Cystic Fibrosis (CF) is the most life-threatening genetic disease among the Caucasian population. This disease is caused by a mutation in only one gene, the CFTR (Cystic Fibrosis Conductance Regulator) gene. The CFTR acts as a chloride channel, pumping this ion through the cell membrane of the epithelial cells that produce mucous. This chloride transport controls the water movement, so it influences the normal mucous production. The lack of the CFTR produces a high reabsorption of water, creating a very sticky and dense mucus that’s very difficult to transport. This retention of the mucus leads to infections because the mucus is very rich in nutrients, so it’s a perfect environment for the microorganisms to grow [1]. The disease primarily affects the lungs, the digestive and reproductive systems and also the secretory glands [2]. This produces various symptoms such as: persistent coughing, shortness of breath, very salty-tasting skin, poor growth and slow weight gain, greater respiratory infections. The most studied effects are the ones that happen in the lung because of their severity and the high mortality rate associated with poor lung function [3].

**The Microorganisms:**

- **Pseudomonas aeruginosa:**
  - Gram-negative bacillus with very simple nutritional requirements, and it’s the most common pathogen in adult CF patients [4].
  - When P. aeruginosa infects the CF airways it rapidly adapts and begins to grow in a biofilm form. Problem**—**antibiotic tolerance 10-100 times higher.
  - Acute infection**—**very virulent, but its eradication is possible if the antibiotic treatment begins as soon as possible.
  - 20% of the acute infections will develop into a chronic infection that can last even a patient’s lifetime. In this phase, P. aeruginosa has a higher antibiotic resistance, and it’s much more difficult to eradicate: [1]

- **Haemophilus influenzae**
  - Pleomorphic gram-negative cocacobacilli that is part of the normal human respiratory microflora. But it’s also an important pathogen in respiratory and systemic infections.
  - Transmission**—**direct contact/aerosols.
  - It can cause an infection in microorganisms, specially in children, but ends up being replaced by P. aeruginosa [6].
  - There’s a vaccine to prevent H. influenzae infections, but it doesn’t work with the CF patients. However, it’s a bacteria that responds well to the antibiotic treatment.

- **Acinetobacter baumannii:**
  - Gram-negative cocacobacilli common in water and soil, but it can be a parasite of animals, and it’s involved in nosocomial infections because it’s a frequent causative agent of opportunistic infections (as it happens with the CF patients).
  - It’s extremely resistant to most antibiotics, so it’s essential to study its sensitivity to antibiotics to guide the treatment [7].

- **Enterobacteriaceae:**
  - A relatively homogenous family of gram-negative bacteria. Some of the species are part of the human intestinal microflora [4].
  - They are occasionally isolated from respiratory secretions from CF patients, but they are opportunistic pathogens, and they cause transitory infections that aren’t associated with a severe disease.
  - The most frequent are: Escherichia coli, Klebsiella pneumoniae and Serratia marcescens.

- **Candida:**
  - Candida albicans and Candida parapsilosis are the most frequently isolated yeasts from the CF respiratory secretions. They are part of the normal oral microbiota, so they can migrate and then persist in the airways of the CF patients.
  - It’s believed that C. albicans could be involved in the decrease of lung function, and it’s frequently associated with P. aeruginosa [10].

**TREATMENT:**

- **Antibiotic therapy**—no consensus treatment. Many strategies have been used by changing the route of administration (systemic, oral, inhaled or a combination), the types of antibiotics and the duration of the treatment. Inhaled antibiotics have high bacteria eradication rates due to the direct delivery of a high antibiotic dose to the respiratory tract without the need to be absorbed by the systemic circulation. However, these antibiotics, currently fluoroquinolones as ciprofloxacin are the most used (but the use is limited due to the rapid emergence of resistances) [1].

- **Gene therapy**—it could be the future treatment, but its cause is very difficult of use, rather than just treating the symptoms and the opportunistic infections. Researchers are currently testing aerosol delivery of the normal CFTR gene using high gain, [12].

- **Alternative therapy**—plant essential oils (cinnamon, clove and thyme) have shown antibacterial activity against S. maltophilia, but their toxicity against respiratory epithelial cells has yet to be tested [8]. Another alternative is phage therapy, but it has yet to be tested [8]. Another alternative is phage therapy, but it has yet to be tested [8].

**References:**


