Chapter 2-1. Anaerobic infections (individual fields): respiratory infections

Roles of anaerobic bacteria in morbid conditions of respiratory infections

Many anaerobic bacteria are resident flora of the upper airway and oral cavity. It is easily understood that anaerobic bacteria are major contributors to morbid conditions of respiratory infections, the occurrence of which involves the inter-relation between the upper and lower airways. The frequency of anaerobe isolation in respiratory infections reportedly accounts for 8–16% [1], and bacteria are particularly involved in aspiration pneumonia, necrotic pneumonia, lung abscess and pyothorax. With regard to the frequency of anaerobic bacteria detection in various types of respiratory infections, however, anaerobe detection in acute bronchitis is second to that of Hae-mophilus influenzae, x-hemolytic Streptococcus, Strepto-coccus pneumoniae (pneumococci), Moraxella catarrhalis and Staphylococcus aureus. Anaerobes are mostly detected at the same frequency as M. catarrhalis and S. aureus (Fig. 1). The frequencies of H. influenzae and Pseudomonas aeruginosa detection in the stable stage of chronic lower airway infection are highest, that for anaerobes low. By contrast, at the time of acute exacerbation of chronic lower airway infection the frequency of anaerobe detection is second to that for H. influenzae, pneumococci and P. aeruginosa, being higher than that for M. catarrhalis (Figs. 2, 3). The frequency of anaerobe detection in nosocomial pneumonia was second to that for x-hemolytic Streptococcus, followed by those for P. aeruginosa and then S. aureus. In contrast, the frequency of detecting pneumococci in community-acquired pneumonia is highest, followed by x-hemolytic Streptococcus, H. influenzae, M. catarrhalis, S. aureus and finally anaerobic bacteria. Thus, anaerobic bacteria are detected at mostly the same frequency as M. catarrhalis and S. aureus in community-acquired pneumonia, though the frequency is not as high as that in nosocomial pneumonia (Figs. 4, 5). Anaerobic bacteria are involved in all morbid conditions of respiratory infections, and the frequencies of isolation are high in pneumonia and at the time of acute exacerbation of chronic lower airway infection. As for detection of anaerobes in other infections, they are detected in 93% of lung abscess and 54% of pyothorax cases. Thus, anaerobic bacteria should not be neglected, because the frequency of their detection varies considerably among morbid conditions, and anaerobic bacteria do not merely drift down from the upper airway but also show major involvement in morbid conditions. It should be recognized that anaerobic bacteria are extensively involved not only in lung abscess and aspiration pneumonia, in which anaerobic infection has conventionally been indicated to participate, but also pneumonia and acute exacerbation of chronic lower airway infection.

Causative bacteria

Anaerobic bacteria isolated from respiratory infections include Peptostreptococcus, Prevotella melaninogenica, Veillonella parvula and Prevotella intermedia (Table 1). However, the majority of cases have polymicrobial infections; the incidence of mixed infection particularly with aerobic bacteria is as high as 75%. The amounts of aerobic isolates are large at the time of acute exacerbation of chronic lower airway infection, while the amounts of anaerobic isolates are equal to or larger than those for aerobic bacteria in lung abscesses and pneumonia.
Anaerobic respiratory infection risk factors

Many patients with anaerobic respiratory infections (97.6%) have underlying diseases. The underlying diseases other than a distinct episode of aspiration include dental and periodontal diseases, diabetes mellitus (DM) and chronic respiratory diseases [chronic lower airway infection, lung cancer, and chronic obstructive pulmonary disease (COPD), etc.]. The prevalences of dental and
Periodontal diseases are high in patients with anaerobic isolates, and the bacteria reportedly correlate with anaerobic respiratory infections. Lifestyle factors such as heavy smoking with a Brinkman index (B.I.) of at least 1,000 and heavy alcohol consumption are also risk factors. There are in addition systemic and regional factors, other than aspiration, underlying the occurrence of anaerobic respiratory infections, i.e., increased anaerobes in the upper airway and oral cavity. Factors promoting the occurrence of anaerobic respiratory infections include decreased defensive capacity and an impaired ability of the entire body to defend against infection, as well as decreased clearance in regional sites of the airway, which accelerates bacterial invasion and growth (Fig. 6). The incidence of respiratory infections related to aspiration is considered to be likely to increase in the future as the Japanese population ages. It is also necessary that anaerobic respiratory infections be increasingly recognized as important infections [2–4].

Diagnosis

Many anaerobic infection cases show polymicrobial infections. They develop not only via mixing of multiple anaerobic types but also mixing of anaerobic bacteria and microaerophilic or facultative bacteria which exert synergetic effects. Collection of appropriate test materials, prompt transport of these materials to laboratories, and appropriate treatment of the materials are necessary for making the diagnosis of anaerobic infection. It is important to collect test materials from the actual sites of infection by a careful sampling method so to avoid contamination with normal bacterial flora. The test materials that merit anaerobic culture include specimens not contaminated with indigenous bacterial flora of the upper airway and oral cavity, i.e., blood, pleural effusion, transtracheal aspiration (TTA) materials, and those obtained by puncture and aspiration from the abscess cavity or percutaneous lung puncture. When any bacteria, confirmable by gram staining, do not grow in the culture despite purulent good-quality test materials, the involvement of anaerobes must be suspected.

Clinical symptoms are cough, chest and back pain and pyrexia of 38°C or higher, but some patients are asymptomatic. Malodorous sputum is a general sign, but is not recognized in some patients. The presence of anaerobic infection can barely be differentiated from any other bacterial infections based on clinical symptoms or findings in patients with pneumonia or at the time of acute exacerbation of chronic lower airway infection. Many lung abscess lesions are located in the right superior, right inferior or left superior lobe of the lung. Considerable attention should be paid to making the diagnosis because of the absence of pyrexia and low C-reactive protein (CRP) levels during the course [4–6].

Antimicrobial therapy

The best selection of antibacterial drugs would be those with antibacterial activity against both facultative and anaerobic bacteria. The antibacterial drugs generally recommended for treatment of anaerobic respiratory infections are β-lactams with β-lactamase inhibitors, CLDM, cephemycins and

\[\text{Chloramphenicol}^b\]

\[\text{Fluoroquinolones}^c\]

\[\text{Vancomycin}\]

\[\text{Tetracycline}\]

\[\text{Cefmetazole}\]

\[\text{Macrolides}\]

\[\text{Cephalosporins}\]

\[\text{Cefoxitin}\]

\[\text{Benzylpenicillin}\]

\[\text{Clindamycin}\]

\[\text{Aminoglycosides}\]

\[\text{Monobactams}\]

\[\text{Sulbactam/ampicillin}\]

\[\text{Tazobactam/piperacillin}\]

\[\text{Carbapenems}\]

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Sulfamethoxazole-trimethoprim (ST), aminoglycosides and monobactams are ineffective. The rates for Peptostreptococcus and Fusobacterium with β-lactamase production are low, while those for Prevotella and Bacteroides are high. The drug resistance rates to ABPC are high in Prevotella and Bacteroides, while the rate to PIPC is moderate in Bacteroides. By contrast, the drug resistance rates for all bacterial species with combinations of these drugs, i.e., SBT/ABPC and TAZ/PIPC, are low (Figs. 7, 8). With regard to cephems, the drug resistance rate for each bacterial species to CAZ is relatively high, while that to CMZ (a cephamycins) is as low as that to carbapenems, showing the majority of strains to be sensitive (Figs. 9, 10). On the other hand, each bacterial species shows high resistance rates to TC and clarithromycin (CAM) (Figs. 11, 12). Therefore, penicillins with β-lactamase inhibitors are recommended for treatment of mild types of...
anaerobic respiratory infections, and penicillins with β-lactamase inhibitors injections, cephapemycins, and the single use of carbapenems or combined use of carbapenems with CLDM are recommended for moderate or more severe anaerobic respiratory infections, taking into consideration polymicrobial infections with aerobic bacteria. With regard to the therapeutic effect, administration alleviates fever in pneumonia and chronic lower airway infection with 3–4 days and in lung abscess with 5–6 days of treatment. In the treatment of pyothorax, tube thoracostomy is used with administration (Fig. 13) [6–9].

References