Streptococcus pneumoniae

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Disease

Pneumococcal pneumonia, also in invasive cases meningitis and occult bacteremia; etiologic agent Streptococcus pneumoniae. (1, 2, 3, 5)

Taxonomy

Bacteria; Firmicutes; Bacilli; Lactobacillales; Streptococcaceae. (9)

Disease Transmission

S. pneumoniae is part of the upper respiratory tract normal flora which can harm the body if it’s immune system is compromised. Found in nose and throat therefore any cough or sneeze that spreads through air and another person inhaling the particles could potentially get sick. There are some conditions that increase the risk of invasive pneumococcal disease such as decreased immune function, asplenia, chronic heart lung liver or renal disease, cigarette smoking and cerebrospinal fluid leak. (1, 2, 4, 8)

Reservoirs

Upper respiratory tracts of humans. (1, 4, 8)

Specific characteristics of MO

Streptococcus pneumoniae cells are non motile bacteria that have pili that are used to adhere to surfaces. They appear in a diplococcal arrangement mainly but can also be found in single and long chains. Cells are lancet shaped, Gram positive, soluble in bile salts and are facultative anaerobic with many serotypes which are on the capsule that coats it. The bacteria causes alpha hemolysis on blood agar but under anaerobic conditions it switches to beta hemolysis due to an “oxygen-labile hemolysin”. They are sensitive to optochin therefore they form a zone of inhibition around an optochin disc. One unique characteristic is the bacteria’s ability to self destruct. Most make the enzyme autolysin which makes it undergo lysis hours after growth initiation, typically between 18-24 hours after. (5, 6)

To diagnose a specimen test is done with a Gram stain and culture. If an invasive infection is suspected a blood, pleural fluid or cerebrospinal fluid culture is also done. In some cases a chest X-ray or CT scan is also performed.

There is a rapid and simple test that has been cleared by the FDA and is commercially available. It is a “urinary antigen test based on immunochromatographic membrane technique to detect the C-polysaccharide antigen of Streptococcus pneumoniae as a cause
of community-acquired pneumonia among adults.” (2) The test is rapid and simple to use, has a reasonable specificity in adults, and has the ability to detect pneumococcal pneumonia after antibiotic therapy has been started. (2, 6)

**Signs and symptoms of disease**

There are many signs and symptoms involved in an infected person with *Streptococcus pneumoniae* one of the main ones being a cough that produces green, yellow or bloody mucus. That is very indicative of *S. pneumoniae*. Fever, chills, shortness of breath, fatigue, loss of appetite, and chest pains are also signs and symptoms. Older patients might have confused mental state or delirium and also experience heavy perspiring, rapid pulse, and breathing. It is important to run the appropriate tests to identify the organism causing these signs and symptoms and to treat it accordingly. (2, 6)

**Historical information**

The microorganism was first isolated in 1881 by Louis Pasteur and around the same time it was shown to be the main cause of pneumonia which therefore made the species known as pneumococcus. In 1884 Pneumococcal pneumonia was differentiated from other causes of pneumonia by the Gram stain technique developed to help. At the beginning of the 1900s several discoveries were made pertaining to the structure of the microorganism. In 1902 serotyping of isolates was done with capsular swelling by specific antiserum demonstrated by Neufeld who alongside Rimpau demonstrated the opsonization of pneumococci in 1904. *S. pneumoniae* gave birth to the field of molecular genetics because of the many experiments it was subjected to. Studies done by Griffith in 1928 transformed a live harmless strain into a deadly one by combining them with an extract from a virulent. This led way for Avery, MacLeod, and McCarthy to show that the genetic material is DNA in Griffith’s experiments. (10, 11)

**Virulence factors**

The main virulence factor for the organism is the polysaccharide capsule to which 90 serotypes are known and have different virulence, prevalence and extent of drug resistance. This polysaccharide capsule completely surrounds the pneumococcal cells and is essential for the determinant of virulence because it interferes with phagocytosis by preventing complement C3b opsonization of the bacterial cells. The capsule and a protein that interfere with phagocytosis help the microorganism against the host immune defense. The infection causes inflammation process which develops after autolysis causes the lysis of bacteria, thus inflammation also involves components of the cell wall and the toxin pneumolysin (2, 7)
Control/Treatment

The main treatment is with antibiotics such as penicillin, but because of the organism's ability to become resistant and genetically recombine and reproduce rapidly, there are multiple antibiotics used. A ‘broad spectrum’ antibiotics are used first and then an antibiotic sensitivity test is done in order to identify what works best. (2)

Prevention/ Vaccine info, new trials

Because of the nature of the spread of the organism it is important to practice proper hand hygiene and proper sneezing/coughing technique to avoid the spread of the organism. There is a vaccine available and recommended for infants or people with compromised immune system. The vaccines available are the 13 valent pneumococcal conjugate vaccine and the pneumococcal polysaccharide vaccine. (2)

In the U.S 2 vaccines are available, the pneumococcal conjugate vaccine and the pneumococcal polysaccharide vaccine. According to the CDC, “Pneumococcal conjugate vaccine is recommended for all babies and children younger than 2 years old, all adults 65 years or older, and people 2 through 64 years old with certain medical conditions. Pneumococcal polysaccharide vaccine is recommended for all adults 65 years or older, people 2 through 64 years old who are at increased risk for disease due to certain medical conditions, and adults 19 through 64 years old who smoke cigarettes.” (2)

Current outbreaks / cases locally

In the state of Texas in the year 2015 the deaths reported due to *Streptococcus pneumoniae* were 102 out of 1,693 reported cases. Only the invasive cases are reported. Adults ages 60 and older are the ones affected mainly and ending in a death due to the microorganism. (1)

Because of the pneumococcal conjugate vaccine there was a decrease in invasive pneumococcal disease in the U.S. from 1998 to 2010. According to the CDC “invasive pneumococcal disease decreased from 100 cases per 100,000 people in 1998 to 9 cases per 100,000 in 2015. Invasive pneumococcal disease caused by the 13 serotypes covered by PCV13 decreased from 91 cases per 100,000 people in 1998 to 2 cases per 100,000 people in 2015.” (2)

Current outbreaks / cases globally

According to the World Health Organization about 14.5 million serious pneumococcal disease infections occurred on estimate in 2000 which resulted in 826,000 deaths in children. Serious disease occurs mainly in children under 2 years of age and in the elderly in the developed world; the case in developing countries is that it is common in children under 2 but the rates of the disease in the elderly population is unknown. (4)
References


