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Klebsiella pneumoniae infections, risk factors, and treatments against humans

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ABSTRACT

The pathogenicity of *Klebsiella pneumoniae* is discussed in this paper in both community and hospital settings. The purpose of this study is to determine the most prevalent cause of hospital-acquired pneumonia and *K. pneumoniae* risk factors. Multiple locations, including the brain, urinary tract, circulation, wounds, and operative sites, are infected by *Klebsiella* species. People with pre-existing medical issues are more susceptible to these illnesses. K. p*pneumoniae* is becoming a major pathogen of concern on a global scale because of the increasing prevalence of carbapenem resistant strains and hyper-virulent.

Key words: *Klebsiella pneumoniae*, hospital-acquired infections, virulence factors

Introduction:

Human existence has always depended on microbes, mold, yeast, and bacteria are known to have both positive and negative impacts. The bacteria that cause infection and sickness make up a very small portion of the global population [1]. An estimated 1,400 bacterial pathogens can cause diseases in human [2]. Public health is significantly impacted by these bacterial diseases [3]. Given the greater number of antimicrobial medications available and their efficacy against bacteria, usually treating bacterial infections is less complicated than treating viral ones. However, bacterial resistance to antibiotics is a rapidly growing problem that could have disastrous consequences, unlike infectious diseases caused by infectious agents and parasites [4]. An early interaction between pathogens and the host innate system, which consists of cellular, chemical, and mechanical barriers, can lead to infections [5]. Infection can be seen as the result of particular ways that infectious agents and hosts interact. The mucociliary clearance system in the respiratory tract must be overcome before any pathogen can enter. Bacteria may be trapped in mucus that covers the airways and is transported by cilia from the distal to the proximal lung airways [6]. Urine flow and low pH prevent bacteria from colonizing the genitourinary tract, but peristalsis and the mucus layer of the digestive system stop pathogens from adhering to the gut epithelium [7]. Due to the growth in infestations as well as several types that are becoming antibiotic-resistant, *K. pneumoniae* is getting more attention [8].

Klebsiella pneumoniae is a facultatively anaerobic, non-motile, encapsulated, Gram-negative bacteria [9]. Carl Friedlander first identified *K. pneumoniae* in 1882 as a bacterium that was isolated from the lungs of people who had passed away from pneumonia [10]. The *Klebsiella* genus is present in all living things, including plants, animals, and people. A naturally occurring member of the Enterobacteriaceae family in the microbiome of the gastrointestinal tract of healthy humans and animals, *K. pneumoniae* is a common pathogen (Khan et al., 2015). *K. pneumoniae* is primarily found in the gastrointestinal system of humans, with a small amount also present in the nasopharynx, where it can cause illness by entering the bloodstream or other organs [11]. Infections in the respiratory tract, urinary tract, and bloodstream are only a few of the infections they are responsible for in people. A third of all Gram-negative infections are caused by this typical hospital-associated opportunistic bacterium [12]. It is involved in infections outside the gastrointestinal system, including as endocarditis and septicemia as well as urinary tract infections, cystitis, pneumoniae, infections of surgical wounds, and others that are life-threatening [13]. Additionally, endogenous endophthalmitis, pyogenic liver abscesses, and necrotizing pneumonia are all caused in large part by it. K. pneumoniae was a major cause of community-acquired pneumonia (CAP) in the pre-antibiotic era, especially in diabetes and alcoholism [14]. On the other hand, a unique strain of *K. pneumoniae* called hypervirulent *K. pneumoniae* (hvKp) has arisen during the past few decades as a significant pathogen that can cause infections that are acquired in the community and, more and more often, in hospitals. hvKp frequently results in infection in healthy people.

Risk Factors

In addition to host intrinsic factors like genetics, age, and immune status, *K. pneumoniae* infection susceptibility is also influenced by extrinsic factors like use of antibiotic, alcoholism, nutrition, and environmental exposure [15]. It is known that a variety of virulence factors contribute to *K. pneumoniae's* ability to spread. [16]. Newborns, particularly those born prematurely or in intensive care units, are more susceptible because of their immature gastrointestinal tract mucosal barriers and underdeveloped immune systems. On the other hand, elderly individuals have the highest chance of death from *K. pneumoniae*. Cancer, diabetic complications, persistent liver disease, hemodialysis and solid-organ transplanting practices are risk factors for developing nosocomial bacteremia caused by *K. pneumoniae* [17]. Invasive medical treatments including an endoscope, percutaneous surgery, implantation and hypodermic injection, are examples of external factors. Additionally, due to the fact that 14% of patients with underlying malignancies and 50% of diabetics with community-acquired *K. pneumoniae* bacteremia, the incidence of these infections is therefore predicted to rise along with the prevalence of diabetes [18].

Other factors include chemotherapy, transplantation, dialysis, hospital and intensive care unit stays, personal behaviors, and antibiotics and glucocorticoids. Numerous of these operations, including intubation, either directly allow pathogens to enter body sites and cause the mucosal barrier at the colonization site to be compromised, allowing the pathogen to escape and cause infections [15].

Pathogenicity and transmission

The term "pathogenicity" refers to a bacterium's capacity to inflict disease. The pathogenesis of *K. pneumoniae* depends heavily on the expression of a number of acridity factors, including as the adhesins, siderophores, endotoxins, and capsules [19]. The likelihood of infections with *K. pneumoniae* strains is significantly higher in individuals with underlying immunodeficiencies than in healthy individuals [20]. *K. pneumoniae* main cause of neonatal sepsis and is frequently the causal agent of sepsis in newborns in many underdeveloped nations [21]. The elderly, who make up the fastest growing demographic in developed countries, are more susceptible to many illnesses due to alterations in their immune systems with time that render them less effective at managing infections [22].

It is noteworthy that People in good health probably have several or multiple responses against incidental infection with *K. pneumoniae* because majority of individuals with *K. pneumoniae,* innate immune responses are impacted by intricate and varied health issues that underlie infections [23]. Meanwhile, the proliferation of hvKp strains as well as the probable increase in resistant antibiotics may be to account for the increase in mortality and morbidity of pneumonial infections that affect healthy and immune-compromised individuals [24].

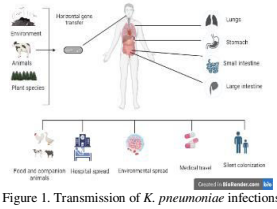

Figure 1. Transmission of *K. pneumoniae* infections

Depending on the phylogroup, *Klebsiella* can be found in many habitats. The transmission of *Klebsiella* has been identified in various food products,

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hospitals spreads [25] environment, and medical travels as shown in figure (1).

Treatment and management

Small case series and succinct reports make up the majority of the clinical data on treatment of pneumonial infections, which is extremely scarce. Numerous combination therapy, with unsatisfactory outcomes, are used, including Fosfomycin, colistin, high-dose meropenem, tigecycline, and aminoglycosides [26]. Now a days *K. pneumoniae* is resist against multidrug-resistant *pneumoniae (*MDR-KP). A significant concern for clinicians is managing antibiotic resistance in MDR-KP [27]. However, a proven optimum course of treatment for MDR-KP infections is still required. Over the past few decades, a number of new antibiotics that target MDR-KP have been developed and are now being investigated in various stages of clinical trials [28].

Conclusion and future perspective

Medically significant but little-studied pathogen is *K. pneumoniae*. It can infect humans at a number of different locations, including the circulation, liver, brain, lungs, and bladder. Even though *K. pneumoniae* was first discovered over a century ago, little is known about its virulence factors, and the host's vital defenses against pneumonial infection have also not been thoroughly investigated. Drug-resistant *pneumoniae* infections are becoming more common, which is concerning because they are hard or impossible to cure. This awareness has lately been raised. We still don't fully understand, though, how *K. pneumoniae* interacts with different components of the immune system in different organs, nor how its virulence factors evade host defense or enable it to spread and occupy niches. Future studies on the physiology, biology, and connections of *K. pneumoniae* with tissue from the host should lead to new insights into the management of pneumococcal infections. As previously mentioned, *Klebsiella* is the cause of 5 to 7.5% of nosocomial illnesses and the majority of these infections are contracted while hospitalized. Even with appropriate antibiotic treatment, serious bacterial infections including bacteremia and pneumonia still have a significant morbidity and death rate. These results imply that a strategy for immune regulation of *Klebsiella* infections is required, especially in light of the rise of multi resistant ESBL-producing (extended spectrum beta-Lactamase) strains.

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