons to be gained from previous epidemics. Pathogens that cause infectious diseases have shown they are capable of emerging and spreading quickly across borders via any method available, have a high potential for pathogenesis, and can develop or mutate to withstand pharmacological attack. This necessitates always having effective armament. This can be accomplished through increased international cooperation, strong local, regional, and global networks for strong infectious disease surveillance and research collaboration to enable the sharing of biological and study materials to enhance the development of antimicrobial products and vaccine trials, and collaboration between animal and human health sciences to strengthen capacity for identifying microbial agents with epidemic potential in order to prevent their emergence. Additionally, there is a need to pay close attention to circumstances that encourage the spread of disease, particularly human actions that harm the environment and modify ecological processes and enhance animal-human interaction. They are necessary for effective pandemic preparedness.

Conclusion

However In addition to continuing to be a key factor in ocular infections, pneumoniae is one of the principal causes of catastrophic systemic illnesses such bacterial pneumonia and meningitis. All three of the forms of ocular infections discussed in this review continue to be primarily caused by the bacterial pathogen pneumoniae. Conjunctivitis can be treated with topical antibiotics, keratitis can be treated but may result in corneal scarring, and endophthalmitis typically results in significant vision loss and may require enucleation. Despite the fact that there are two pneumococcal vaccinations for the protection of non-ocular diseases, they are not very effective against ocular infections. Numerous virulence factors present in this infection cause havoc on the conjunctiva, cornea, and intraocular system. The bacterium may avoid the complement system thanks to the polysaccharide capsule. PLY controls an inflammatory chain reaction that can cause just as much harm as the pathogen itself. S. Additionally, pneumoniae has three neuraminidases (NanA, NanB, and NanAB) that are involved in adhesion and later colonisation. The vital glycoproteins that are required for the recruitment of MMP-9, a critical metalloprotease for wound healing, are eliminated by the metalloproteinase ZmpC. It might be possible to understand the functions of pneumococcal virulence factors in the pathogenesis of hitherto unrecognised ocular infection types if more was known about them. New virulence pathways may be discovered by better understanding the nutritional milieu of the intraocular environment and pneumococcal metabolism. Infectious illness outbreaks can have negative social, political, and economic impacts in addition to posing a real hazard to public health from emerging and neglected infectious diseases. Since the groundbreaking IOM study [16], which emphasised the significance of emerging infectious diseases, there have been significant advancements as well as many lessons gained from earlier outbreak incidents. The ability to prepare for pandemics is still a significant issue worldwide. Infectious illness onset and transmission have been discovered to be influenced by a wide range of factors, including human behaviour and activities, pathogen evolution, poverty, environmental changes, and dynamic human relationships with animals. For the development of diagnostics, treatments, and vaccines as well as to potentially enable the detection of pathogens with the potential to cause disease, vigorous study is required to understand key properties of pathogens.

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Conflict of Interest

The author has no known conflicts of interested associated with this paper.

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