Bacteria of Streptococcus Pneumonia

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ABSTRACT

The upper respiratory tract is colonized by many microorganisms immediately after birth by transmission vertically from mother to child. The density of these germs decreases with the development of the immune system in adults, and some germs remain coexisting in the nasal cavity, including Actinobacteria, Bacteroidetes, Firmicutes, Bifidobacterium, Corynebacterium Streptococcus, Staphylococcus and rarely, fungi and viruses inhabit the respiratory tract. The pathogens of the respiratory system vary, as they are not limited to specific types of microorganisms, as they include many viruses and germs, and fungi and parasites record dangerous pathological conditions. Infections of the upper respiratory tract are less severe than those of the lower respiratory tract, and acute lower respiratory tract infections are the third major cause of human death worldwide, as the number of deaths reached3.2 million in 2015 and the number one cause of death for children under the age of five, according to the World Health Organization (WHO) 2017 (WHO). Acute lower respiratory tract infections are a major global health problem due to the emergence of antibioticresistant strains, which leads to recurrence of infection and the continuous spread of infection.

Keywords: Streptococcus Pneumonia , upper respiratory tract

Introduction

The respiratory system is one of the organs most vulnerable to infection with germs and microorganisms because it is in direct contact with the atmospheric air and the external environment

which starts with Nostril and end by pulmonary alveoli which is divided into two parts the first one is Upper Respiratory System, and the second is the Lower Respiratory System (Perez *et al.,* 2021).

The upper respiratory tract is colonized by many bacteria that are commensal microbiota, and it was previously believed that the lower respiratory tract is a sterile area devoid of any bacterial presence in healthy people, but in fact the lower respiratory tract contains coexisting germs, but it was not highlighted by researchers due to the difficulty of obtaining pure cultures using traditional agricultural methods With the advancement of diagnostic methods in the field of molecular diagnosis, samples taken from the lower respiratory tract can be accurately diagnosed by detecting genes specific to each bacterium by means of the polymerase chain reaction (PCR) (Sadowy *et al.,* 2020).

Pneumoniae germs topping all gems that cause severe secondary infections that accompany viral infections (Marzoli *et al,* 2021). The destroyed tissues exploit the effect of infection as a source of nutrients to begin the process of colonization, invading cells, and making holes in the respiratory membranes, which causes the spread of infection to the bloodstream and threatens that organ. and its soft tissues such as the endocardium and meninges (Figueiredo et al, 2020).

Pneumoniae germ. is a gram-positive bacterium, facultative anaerobic, difficult to satisfy, does not grow in normal media, but needs rich media that contain growth promoters such as blood culture medium and cooked blood culture, as it shows partial decomposition of type alpha a-hemolysis, the effect of its growth on culture medium blood (Me Devitt *et al,* 2020) described the bacterium as one of the coexisting germs in the oropharynx, but it possesses virulence factors that enable it to take advantage of weak host immunity and invade and colonize the surfaces of cells lining the upper respiratory tract and cause extremely dangerous diseases and cause high mortality rates annually for children, the elderly and immunocompromised cancer patients And alcoholics, and the transmission of the germ from the nasopharynx towards the lung leads to the infection of bacterial *pneumonia* by secreting the germ of virulence factors, including *nemolysin*, which results in necrosis of the membranes lining the alveoli and their destruction, and leads to the transmission of the germ from the lung towards the bloodstream, bacteremia, and possibly moving towards the membranes of the heart and brain. (Aprianto et al., 2018 a Liu *et al.,* 2022).

Streptococcus pneumonia germs characterized by its ability to secrete *pneumolysin* which described as one of the most important and prominent virulence factors, as it belongs to the group of pore forming toxin and is classified within the toxins that depend in their effectiveness on binding to cholesterol in the cell membranes Cholesterol dependent cytotoxin, the most prominent of which is classified within the broad group of toxins *Dal Streptolysino* (Peraro *et al.,* 2016).

Gene-deficient flying strains are responsible for the activation of *limulocin* production are less virulent than those containing it (wild type).

(Gingerich & Mousa 2022)

The production of *nemolysin* enables the bacteria to invade the mucous membranes lining the respiratory cells of the host and causes their destruction and necrosis. The classic pathway of complement and its activation early in the infection and effect increases the secretion of cytokines dramatically in the area of infection. It develops into cancerous conditions, most notably lung and bronchial cancer.

(Thapa *et al.,* 2020)

Germ pneumoniae have the ability to analyze red blood cells in the medium of blood agars, depending on the incubation conditions, possesses hemolysin toxin as another toxin of a protein nature, which in turn belongs to the wide group of toxins that form holes in the membranes and is classified in particular among the toxins released by the genera of *streptolysins* that cause *B-hemolysis,* which has the ability to

destroy a wide range of blood cells, including white blood cells and platelets (Dal Peraro et al., 2016; Ryan *et al.,* 2004).

The germ's possession of a wide range of virulence factors with diverse mechanisms led to the emergence of new strains that are resistant to antibiotic treatment (In Elisha *et al,* 2021) which prompted researchers to devise modern methods of treatment, including the use of medicinal herbs and plant extracts, and the exploitation of the effective substances they contain to inhibit the growth of the germ. (Raut *et al,* 2019).

Molecular diagnostics has recently shown a broad superiority in the field of diagnosis over the old diagnostic methods in the accuracy it shows in identifying and diagnosing samples and for the analytical study of nucleic acid sequences and comparing them with the technique sequence plays a major role in identifying new strains or those flying strains in the development of these techniques, so the most accurate diagnostic results can be obtained in a very short time and the types of different types of bacteria present in a single sample (Crossley *et al,* 2020)

Germ pathogenicity S. pneumoniae

Streptococcus pneumonia germ has a strong influence that threatens human health, as although it is a coexisting germ in the oropharynx, it causes serious diseases if it is transmitted to the lower respiratory tract. (Guziejko *et al,* 2022).

Adherence

The bacteria sticks to the surfaces of the cells of the upper respiratory tract, which indicates its possession of the polysaccharide capsule and its formation of the biofilm layer, and the filaments play a role in this stage of the infection and cause adhesion to the surfaces of the cells and surround them with the biofilm layer, which prevents antibiotics from reaching them and prevents the binding of antibodies Ab and enables the germ, by overcoming the first immune defense lines, to move to the stage of invasion (Carr *et al,* 2022).

Colonization

It is an important step in the pathogenesis of the disease, and the bacteria begins to secrete *nemolysin* and uses surface and preservation proteins to adhere to and escape from phagocytic cells, and the bacteria works to resist lysosomal enzymes lysozyme, therefore, ensures the stability of the bacteria and its adhesion to the surfaces of the epithelial cells lining the upper respiratory tract.

(Sakatani *et al.,* 2022).

Invasion

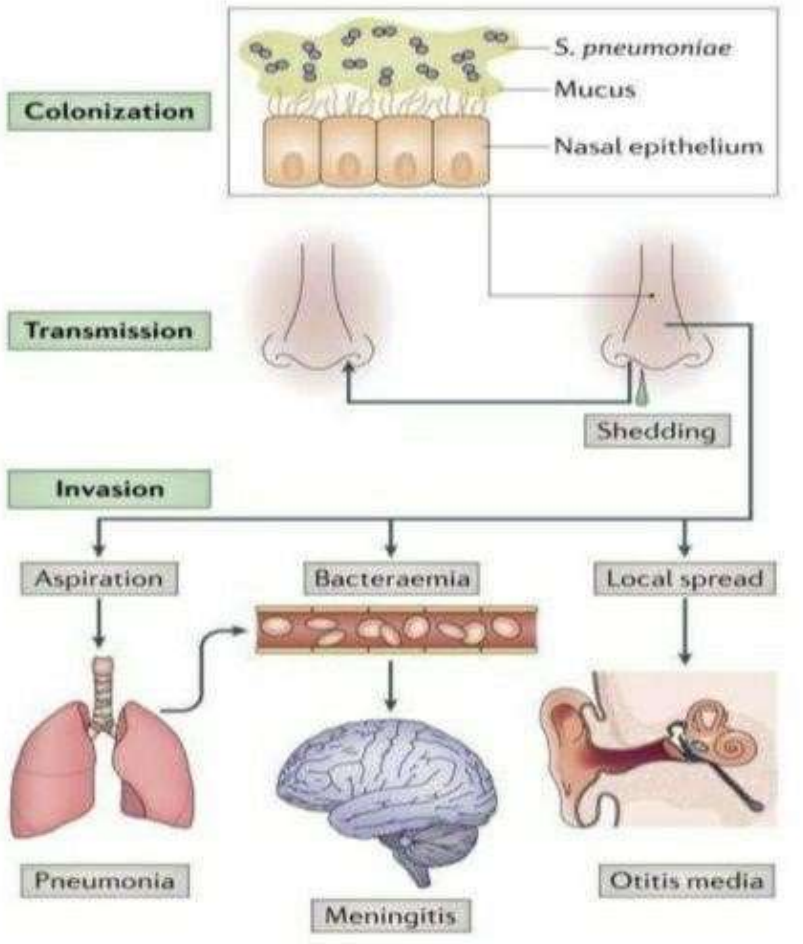
When the germ arrives in sufficient numbers after many divisions, it begins to move from one place to another, and in this period, as the infection is transmitted from one person to another, and the process is organized in sensing the quorum, as a signal is given to the germs to invade and move to settle in another place, and the germ causes secondary infections Co-infection takes advantage of the destroyed tissues as a result of viral infections or previous infections with the germ and its interactions with the immune response of the host, including the secretion of cytokines in the area of infection, which leads to tissue necrosis and complete destruction, and gives the opportunity for the germ to invade the rest of the parts (Platt *et al.,* 2022).

Germ Streptococcus pneumonia Transmission

Nemolysin affects the process of transmission of the germ from an infected person to a healthy person by stimulating the immune system to produce neutrophils in the early stages of the infection, which causes a runny nose and the germ descends with those fluids and is transmitted by direct contact or by spraying while talking. The germ pneumoniae. Its virulence depends entirely on *nemolycin*, in which it causes the destruction of host tissues, as well as interference with the patient's immune interactions, which weakens the immune system and increases the pathogenicity of the bacteria (Weiser *et al.,* 2018).

Bacterial survival outside the host (Invitro survived)

The availability of nutrients outside the body of the host has a significant impact on the extent of the resistance of the germ and its survival outside the body of the host organism, as the researcher pointed out. (Morimura *et al,* 2021) indicate the ability of the germ to survive on flexible surfaces, such as children's toys, which are within easy reach of their hands, as the droplets of people sneezing on the surfaces cause the transmission of the germ from one person to another, while the lack of nutrients reduces the metabolic activity of the germ and thus reduces its susceptibility to escape from the host.



Germ pathogenicity *Streptococcus pneumonia* (Weiser et al., 2018)

Ferocity

Where the factors that help the germ to cause infection were described as molecules that help colonize the host cells, and these molecules are either secretory factors that are associated with a membrane or within the composition of the bacterial cell, which facilitates the rapid adaptation of the metabolic, physiological and morphological cells and helps the membrane-bound virulence factors in adhesion and escape The pathogen is prevented from being ingested by the patient's defense immune cells, where secretory factors act in a cascade to destroy the host's cells (Liu.*et al,* 2022)

The virulence factors include:

a. *Bio film*
b. *Polysaccharide wallet (polysaccharide capsule)*
c. *Toxins include*
    1. *Timuline*
    2. *Hemolysin;*
    3. *Neuromander*
    4. *Autolysin*
d. *surface proteins.*
e. *Ipl*

(Brooks *et al,* 2018)

A. [Capsule and bio film]

The capsule is one of the most important factors of virulence in the germ Streptococcus pneumoniae, which contributes to its colonization of the nasopharynx and evasion in swallowing by phagocytic cells in the host, which affects the resistance of the germ to antibiotic treatment as it makes it more resistant and contributes to the adhesion of the germ to the surfaces of the host cells for colonization and sorting and works on the convergence of germ cells with each other, which facilitates the process of formation biofilm.

(Troxler *et al,* 2019) (Weiser *et al,* 2018)

Likewise, the biofilm layer consists of an assembly of microorganisms that grow within a polysaccharide template, and this layer contains various genes that bacteria exchange between them, and one of the most important genes is antibiotic resistance (Yadar.*et al,* 2020) as well as the luxs gene controls the encoding process to produce the materials required to build the biofilm (Wany *et al,* 2019) and the researcher. *Aprianto* and others mentioned in 2018 that these bacteria exploit the breakdown of respiratory tissues following virus infection and colonization as nutrients such as obtaining ATP energy and glucose directly

B. [Toxins]

The secretion of toxins is one of the most important factors of virulence occupied by a germ Streptococcus pneumoniae, as it is secreted into the membrane and contributes to increasing the germ's ability to colonize and colonize the surfaces of host cells in the nasopharynx. The toxins produced by Streptococcus were discovered in 1949 and called them streptozotocin, which by their origin inhibit other types of germs (Aholey *et al,* 2019),).

The bacteriocins (toxins) of the positive bacterial species are divided into four distinct types, and each category has characteristics. First, the first category is small, heat-stable peptides that suffer post-translational modification and produce amino acids such as lanthionine. As for the second class of bacteriocins11 are smaller than 10 kDa and rarely contain post-translational modifications

As for the third category, proteins are usually thermal with a molecular weight of approximately 30 kDa. As for the fourth category, IV, highly complex proteins that contain fatty or carbohydrate moieties. Hence, we reproduce that the first and second groups work to increase the permeability of the bacterial membrane, but the following perform enzymatic functions by killing the mutation in the structure of the cell wall (CHINKIDAS.*et al,* 2018)

1- Nemo Lysine

Nemolysin belongs to a broad group of catalytic toxins that depend on their actions to bind to cholesterol, which is a component of cell membranes. CHOLESTEROL DEPENDING CYTOLYSIS FAMILY It is a family that includes many toxins that are released by Gram-positive bacteria, and LISTERIA CLOSTRIDIUM PERFRINGENS . *Streptococcus pneumonia* derives the name of all toxins from the name of the germ that releases it, as the name *timolais* is due to the ability of the bacterium *Streptococcus pneumonia* to secrete in particular and was classified within the toxins secreted by the streptococcus group SLO.STREPTOLYSIN-O, which has the ability to molecular analysis of the erythrocyte membrane (Ray.*et al,* 2022)

Likewise, hemolysin contains two proteins B-hairpin, which are structures similar to a hairpin in shape, if they contain a twist, thus preventing the beta strand from recessive image, which gives the ability to suspend the lipid bilayer.

(Tilley *et al.,* 2005)

It also consists of hemolysin 471 amino acids. It is a protein with a molecular weight of 53.7 kilodaltons. It consists of four units that depend in their connection with each other on the carboxylate end of the amoebic acids, as the first and second unit are linked in the second unit by its carboxylic end. It is linked to the fourth unit, which means attachment to the cell membrane of the target cell and also causes growth Lysine destroys cell membranes through the ability to form holes and is superior in size to the pores it causes than the rest of the types of toxins that belong to the same family CDFC and have shapes, including arc or ring (kwon. *et al,* 2022).

Nemolysin is a toxin with extracellular activity, and studies have indicated the susceptibility of the germ to all. This toxin is the effect of lack of nutrients and its role in destroying tissues, because the tissues destroyed by an action are nutrients that are easy for the germ to consume. Also, *nemolysin* greatly affects the immune defense lines, as it slows down the immune response. The movement of the ciliated cells lining the trachea together makes it easier for the bacteria to move from the upper respiratory tract to the occupational tract and from there to the lungs and pulmonary alveoli. the nose and ensuring the transmission of the germ from one person to another, but rather by spraying (Pereira. *et al,* 2022)

Also, studies have indicated its ability to prepare the process of programmed cell death, which leads to cancerous conditions as a result of cells death.

(Nerlich *et al,* 2018)

And because of its role in causing infection and that it contributes to the process of invasion, settlement and transmission of the germ through the host was one of the innovations of treatments targeting these toxins, as the researcher indicated Jahn et al. (2020) showed that the use of anti-ply-AB antibody to growth lysin can reduce the risk of infection and the diseases that arise from it, as well as the researcher

and others (2020) that the base strains of the gene responsible for encoding the production of neomycin ply are less virulent than the wild species that possess it. .

2- Hemolysin Mitlycin

It was first diagnosed in a year1905 by researcher (Libman) and called it hemolysin for its ability to analyze blood cells (Rajbhandari, 2011)

It also belongs to a group pft is part of the cytolysin family, which is distinguished by its ability to analyze red blood cells completely, as it secretes many bacteria, whether they are gram-positive or negative, and speuoniae is a coexisting but opportunistic pathogenic germ (Tabata and Nagamane, 2021)

3- Neuromindase

This enzyme contributes to the invasion and destruction of cells, and this enzyme is secreted in three forms that work together to invade the surfaces of cells and cause the phenomenon of urea blood halal, which rarely occurs *Streptococcus pneumonia* into the bloodstream (Janesch. *et al,* 2018)

4- Auto-lysineautolysin

It is an essential enzyme in the process of division of the germ, as it works to split the wall and loosen the bonds between the components of the wall of the germ, and these toxins secrete them to free the parts of the wall from that (Sakatani.*et al,* 2022)

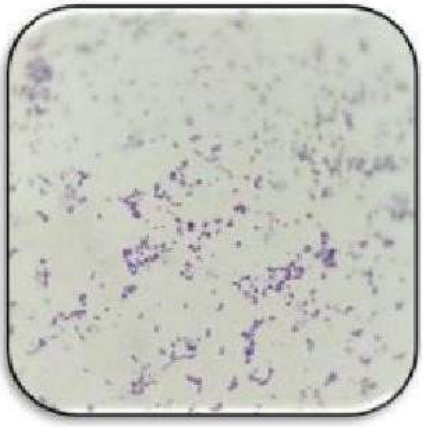
C. [surface proteins]

It facilitates the process of adhesion to the surfaces of host cells, as well as facilitating the process of invasion and obtaining nutrients. A to prevent the acute case proteins from eliminating the germ and characterizing its distinction by lactoferrin, a drug that helps in the treatment of anemia, hepatitis and osteoporosis, and it is a protein available in cow's milk and prevents the growth of bacteria and induces the invasion of the lower respiratory tract (Sakatani *et al,* 2022)

D. [The hairs] pilin

They are filaments located on the surface of the wall and consist of baleen protein (pilin) and under the adhesion and exercise the germ epithelial cells and it plays the role of colonization in two of the units p1 and p2 and it works covalently if one stimulates the other and studies have shown that the apparent strains that lack the embryo responsible for the coding for the production of pilin are sensitive to antibiotic treatment by a greater percentage than those strains wild type.

(Dzaraly *et al,* 2020)



الصورة (4-4) جرثومة *S.pneumoniae* تحت المجهر الضوئي قوة تكبير 1000x

Diagnosis

Isolation and identification of other bacterial species from sputum samples

1- Sowing on nutrient media

(Blood agar medium, menthol salt agar medium, and MacConkey medium) and testing their shape, size, smell, and viscosity in growing colonies.

2- Microscopic diagnosis

Selection of a part of the pure bacterial colony and thin films from it on clean glass slides containing a drop of buffered saline solution, then the slides were

dried, fixed quickly, and stained with Gram stain (Bauman 2018)

3- Chemical diagnosis (Gabtech technology)

Biochemical tests were carried out using the Gabteck technique to confirm the diagnosis of bacterial isolates (Bauman, 2018)

Diagnostics by polymerase chain PCR

It is a modern diagnostic technique based on the amplification of a special DNA sequence DNA It has been used since the twentieth century and is considered a revolutionary and huge diagnostic method in genetics and molecular biology. It relies in its work on the automatic multiple copying of a specific part of the original DNA template with the help of the enzyme Tag DNA polymerase under ideal conditions such as temperature, PH and time. In addition, this is almost done. In which a single copy of the original DNA is amplified into millions of copies.

(Danilov.*et al,* 2021)

Diagnostic tests

1. Phenotypic diagnosis

That is, to study the shapes of colonies growing on different media, their sizes, color, viscosity, and texture, and to investigate their ability to analyze blood, the type of analysis on blood agar media, and the sensitivity of this bacteria against optogen on cooked blood agar media.

2. Microscopic diagnosis

Part of the pure bacterial colonies were taken as thin-film preparations on clean glass slides by placing a drop of buffered saline solution, then the slides were dried, fixed by inflammation, and

stained with a gram-dependent stain Microscopy ⇒ Cultivation on culture media ⇒ Optogen sensitivity test

(Bauman, 2018) **Diagnostics with Vitec 2 system**

It is an automatic device that is fast and accurate in diagnosing germs without the need for fears, which reduces pollution compared to the traditional method of diagnosis, biochemical tests, as it contains an electronic card with self-detectors for each type of microorganism.54 biochemical tests. Its diagnostic accuracy reaches 99%, as antibiotic susceptibility tests can be performed through it.

(Ksiazczyk.*et al.,* 2016).

Diseases caused by germs *Streptococcus pneumonia*

* Pneumonia.

* Bacterial meningitis.

* Otitis Media (OM).

* Bacteremia.

* Endocarditis.

* Lung Cancer

* Eye Conjunctivitis

Pneumonic Pneumonia

Patients with pneumonia are described as an inflammatory condition that affects the lung and mainly affects the pulmonary alveoli. Its symptoms include coughing, chest pain, mental confusion, fever and fatigue. This disease often occurs as a result of the transmission of infection from one infected person to another within community gatherings such as schools and hospitals. It is called acquired pneumonia, which is an infection. acute cause (Community acquired pneumonia) from the community with inflammation of the lung tissues acquired by the person as a result of his contact with a disease for a period of 24 hours, and this infection also acquires the effect of hospitalization (Hospital acquired pneumonia) and artificial respirators (Ventilation acquired pneumonia) cause the transmission of the germ and cause acute injuries to elderly people in care homes and dialysis centers (Sattar *et al,* 2021). Streptococcus pneumonia. Pneumonia caused by typical pneumonia* and other Gram-positive and Gram-negative bacteria cause pneumonia Legionella, Mycoplasma pneumoniae and Chlamydia (Jain *et al.* 2018)

Bacterial meningitis

It is described as a severe and dangerous infection of the brain and its membranes, as it leads to death if it is not treated. Streptococcus pneumoniae is the most common case of meningitis, as it represents 70-75% of detected cases, and the appearance of symptoms precedes the appearance of the disease. It penetrates the three coverings of the brain and enters the central nervous system, exploiting the weakness of the host's immunity, and neem and lysine play a major role in this, as most of the diagnostic cases of meningitis or sinusitis and complications of pneumonia are carried out by investigating the presence of neem and lysine in modern diagnostic techniques, most notably molecular diagnosis .

(Brooks *et al,* 2018)

The ability of the germ to secrete virulence factors would destroy the mucous membranes of the respiratory tract and lead to the transmission of the germ through the bloodstream or the sinuses and infect the envelopes surrounding the brain, as the germ is able to overcome the cells and immune defense lines, and often occurs in the disease of weak immunity from patients with cancer and tumors malignant or alcoholic. (Figueredo *et al,* 2020)

Inflammation of the middle ear (Otitis Media)

Otitis media poses a general health dilemma that children suffer from at this stage, as it is the most common reason for children visiting medical clinics, undergoing ear surgery, and taking broad-spectrum antibiotics. This disease includes symptoms, the most important of which are: fatigue, dizziness, and high fever.

Streptococcus pneumoniae is one of the most important causes of acute middle ear infection, while other germs cause it, it seizes the opportunity of viral infections, which makes it one of the most prominent causes of secondary infections that accompany viral infections, which destroy tissues, provide nutrients, and increase the growth and colonization of germs in the nasopharynx area.

(Silva *et al.,* 2022).

Inflammation of the eye cornea (Conjunctivitis)

Streptococcus pneumoniae germ rarely causes eye infections, but recent studies indicate the ability of this germ to cause conjunctivitis, and this is accompanied by infection of the eyes with other bacterial causes, including Pseudomonas and Sauers, as Streptococcus pneumoniae means secondary infections and exploits its possession of virulence factors in which it can invade soft tissues where it affects Neem does not lysine on the tissues of the eye, in addition to having Ace, which has the ability to bind to the immune protein found in the eye, and many infections with the emerging virus, Coved 19, were recorded - diagnosed cases of eye infections with the bacterium Streptococcus pneumoniae associated with viral infection

(Ayalew *et al,* 2019).

Endocarditis

Endocarditis is one of the most serious infections represented by inflammation of the inner lining of the heart (endocardium) among the most frequent infections resulting from bacteremia, as the entry of the germ into the bloodstream leads to the transmission and spread of the infection towards the sterile organs, and the process of invading the bloodstream through germs is an indication of the occurrence of diseases others target all parts of the body, such as the heart, brain, and arthritis.(Saxton *et al,* 2018).

Streptococcus pneumoniae germ which isolated from the bloodstream is one of the most important causes of endocarditis in immunocompromised patients, as its role in the secondary infections that accompany the patient's infection with other pathogens leads to the invasion and destruction of the patient's tissues. The germ was recorded among the most deadly germs in the age groups 65 and over, children and infants, as if patients with malignant tumors were at risk of developing endocarditis due to the spread of the germ and its blood transmission.

(Cham at Hedem and *et al,* 2020)

Bacteremia

Bacteremia is defined as the process of invasion of the blood by microorganisms that. It would cause serious disease conditions if it reaches the rest of the host's body organs, as the presence of the microorganism is continuous, intermittent, or transient, and poses a threat to all body organs. (Rögnvaldsson, *et al.* 2022)

The idiom (media) is derived from the Greek word that means (blood), and the presence of germs in the bloodstream is referred to by the word (Bacteremia), while the presence of bacterial hyphae in the bloodstream is referred to by the word (Septicemia) limitation of embolism, muscular failure, and sometimes death in the absence of treatment (Sexton *et al,* 2018)

Bacteria are one of the most important pathogens of patients isolated from the bloodstream of all types positive and negative for Gram stain such as Sauers, Enterococcus *S.epidermidis,* and other types of bacteria that result from patients lying in hospitals that colonize the skin and the oropharynx, as you are. Contamination of tools in the hospital is a reason for the transmission of infection between the inmates, as the use of a catheter is a reason for the entry of germs from the patient's skin directly into the bloodstream. In this case, a germ is described as a lesser cause of this pathological condition, and the patient's immunity plays an important role in optimizing his resistance to the occurrence of infection, as he is weak in immunity from people with immunodeficiency and alcoholics who are most susceptible to infection with germs k-Pneumonia, Pneumonia, Bacteroide Clostridium spa - hemolytic streptococcus ,Proteus SP is one of the most important germs that cause deadly diseases of the respiratory system, as sick cases of pneumonia were recorded that were not treated, and this led to bacteremia, the spread of the germ and the invasion of the bloodstream after overcoming the immune defense lines of the host, and then spreading to the rest of the soft tissues, including the endocardium and its vessels the brain. (Wile *et al,* 2022)

Lung Cancer

Lung cancer is one of the most common cancers, which leads annually to the death of many people, and the causes of this disease are multiple, as inhaling the vapors of chemicals causes damage to the lung tissue and the emergence of cancerous tumors, and chronic bacterial and viral infections destroy cells and spread them and cause malignant tumors and germs Including germs Streptococcus pneumoniae, which coexist in the oropharynx, are susceptible to pneumonia, and in turn secrete virulence factors that interfere with immune factors and lead to exacerbation of infection and end with the emergence of cancerous tumors as a result of necrosis of lung tissue. (Mohr *et al,* 2022)

Some studies have ignored the presence of commensal bacteria in the lower respiratory tract, as the prevailing belief is that the lungs are sterile and contain commensal germs. (Somayaji *et al,* 2022)

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