Strep Throat

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Introduction

It is the purpose of this paper to present a comprehensive and exhaustive description of the disease Streptococcal Pharyngitis, commonly referred to as strep throat (University of Maryland Medical Center). The information pertaining to this disease will be organized according to causative agent, history, epidemiology, pathology, response and treatment, and socio-politico-economic influence.

Causative Agent

Strep throat is identified as a bacterium whose name is *Streptococcus pyogenes*. *S. pyogenes* also forms a category called Group A Beta Hemolytic Strep (GABHS) which is responsible for a number of diseases, however strep throat is the most epidemic (Patterson, 2005). There are currently 80 known strains of GABHS antigens that have been divided according to cell wall structure and the presence of a particular M protein (UNC School of Medical Health). The bacterium attributed to strep throat stains gram positive (refer to Figure 1) and is spherical in shape. It occurs in either a chained or paired arrangement (refer to Figure 2) and is a nonmotile, nonsporeforming organism whose cells range from 0.6-1.0 micrometers in diameter (Textbook of Bacteriology).

The metabolism of *S. pyogenes* is fermentative, catalase-negative facultative anaerobe that requires enriched mediums containing blood in order to grow (Textbook of Bacteriology). It is a DNase positive organism, meaning it is capable of producing the exoenzyme DNase that is a catalyst in DNA processes. Other bacteria that produce the same catalyst are *Staphylococcus aureus* and *Serratia marcescens* (Photographic Guide to Microbiology Lab).

History

With a disease such as strep throat, it is difficult to locate its historical origin because scientific means used in diagnosing this particular infection were not created until the late 17th century. Instead, pathologists trace the bacterium *S. pyogenes* by broadening their search through reviewing medical accounts of other diseases found among the GABHS (Altemeier, 1998). The other diseases, which include scarlet fever, necrotizing fasciitis, and streptococcal toxic shock syndrome, produce more severe symptoms and can even lead to death (Center for Disease Control).

Scarlet fever has been traced as far back as Hippocrates in the 5th century BC and is believed to be the cause of the Plague of Athens which went from 430-426 BC. By 1735, evidence of scarlet fever was found in North America due to an outbreak in
Massachusetts. In 1879, Louis Pasteur used the blood of a woman who had puerperal fever to isolate the organism and a few years later a scientist by the name of Löffler isolated and named the bacterium *S. pyogenes* (Altemeir, 1998). During the 18th century, physicians considered scarlet fever a “mild ailment” that was not a great worry. However, as soon as the turn of the 19th century, several epidemics throughout Great Britain and the United States showed increases in disease occurrence and fatalities. At one point fatality rates jumped to as high as 30% in Europe and did not curtail until the end of the 19th century (Altemeir, 1998).

Evidence of necrotizing fasciitis extends back to the American Civil War with records showing 2,642 total cases and a mortality rate as high as 46% (Altemeier, 1998). Streptococcal toxic shock syndrome, on the other hand, has only recently been discovered and accounts for only a small percentage of the population suffering from a GABHS disease (Center for Disease Control). It seems as though, at the onset of many diseases within the GABHS family, physicians appeared apathetic about their risk to the population. One would think, because of the definitive role these diseases have exhibited throughout history, that concern for the pathogenic quality of *S. pyogenes* would have developed more quickly.

**Epidemiology**

*S. pyogenes* is a bacterium that is found in all parts of the world. In the United States alone, over 10 million new cases of skin and throat infections are reported annually (Center for Disease Control). Among those reported cases, only 5-10% were caused by the strep throat bacterium, with GABHS being the most common etiologic agent (Hayes, and Williamson, 2005). It is estimated that between 5-15% of normal individuals harbor the bacterium responsible for strep throat without showing any signs of infection, this is referred to as colonization (University of Maryland Medical Center). Currently, the morbidity and mortality rate of strep throat is very minimal; however, morbidity and mortality rates from complications due to strep throat are on the rise (Bochicchio *et al*., 2001). Estimates from the CDC report annual occurrence at 500-1,000 cases of necrotizing fasciitis and 2,000-3,000 cases of streptococcal toxic shock syndrome. It is believed that from these cases 20% of those infected with necrotizing fasciitis and over one-half of those infected with streptococcal toxic shock syndrome will die. Also, roughly 10-15% of those suffering from other GABHS diseases will not survive (Center for Disease Control).

Strep throat can be spread through direct or airborne contact with respiratory droplets such as saliva or nasal discharge from a subject infected with *S. pyogenes*. There have been isolated reports of contamination through food and indirect contact with objects handled by infected individuals (Center for Disease Control). For *S. pyogenes* to survive, it must be introduced to blood that is nutrient rich or enter the body through the oral or nasal cavities. Therefore, those at high risk include people with cuts, wounds, lesions, or open sores. Also, populations at risk include those with chronic illness, because they already have lowered immune response capability, as well as children and
the elderly (UNC School of Medical Health). Children become infected with strep throat more than any other population because they are poor at protecting themselves or others from spreading the bacterium and infections are easily spread when children are in close proximity to each other in areas such as daycares and schools. The months that produce the highest rates of strep throat range from October to April (Center for Disease Control).

Pathology

Strep throat has many virulence factors that make it a very challenging disease for the host immune system to effectively handle. Since strep throat primarily occurs in the pharynx (area of the throat between the tonsils and larynx), it is listed as an upper respiratory system infection. Other diseases which are part of the GABHS occur not only in the upper respiratory system but on the skin as well. *S. pyogenes* is characterized by hemolysis, because the bacterium responsible for strep throat is able to lyse and destroy red blood cells (Nestor, 2004). Beta-hemolytic bacteria are identified by zones of complete clearing of blood cells around colonies that have been allowed to grow on a blood agar culture. This is the reason why strep throat is associated with the group GABHS (Nestor, 2004). *S. pyogenes* also has very effective methods of dealing with the immune system. It has the ability to release a chemical called C5a peptidase which degrades a component of the immune system called C5a that attracts phagocytes (white blood cells) to foreign matter. Also, the bacterium has a hyaluronic acid capsule feature to its cell wall which inhibits its destruction by phagocytes and allows it to more readily enter cells (Nestor, 2004). Some strains of *S. pyogenes* can produce a toxin and cause streptococcal diseases, including scarlet fever, necrotizing fasciitis, and streptococcal toxic shock syndrome (Nestor, 2004). However, only scarlet fever is an infection that results from complications in treating strep throat.

People who come into contact with strep throat are usually asymptomatic until 2-5 days after exposure (Medline Plus). It is after this time that they will see symptoms such as a sore throat, red throat (that is characteristic of hemolytic), have difficulty swallowing, fever, swollen lymph nodes in the neck, general malaise (ill feeling), nausea, loss of appetite and rash (University of Maryland Medical Center). Those who have strep throat, and are on antibiotics to treat it, remain contagious for up to 24-48 hours once they have started taking antibiotics (Medline Plus). Once the individual is no longer contagious, it is common for the symptoms to begin receding. With antibiotics strep throat symptoms commonly last 3-5 days. If left untreated symptoms can last 10-12 days and complications, such as contraction of other streptococcal diseases, increase dramatically (Center for Disease Control).

Response and Treatment

Though the bacterium itself has such a wide range of virulence factors that make it difficult for the immune system to destroy, the immune system is aided in large part by medications and antibiotics which make the job much easier. When the immune system
identifies foreign matter or material in the body, different defense mechanisms, such as phagocytes, are activated to seek out and destroy or neutralize those foreign substances. Such is the case with S. pyogenes. Strep throat is well adapted in that it has features which obstruct the work of the phagocytes. Fortunately, phagocytes are not the only features and adaptations of the immune system and with antibiotics, (which usually are affective against S. pyogenes) people recover (Center for Disease Control).

A person who shows symptoms of strep throat may not always have the bacteria that are associated with streptococcal pharyngitis (sore throat). Many times, their sore throats may be caused by a virus or some other condition (Hayes and Williamson, 2005). However, a swab of the throat by a doctor can determine if the symptoms are truly caused by S. pyogenes. Usually two swabs are taken of the throat. The first swab is used in a rapid strep test, which can take 10-15 minutes to complete. With the rapid strep test the diagnosis accuracy rating is 80-90%. If this test comes back negative for strep throat, even though the individual is experiencing symptoms, the second swab is used in a throat culture test. The throat culture test involves inoculating a blood agar plate and results take 24 hours to incubate. Results of throat culture tests are more accurate at 95% (University of Chicago Pritzker School of Medicine). Once it has finally been determined that a patient in fact does have strep throat, they are placed on antibiotics such as penicillin or cephalosporins (Medline Plus). Even a person who seems to get better is urged to undergo a complete round of antibiotics, taking 10 full days, to prevent complications such as scarlet fever.

To minimize the risk of infection of strep throat, it is best to identify the ways in which it is spread and to be proactive about prevention. Since S. pyogenes is transmittable from person to person contact and respiratory droplets, good hand washing, covering mouths while coughing or sneezing, reducing contact with others if one is infected, and seeking care if one suspects they have strep throat are very effective prophylactic measures that will help to limit the spread and risk of infection (Center for Disease Control).

**Socio-politico-economic**

Though strep throat is not relatively serious when compared to other diseases, it has potential to become epidemic and precautions should be taken to prevent its spread. Treatment of strep throat may seem relatively easily and accessible, but such treatments in some countries may be scarce. Not all civilizations around the world have access to healthcare that is able to provide them with the best, most effective medications. Combine this with the ease at which people can travel around the world and the simple means of infection and the potential for a dangerous epidemic of strep through is possible.

A characteristic of bacteria is that they are able to mutate and change in virulence and type, especially that of streptococci (Altemeier, 1998). Antibiotic resistance is a type of mutation that some bacteria may undergo. S. pyogenes is one of those bacterial types that are increasing in resistance to penicillin and, as a result, stronger antibiotics are being necessitated in order to effectively treat strep throat (Medline Plus). Because third-
world countries around the world have limited access to the advanced medications that are effective in treating mutated strains of strep throat, their ability to treat the infected will become more difficult. This lack of resources could lead to a mass epidemic that might be prevented in a country with better healthcare, but in economically limited countries strep throat might yield high mortality rates. Medications that are effective would become scarce, making advancements in technology and research important for the development of superior antibiotics. Such advancements require money and debates about funding would become a global issue at the forefront of political agendas.

An issue that is of great concern is how a bacterium such as *S. pyogenes* comes to be antibiotic resistant. Many people who are on antibiotics feel the need to stop taking the medications once they are relieved of the symptoms and no longer feel they have the illness. Such irresponsible actions have an adverse effect on all people as some bacteria may survive if the antibiotics are not taken for the full course. These bacteria are then able to develop a better resistance against that type of antibiotic, making it useless as a treatment further down the line (Center for Disease Control).

As medications and antibiotics for diseases such as strep throat become scarce and more expensive, there is a definite trend for the bacteria to become stronger and one day become extremely resistant. It is the responsibility of individuals to limit its distribution and to be conscious of the way they are using their antibiotics. Also, those who understand the pathology and etiology of the disease should bear the burden of educating the general population about proper precautionary measures in prevention before and treatment after contact, thereby making sure that strep throat and the bacterium that causes it does not become an epidemic.

**Conclusion**

*S. pyogenes* is a complicated and diverse bacterium. While there is much known about its history and the group of diseases it causes as part of the GABHS, little is known about its genetic structure. It is fortunate that strep throat responds to such a common antibiotic as penicillin. However, if mutations take place in the form of penicillin resistance, valuable information pertaining to *S. pyogenes*’ genetic structure could aid in creating or selecting other antibiotics that are just as effective in treatment. Therefore, while much has been discovered about *S. pyogenes*, it is still clear that more needs to be discovered.
Work Cited


Figure 1: Gram-Stained *Streptococcus pyogenes*

Figure 2: Enlarged View of *Streptococcus pyogenes*