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Article Review :Klebsiella Pneumonia: Epidemiology, Virulence Factors and Treatment

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A B S T R A C T

Klebsiella pneumoniae is a rare cause, excluding alcoholics, of community-acquired pneumonia. *Klebsiella* can resemble lung tuberculosis because it occurs with hemoptysis and lesions of the lumen. *K. Pneumoniae* is an infection hard to handle because of the organism's thickened capsule. Klebsiella is best handled with cephalosporins, quinolones or carbapenems of the third and fourth century. In lung inflammation, monotherapy is just as effective as combination therapy because newer agents are used. Older agents with less *Klebsiella* involvement were used for successful treatment in the past. Initially, the patient that we attended was believed to have pulmonary tuberculosis and the recommended medication was ceftriaxone monotherapy until it was discovered to be pneumococcal disease. The patient was initially treated with injection, then orally for 3 weeks. The purpose of this article is to address this type of bacteria, its epidemiology, virulence factors and treatment methods, due to its widespread spread within the country, which causes many respiratory diseases and can share with other pathogens such as viruses, particularly the Corona virus, which can inevitably cause death in a particular individual.

1. INTRODUCTION

K. pneumoniae is gram-negative, non-motile, encapsulation-fermenting, optional anaerobic bacteria that are rod-shaped, established in normal mouth, skin, and intestines flora and feces of about 5% of people. It triggers tiny bacterial pneumonias. It may cause substantial hemorrhagic necrotizing lung consolidation. Occasionally, it induces urinary tract infection and focal lesion bacteremia in compromised patients [1]. *K. pneumoniae* is often linked to hospital infection. Some underlying diseases including malignantness, cirrhosis, biliary diseases, urinary and Infections of biliary tract, diabetes mellitus osteomas and bacteremia and alcoholism can impair the defenses of the person and increase the risk of *K. pneumoniae* infection.

This species is a second most common cause of GNB after Escherichia coli. *K. pneumoniae* bacteremia in general populations are responsible for significant morbidity and mortality. The most important features of *k. pneumoniae* infections are metastatic infections – for example, pyogenic brain abcess, meningitis, and endophthalmitis [2].

K. pneumoniae has been shown to develop in vitro as a biofilm since the late 1981s, but only in 1992 did Reid and his colleagues scan the bladder epithelial cells of a patient with spinal cord *K. pneumoniae* infection [3]. In vitro studies subsequently showed that approximately 41% of *K. pneumoniae* was capable of developing biofilms not only from urine but also from sputum, blood and wound swabs [4].

2. GENUS KLEBSIELLA

Klebsiella, a genus that is belongs to the Enterobacteriaceae family. It is so-called after the German microbiologist Edwin Klebs (1834–1913) [6].

Klebsiella are found throughout nature. This is due to different sub-lineages, which evolve unique niche versions with associated biochemical adaptations, making them more appropriate for a given climate. It is present in water, soil, plants, insects, animals and humans [6]. Typically, they are straight rods with circular or slightly pointing ends. It is found individually in pairs or small chains [7] and produces colonies with a little or fewer dome-shaped, glossy form with varying degrees of stubbornness, contingent on the medium's pressure and structure [8].

In the human nose, throat and gastrointestinal tract, *Klebesiella* species are generally known as the natural

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flora; however, they may also serve as opportunistic human pathogens [8].

3. TAXONOMY OF GENUS KLEBSIELLA

According to the second publication of the Bergeya Systematic Bacteriology Manual [8], the species of *Klebsiella* are usually identified and distinguished by their biochemical reactions. In accordance with the general description of the Enterobacteriaceae family. Gram negativ, non-motile (with the exception of *K. mobilis*), possible anaerobic, with a respiratory and fermentation form and negative oxidase A common encapsulated rod form, which produces lysine decarboxylase but not decarboxylase ornithine, and which is normally positive in the Voges-Proskauer test.

4. KLEBSIELLA PNEUMONIAE

K. Pneumoniae was first isolated from the lungs of pneumonia patients by Friedlander in 1882. In 1886, this encapsulated bacterium, originally known as the bacillus of Friedlander, was renamed *Klebsiella.* It was later identified as a microorganism saprophyte that colonizes not only human gastrointestinal, skin and nasopharynx [2].

In respiratory tract and feces of approximately 5% of normal people, K. *pneumoniae* is found. It causes a small proportion of bacterial pneumonia (approximately 1%). *K. pneumoniae* can achieve extensive lung consolidation by hemorrhagic necrotizing. It sometimes triggers urinary tract infection and bacteremia with focal lesions in compromised patients. Some enterics can also cause pneumonia. *K. pneumonia* and *K. oxytoca* cause infections from hospitals [1].

K. pneummiae an individual from the human digestive system verdure is every now and again related with clinic obtained contamination. Certain hidden sicknesses, for example, danger, cirrhosis, biliary lot issues, urinary and biliary plot diseases, osteomyelitis and bacteremia diabetes mellitus, and liquor abuse may hinder a person's guards and increment the danger of *K. pneumoniae* contamination. *K. pneumoniae* is the second greatest regular reason for gram-negative bacteremia after *Escherichia coli. K. pneumoniae* bacteremia causes noteworthy bleakness and mortality all in all populaces. Metastatic diseases, for example, pyogenic cerebrum boil, meningitis, and endophthalmitis–are the best significant attributes of *K. pneumonia* diseases. [9].

K. pneumoniae could be divided into three sequence clusters; *K. pneumoniae* subsp. *pneumoniae, K. pneumoniae* subsp. ozaenae and *K. pneumoniae subsp. Rhinoscleromatis*[8].

5. EPIDEMIOLOGY

Persons serve as *K.pneumoniae 's* primary reservoir. In the general community, 5-38% of persons bear the organism in their stool and 1-6% in the nasopharynx. The major sources of infection are gastrointestinal tract and hospital worker's hands. It can cause nosocomial eruption. Though, Chinese ethnicity and those experiencing chronic alcoholism have reported higher colonization rates. In hospitalized patients, *K.pneumoniae* carrier prevalence is ample higher than in the population. In a single sample, carriers' levels of up to 75% in the stool of those hospitalized can be seen and felt to be consistent with the amounts of antibiotics given [10,11].

6. VIRULENCE FACTORS OF K. PNEUMONIAE

The pathogens of *Klebsiella* infections have been searched for some bacterial factors that share these bacteria's pathogenesis [12].

6.1. Capsular Polysaccharides

A commonly thick hydrophilic polysaccharides capsule, accountable aimed at the sparkling, mucoid aspect of agar colonies, surrounds the *Klebsiella* strains [6]. This capsule is resistant to many mechanisms of host defense [12]. The damage of this phenotype was linked to a discount in virulence in subcultures [6]. The capsule's presence significantly inhibits the deposition of the bacterial complement components in vitro and has shown a measurable decrease of bacterial phagocytosis with macrophages [13]. Capsules are also produced to prevent the adequate assembly of Type 1 fimbria on the bacterial surface and may lead to transcriptional inhibition in another adhesive [14]. Consequently, there is a greater adherence to and invasion of different cells cultivated in combination with wild-type strains by isogenic capsule-negative pieces [15].

6.2. Lipopolysaccharides

The O-antigen's most crucial function is to keep *K. Pneumoniae* from accompaniment arbitrated kills are very delicate for the bactericidal act of other and classical complementary paths, as capsular or non-capsular strain lacking the O1 antigen [16]. Nevertheless, O-antigen is exceptionally successful in activating the first components, and opsonizing allows K-O+ phagocytosis-prone bacteria in non-immune serums. Protective antibodies against the portion of lipopolysaccharide (toxicity) in the extracellular toxic complex (ETC) were shown [17].

6.3. Siderophores

As a result of iron deficiency, *K pneumonia* strains induced between four to six external casing proteins repressible in the 45–67 kDa variety. All components are establishing to yield enterochelin, though lone a limited can make aerobactin. The iron supply's significant effect in

the host body on infection pathogenesis was demonstrated for *Klebsiella* [6].

6.4. Adhesins

The first step towards colonisation and infection is often the adhesion to the surfaces of the mucosal and epithel cells. Adhesins are also also hemagglutinins and may be found on bacterial cell surface fimbriae. *K pneumonia, K oxytoca, K planticola and K terrigena* strains may yield thick, channeled (type-1) fimbriae closely associated with other Enterobacteriaceae fimbriae. *Klebsiella* type 1 is responsible for D-mannose-sensitive hemagglutination. *K. pneumonia* clinical and fecal transport isolates 1 fimbriae rather than environmental strains [18].

Form 1 fimbriae mediate K. pneumonia attachment in uroepithelial cells and develop rat bladder infection. This fimbria also interacts with ciliated in vitro tracheal cells [19].

Klebsiella strains also form small (Type-3) fimbrias with the nonappearance or presence of D-mannose only agglutinating tannine ox erythrocytes when previously treated. This type of agglutination was called "mannose resistant *Klebsiella* hemagglutination" (MR / K-HA), as initially discovered in *Klebsiella* strains [20] and 85 percent of *Klebsiella* strains have been found to have occurred.

6.5. Biofilm Formation by *K. pneumoniae*

A biofilm is any micro-organism community in which cells twig to a surface. These adherent cells are often embedded in self-produced matrix of an extra-cellular polymer (EPS) material. Biofilm Extracellular polymers, also referred to as slime (although goo is not a biofilm), is a polymeric accumulation typically comprised of extracellular DNA, proteins, and polysaccharides. Biofilms can be applied to the living or nonliving surfaces and can be widely used in natural, industrial, and hospital environments [21].

Some species cannot bind to their own surface but can often be attached to the matrix or directly to previous colonists. During this colonization, cells may interact with products such as acylated homoserine lactone (AHL) using quorum sensing. Because of their restricted mobility, some bacteria cannot form biofilms as effectively. Nonmotile bacteria can not differentiate or accumulate the surface as easily as motile bacteria. [22].

The followings are major stages involved in the process of biofilm formation:

A. Reversible attachment

Through this first contact among bacterial cell and surface, various physical, chemical and biological processes occurred on the surface. The primary bacteria-surface fastening on the abiotic surface is typically assisted by non-specific interactions counting electrostatic forces, hydrophobic powers, or van der Waals. By comparison, biotic surface binding, such as tissue, is accomplished by complex molecular docking mechanisms (lectin or adhesive) [23]. Additional studies suggest motility to initial surface contact with abiotic surfaces and bacteria for planktonic cells [24].

B. Irreversible Attachment

Following the exopolymer-led surface authority, the period of irreversible attachment, expansion and aggregation of bacterial cells starts as multi-layered cell classes. These extracellular grids, including a blend of resources, such as polysaccharides, proteins, nuclear acids and other elements, are reflected to be necessary to hold bacterial cells together in the biofilm structure, to assist in capturing and retaining nutrients in the production of biophilm, and also to protect cells from drying out and the impact of antimicrobial specialist [25].

C. Maturation of biofilm formation

Once the bacterial cells have been irrevocably devoted to a surface, they undergo phenotypical variations, and the biofilm maturation procedure begins. Bacteria begin forming micro-colonies either by aggregating cells that have already been secured, by clonally growing or by recruiting planktonic cells or bulk fluid cells. The attached cells generate many extracellular constituents interacting in the immediate environment with organic and inorganic molecules to form glycocalyx[26].

[27] It was proposed that the central unit of biofilm development is the microcolony in the same way as tissues make up the more complex species. Similarly, the biofilm's water channels are a embryonic circulatory structure that resembles those of higher organisms. Microbial biofilms have a safe time and space structure. The fundamental "style" of mushroom-like microcolonies with overriding water canals is ideal for nutrient admittance, as nutrients are transferred to bacteria at a low water flow rate through water channels [28].

K.pneumonia has been reported to grow a biofilm in vitro since the end of the 1980s. However, in 1992, clear evidence was provided for in vivo biofilm only by Reid and other members who examined certain bladder epithelial cells of a person with an asymptomatic urinary tract contagion rise by from the spinal cord injured by Electron Microscope *K. pneumonia* [3].

Later in vitro studies show that approximately 45% of *K. pneumonia* was remote not only as of urine, but also from sputum, blood, and tumor swabs and that around 63% of *K.pneumoniae* isolates were optimistic for in vitro biofilm output from catheterized urinary tract infection (UTI) samples[29].

Also, a high prevalence of endotracheal (ETT) isolated *K. pneumonia* strains in patients with ventilator-associated pneumonia (VAP) is capable of forming an in vitro biofilm [30].

Biofilm development on abiotic surfaces was exposed to be other stable at 41°C than 33°C, using scanning microscopy [31]. *K. pneumoniae* clinical strains have recently been examined for the ability to stick to and from biofilm in vitro using electron scanners of field emission (FESEM) [32].] and by confocal laser scanning microscopy (Figure 1).

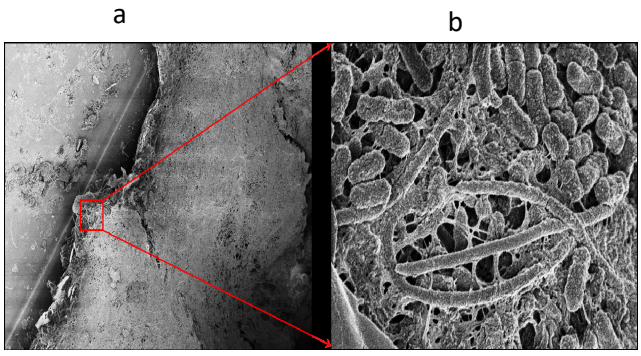

Fig:1: FESEM micrographs (a = 1000×; b = 22,000×) of a polymicrobial biofilm grown in the lumen of a urinary catheter. The species identified by culture methods were *K. pneumonia* [2]..

7. TREATMENT

Given the low incidence of *K. pneumonia* in the population, pneumonia care should meet standard antibiotic treatment guidelines. Once either supposed or established *K.pneumonia* infection, antibiotic therapy should be couturier to native antibiotic compassions [33]. Present routines of acquired population pneumonia include 14-day action with cephalosporin of either third or fourth group as monotherapy or respiratory quinolone in monotherapy or with an aminoglycoside of one or both preceding regimes. If the patient is allergic to penicillin, a course should be taken of aztreonam or quinolone in the air. Carbapenem can be used as monotherapy in nosocomial infections before sensitivities are reported [34 -35].

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بكتريا الالتهاب الرئوي *Klebsiella pneumonia*: وبائيتها وعوامل ضراوتها وعلاجها.

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الخلاصة:

تعد *Klebsiella Pneumoniae* سببًا نادرًا للالتهاب الرئوي الذي يصيب المجتمع البشري، بأستثناء مدمني الكحول. أن الاصابة *Klebsiella* يشبه مرض السل الرئوي بسبب تشابة الاعراض. *K. Pneumoniae* هي عدوى يصعب التعامل معها بسبب الكبسولة السميكة للبكتريا. وبالتالي فأن علاجها الأفضل هو cephalosporins, quinolones or carbapenems في العقدين الثالث والرابع. الالتهاب الرئوي، يكون العلاج الأحادي بنفس فعالية العلاج المركب لأنه يتم استخدام علاج أكثر تطوراً. في السابق، كان يُعتقد أن المريض الذي يصاب بمرض السل الرئوي يتم علاجه بالسيفترياكسون حتى تم اكتشافه على أنه مرض المكورات الرئوية. تم علاج المريض في البداية عن طريق الحقن، ثم عن طريق الفم لمدة 3 أسابيع. الغرض من هذه المقالة هو معالجة هذا النوع من البكتيريا ووبائيتها وعوامل ضراوتها وطرق علاجها، نظرا لانتشارها الواسع داخل الدولة، مما يسبب العديد من أمراض الجهاز التنفسي ويمكن أن يتشارك مع مسببات الأمراض الأخرى مثل الفيروسات، وخاصة فيروس كورونا. والتي يمكن أن تسبب وفاة الفرد المصاب.