

# Streptococcus pneumoniae



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Introduction Pneumococcus, a Gram positive lanceolate Diplococcus, formally named as Diplococcus pneumoniae has been reclassified as Streptococcus pneumoniae because of its genetic relatedness to Streptococci.

Morphologically, they are typically small (1  $\mu\text{m}$ ), slightly elongated cocci, with one end broad or rounded and the other pointed, presenting a flame-shaped or lanceolate appearance. They occur in pairs (diplococci), with broad ends in apposition, the long axis of the coccus parallel to the line joining the two cocci in a pair. They are capsulated, the capsule enclosing each pair. They are readily stained with aniline dyes and are Gram positive. The capsule may be demonstrated as a clear halo. They have complex growth requirements and grow only in enriched media. They are aerobes and facultative anaerobes, the optimum temperature being 37°C. On blood agar after incubation for 18 hours, the colonies are small, dome shaped and glistening with an area of green discoloration along them. Some strains that develop abundant capsular material (types 3 and 7) form large mucoid colonies. Under anaerobic conditions, colonies on blood agar are surrounded by a zone of beta hemolysis due to oxygen labile hemolysin O. In liquid media, such as glucose broth, growth occurs as uniform turbidity.

Streptococcus pneumoniae ferment several sugars, forming acid only. Fermentation is tested in Hiss's serum water or aerum agar slopes. They are bile soluble. Bile solubility is a constant property and hence is of diagnostic importance. Pneumococci are catalase and oxidase negative. They are delicate organisms and are readily destroyed by heat and antiseptics. The most important antigen of pneumococcus is the type specific capsular polysaccharide. Pneumococci isolated from lobar pneumonia were originally classified into 3 types, I, II, and III and a heterogeneous group IV. Members of

Group IV were later classified into types, and 90 different serotypes are recognized. Typing may be carried out by i) agglutination of the cocci with a type specific antiserum; ii) precipitation of the SSS with the specific antiserum; or iii) the capsule swelling reaction described by Neufeld (1902). An abnormal protein (beta globulin) that precipitates with the somatic ' C' antigen of the pneumonia, appears in the acute phase sera of cases of pneumonia but disappears during convalescence. On repeated subculture, pneumococci undergo a smooth-to-rough (S-R) variation. The virulence of pneumococci depends on its capsule and the production of called pneumolysin (Paniker, 216)

Within the lower respiratory tract *S. pneumoniae* is the commonest pathogen to cause pneumoniae. Although occasional clustering of pneumococcal infections are recognized, person to person spread is uncommon. Infection usually results from the aspiration of pneumococci within upper airways secretion into the lower respiratory tract.

Aspiration occurs under variety of circumstances, usually when the normal mechanisms of mucus entrapment and expulsion by an intact glottic reflex and mucociliary escalator are impaired. This situation may arise when consciousness is disturbed in association with general anesthesia, convulsions cerebrovascular accident, epilepsy or head trauma. Other predisposing states include ischaemic heart disease, chronic renal failure, diabetes mellitus, as well as advancing age. Pneumococcal pneumoniae may be the terminal event in the conditions and this has given rise to the description of the disease as ' old mans friend'. Other specific deficiencies in host which predispose to pneumococcal infection include human gammaglobulinaemia, asplenia or hyposplenism and malignancies such as

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multiple myeloma. Bacteremia may complicate pneumococcal pneumoniae in upto 15% of the patients and this can involve the meninges, joints and rarely the endocardium. Pneumococcal pneumoniae follows aspiration with subsequent migration through the bronchial mucosa to involve the peribronchial mucosa. Mortality is increased with age, underlying disease, bloodstream involvement, metastatic infection and certain types of pneumococci such as serotypes 3 and 7. The incidence of pneumococcal meningitis is bimodal and affects children less than 3 years of age and adults of 45 years and above. Approximately, 90% of cases of bacteraemic Pneumococcal pneumoniae and meningitis are caused by 23 serotypes, of which capsular polysaccharide is the major pneumococcal virulence factor which is both antigenic and type-specific (Greenwood et al (185).

Further information are given in the following table (CDC)

Fact

Data/Information

Diseases caused by *S. pneumoniae*

Pneumonia, bacteremia, otitis media, meningitis, sinusitis, peritonitis and arthritis.

Number of hospitalizations due to infections caused by *S. pneumoniae*

Pneumonia

100, 000-135, 000

Otitis media

6 million

Invasive diseases

60, 000

Death Rate in hospitalized adults

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14%

### Symptoms of Pneumonia

Chills, fever, cough, sneezing, chest pain, rusty looking phlegm, ear pain, sinus drainage.

In adults, types 1-8 are responsible for about 75 percent of cases of pneumococcal pneumonia and for more than 50% of all fatalities due to pneumococcal bacteremia. In children, types 6, 14, 19, and 23 are frequent causes.

### Laboratory Diagnosis

The clinical diagnosis of pneumonia is easy but as the disease may be caused by several different microorganisms, etiological diagnosis should be made by laboratory tests.

In the acute phase of lobar pneumonia, the rusty sputum contains pneumococci in large numbers, with hardly any other kind of bacterium. They may be demonstrated by Gram stain. The sputum, after homogenisation if necessary is inoculated on blood agar plates and incubated at 37°C under 5-10% CO<sub>2</sub>. Growth occurs after overnight incubation. Isolation from respiratory secretions is facilitated by using blood agar containing 5µg /ml of gentamicin. From specimens where pneumococci is scanty, isolation may be obtained by intraperitoneal inoculation in mice, even if cultures are negative. Inoculated mice die in 1-3 days, and pneumococci may be demonstrated in the peritoneal exudates and heart blood. In the acute stage of pneumonia, the organism may be obtained from blood culture in glucose broth. Isolation of pneumococci from blood indicates a bad prognosis. In case of meningitis, presumptive diagnosis maybe made from Gram stained films of CSF. Capsular polysaccharide can be

demonstrated in the blood, urine, and cerebrospinal fluid by counterimmunoelectrophoresis. Antibodies can be demonstrated by agglutination, precipitation, mouse protection tests and bactericidal test with blood. Indirect hemagglutination, indirect FA tests and radioimmunoassay have been employed (Paniker, 220).

#### Discussion

Torres et al (387) carried out a retrospective study 71 consecutive patients whose blood cultures grew *S. pneumoniae*. The patients were analyzed by sex, age, clinical presentation, and ethnic background. CBC count, electrolyte levels, liver function studies, chest radiograph, HIV status, a sputum culture and Grams stain, and sensitivities for the *S. pneumoniae* isolated were examined in the laboratory data studied. The authors suggested that there is a substantial mortality rate due to Pneumococcal pneumoniae. Most of the patients in the study lacked the classic presentation of pneumoniae which includes fever, chills, and productive cough. Only 35% of the patients presented with pleuritic chest pain. The risk factor included elderly status, leukopenia and lack of fever. The common symptoms noted were hyponatremia and hyperbilirubinemia. Myalgia and mental status change were seen in some patients who were suggestive of atypical pneumonia.

#### Conclusion

*Streptococcus pneumoniae* is a Gram-positive, alpha-hemolytic diplococcus bacterium and is a member of the genus *Streptococcus*. It is normally found in the nasopharynx of 5-10% of healthy adults, and 20-40% of healthy children. It is the leading cause of pneumonia. It also causes otitis media, meningitis, acute sinusitis, osteomyelitis, septic arthritis, endocarditis,

peritonitis, pericarditis, cellulitis, and brain abscess.

#### REFERENCE

Greenwood, D., Richard, S, and John, P., ed. Medical Microbiology: A guide to microbial infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control. New York: Church Livingstone, 1997.

Torres, Jose M., Omar Cardenas, Andres Vasquez, and David Schlossberg. “ Streptococcus pneumoniae Bacteremia in a Community Hospital”. Chest 113 (1998): 387-390

[http://www.cdc.gov/ncidod/dbmd/diseaseinfo/streppneum\\_t.htm](http://www.cdc.gov/ncidod/dbmd/diseaseinfo/streppneum_t.htm)

C. K. J. Paniker., ed. Ananthanarayan and Paniker’s Textbook of Microbiology. Hyderabad: Orient Longman Pvt Ltd, 2005.