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Disease factsheet about pneumococcal disease

Factsheet

Pneumococcal diseases are symptomatic infections caused by the bacterium Streptococcus pneumoniae (S. pneumoniae), commonly referred to as pneumococci. The term invasive pneumococcal disease (IPD) is used for more severe and invasive pneumococcal infections, such as bacteraemia, sepsis, meningitis and osteomyelitis, in which the bacterium can be isolated from normally sterile sites. Pneumococcal infections and IPDs are major causes of communicable disease morbidity and mortality in Europe and globally, with the highest burden of disease found in young children and the elderly. A large proportion of IPD is vaccine preventable.

The pathogen

Streptococcus pneumoniae is a Gram-positive bacterium that appears in pairs—diplococci—when examined in the microscope.

The polysaccharide capsule is an important virulence factor that protects the organism from phagocytosis.

Encapsulated strains are almost exclusively the cause of invasive infections and non-encapsulated strains only rarely cause disease.

Streptococcus pneumoniae is classified into serotypes based on the polysaccharide capsule antigens. The more than 90 immunologically distinct serotypes are numbered and structurally related serotypes are grouped together and labelled alphabetically (e.g., 6A, 6B).

Some serotypes possess distinct epidemiological properties and 23 serotypes account for most of pneumococcal bacteraemia and meningitis worldwide.

Clinical features and sequelae

Streptococcus pneumoniae is a common cause of otitis media, sinusitis, conjunctivitis and community-acquired pneumonia in addition to causing more severe IPDs such as meningitis, osteomyelitis and sepsis.

Other, less frequent infections caused by S. pneumoniae include periorbital cellulitis, osteomyelitis, endocarditis, pericarditis, peritonitis, pyogenic arthritis, soft tissue infections and neonatal septicaemia.

Clinical signs and symptoms do not allow for pneumococcal infections to be distinguished from other bacterial infections in the absence of laboratory tests.

Streptococcus pneumoniae is the most commonly isolated bacterial pathogen in acute otitis media (AOM) in both children and adults. The disease is frequently preceded by a viral respiratory tract infection.

Streptococcus pneumoniae conjunctivitis is a characteristically acute and painless infection with occasional pruritus. On inspection, the conjunctiva is thickened and injected and there is purulent, sometimes profuse, discharge. The infection is often self-limiting but topical antibiotic treatment may be required.

Streptococcus pneumoniae is the most common cause of community acquired bacterial pneumonia. Pneumococcal pneumonia is frequently preceded by a viral respiratory tract infection and typically presents abruptly with chills and high fever often followed by productive cough and pleuritic pain. The clinical picture is often less specific in infants and children who, more often than adults, will have bacteraemia on presentation. Symptoms are often less florid in the elderly and in immunocompromised patients. Pleural effusion is the most common complication of pneumococcal pneumonia. Lung abscesses and pericarditis resulting from local extension of the lung infection are relatively rare but well recognised complications of pneumococcal pneumonia. Bacteraemia is found as often as in 15–30% of patients with pneumococcal pneumonia. Hospital mortality has been estimated at 15%. Prognostic factors include age, underlying diseases, extent and complications of infection and the timeliness of effective antibiotic therapy.

Streptococcus pneumoniae is the most frequent aetiology of mastoiditis, as well as of the feared complications of mastoiditis; meningitis and brain abscesses.

Invasive pneumococcal disease is defined as the isolation of S. pneumoniae from blood or another normally sterile site. Invasive pneumococcal disease is therefore not one condition but a group of pneumococcal infections in which the pathogen has penetrated the body's barrier defence and invaded normally sterile sites. The EU case definition of IPD (2002/253/EC) for the purpose of reporting communicable diseases to the community network can be found here.

Streptococcus pneumoniae is the most common cause of bacterial meningitis in adults. Invasion of the meninges is usually via the bloodstream but can result from direct entry following a skull fracture. Presentation may be acute or sub-acute with fever, irritability, confusion and seizures. Signs of meningism are often prominent, and patients may present with focal neurological deficits and cranial nerve palsies. The case fatality ratio is as high as 10–30% and pneumococcal meningitis is associated with a higher risk of both death and permanent disability than other bacterial meningitis.

Bacteraemia is the most common manifestation of IPD. A large proportion (up to 90%) of culture confirmed IPD is the result of a primary lung infection as bacteraemia is common with pneumococcal pneumonia. Bacteraemia can present without localised symptoms and signs although, particularly in adults, there is often a focus from which the infection has spread. Bacteraemia may result in the seeding of pneumococcal infection to the meninges, peritoneum, bones, joints or lungs.

Sepsis refers to the clinical systemic manifestations of a severe infection and is associated with tachycardia, low blood pressure and circulatory collapse. It is therefore a more severe condition than bacteraemia which can be transient or occult.

Streptococcus pneumoniae is a common cause of osteomyelitis with or without contiguous joint infection, but a less common cause of soft tissue infections.

Epidemiology

Pneumococcal infections affect people of all ages but children younger than two years of age and adults aged 65 years and older are at higher risk.

A limited number of S. pneumoniae serotypes are responsible for most serious pneumococcal infections in both adults and children around the world.

The prevalence and distribution of invasive S. pneumoniae serotypes differs across populations and geographical areas.

The incidence of pneumococcal diseases peaks in the winter months in temperate climates. The seasonality is attributed to multiple factors including lower humidity, indoor crowding, associated viral infections, cold weather and air pollution.

Streptococcus pneumoniae is the leading cause of community-acquired pneumonia and the incidence is estimated at one per one thousand adults per year.

The introduction of Haemophilus influenzae type b (Hib) vaccine in the 1990s dramatically reduced invasive Hib disease in many European countries and led to S. pneumoniae becoming the leading cause of bacterial meningitis and sepsis in young children.

Routine immunisation with the 7-valent Pneumococcal Conjugate Vaccine (PCV 7) has in recent years profoundly changed the epidemiology of IPD in many European countries. Studies from the US, which in 2000 was the first country to introduce PCV 7, have documented reductions in the incidence of IPD caused by vaccine serotypes of 94% and overall reductions of IPD incidence of 75% in children below 5 years of age.

Immunisation against pneumococcal disease reduces carriage rates of vaccine serotypes. This leads to herd immunity against vaccine serotypes as transmission of vaccine strains from colonised to susceptible individuals goes down. Substantial reductions in the incidence of IPD and pneumonia have been demonstrated in unimmunised children and adults as a result of routine PCV 7 immunisation.

Otitis media is a leading indication for antibiotic treatment in Europe and pneumococcal vaccination has been shown to reduce the risk of otitis media.

The reported incidence of IPD in Europe ranges from 0.4 cases per 100 000 population to 20 cases per 100 000 population but it should be noted that surveillance strategies for IPD are heterogeneous across Europe making it difficult to compare data. The large variations in the reported IPD incidence across Europe are likely to reflect both true differences as well as differences in diagnostic and surveillance practices..

IPD cases are reported to the European Community network under Decision No 2119/98/EC and epidemiological updates are published annually in the Annual epidemiological report on communicable diseases in Europe.

Most cases of serious pneumococcal disease (pneumonia, septicaemia and meningitis) are sporadic, but outbreaks have been described in closed settings such as long-term care facilities, hospitals and households.

The incidence of penicillin-resistant S. pneumoniae infections is increasing in several but not all of the European countries. Studies have demonstrated a positive impact from pneumococcal vaccinations on antibiotic resistance.

Transmission

Transmission of S. pneumoniae is from person to person by respiratory droplets.

The incubation period is uncertain but assumed to be around 1–3 days.

The infectious period is not known but is presumed to last until discharges from mouth and nose no longer contain pneumococci in significant numbers, and once effective antimicrobial treatment has been started, patients are thought to remain contagious for less than 24 hours.

The human nasopharynx is the only known reservoir for S. pneumoniae.

Asymptomatic nasopharyngeal colonization is common and ranges from 20 to 40% in children and from 5 to 10% in adults.

Colonisation with S. pneumoniae occurs early in life and is generally acquired at about six months of age, although there is considerable variation between populations.

The outcome of colonisation depends on the virulence of the specific serotype and on the host's immune response. Susceptibility is increased by processes affecting the integrity of the lower respiratory tract including influenza, chronic lung disease or exposure to irritants, such as cigarette smoke.

There is a marked variation in the propensity of different S. pneumoniae serotypes to colonise the nasopharynx. For example serotypes 1, 3 and 46 are rarely found in the nasopharynx, even in

populations in which they comprise a high proportion of IPD isolates, while other serotypes commonly identified in carriage studies rarely cause invasive disease.

Host risk factors for pneumococcal infection include young age, old age, diabetes, smoking, chronic lung disease, alcohol abuse, functional asplenia, sickle cell disease, leukaemia, multiple myeloma, HIV infection, and other immunodeficiencies.

The organism may spread locally from the nasopharynx to the sinuses or middle ear cavity, causing sinusitis or otitis media. The conjunctiva is infected via respiratory droplets or by direct contact. The primary focus of infection is not always obvious and in one study only 50% of adults with pneumococcal septic arthritis had another focus of pneumococcal infection.

Daycare centres provide an environment that facilitates transmission and outbreaks have also been reported among adults in closed settings such as nursing homes, military camps, prisons and shelters for the homeless.

Children are frequently the route of entry of the bacterium into households and the risk of transmission within a household is associated with family size.

Prevention

Immunisation has been shown to reduce the prevalence of antibiotic-resistant pneumococci through several mechanisms. First, the serotypes covered by the PCV 7 vaccine are responsible for the majority of both antibiotic resistant and non-resistant infections and by reducing the overall incidence of PCV 7 strains, the number of resistant infections will go down. Secondly, PCV 7 reduces carriage rates, thereby reducing the risk of vaccine serotypes being exposed to antibiotic pressure.

Childhood immunisation against S. pneumoniae is the most effective public health measure for preventing IPD both among vaccine recipients (direct effect), and among unimmunised populations (indirect ‘herd’ effect).

There are two principal types of pneumococcal vaccines currently in use: pneumococcal polysaccharide vaccine (PPV) and pneumococcal conjugate vaccines (PCV):

New pneumococcal conjugate vaccines are being introduced. In 2009 for example, the European Medicines Agency approved 10-valent and 13-valent vaccines that protect against a wider range of the most pathogenic serotypes.

PPV-23 contains purified capsular polysaccharide from the 23 serotypes that most commonly cause IPD. It is poorly immunogenic in children younger than two years of age and does not reduce pneumococcal carriage. The vaccine induces a T-cell independent response and there is no booster effect from repeated immunisations.

PCV-7 contains capsule polysaccharide conjugated to a protein that stimulates the immune response. PCV 7 is effective for infants, induces immunologic memory and reduces pneumococcal carriage rates.

PCV 7 is the pneumococcal vaccine currently used in most European immunisation programmes.

PCV 7 was first licensed in Europe in 2001 and more than half of the European countries (18/32) reporting to the European surveillance network for vaccine-preventable diseases (EUVAC) have since introduced PCV 7 to their routine childhood immunisation programs. Current national immunisation schedules can be accessed here.

Management and treatment

Pneumococcal infections are treated with antibiotics and the choice of antibiotic should reflect local resistance patterns and national treatment guidelines.

Antibiotic resistance is an increasing problem across Europe and susceptibility to macrolide antimicrobials, penicillins and cephalosporins can no longer be assumed in many countries.

Vancomycin is the only antimicrobial against which pneumococci have not developed resistance.

Note: The information contained in this factsheet is intended for the purpose of general information and should not be used as a substitute for the individual expertise and judgement of healthcare professionals.

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