Insights Of Antimicrobial Resistant *Acinetobacter Baumannii* And Its Role In Biofilm Formation Causing Pathogenicity

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ABSTRACT: *Acinetobacter* which grow in a moist environment aerobic, gram negative, non-fermenting, non-fastidious, non-motile, catalase-positive, and oxidase negative coccobacilli. Antimicrobial resistance has significantly increased among Acinetobacter species. Resistance to ⩾3 categories of antimicrobials or carbapenem resistance are two of the most prevalent definitions of multidrug resistance. *A. baumannii* has been known majorly, as responsible for spreading diseases throughout the world's hospitals, especially in intensive care units (ICUs). They are known as "super bugs" because they cause a significant amount of infections in certain patient populations in modern hospitals, notably in critically ill patients in the ICU. There are several ways to detect this, including the Tissue Culture Plate (TCP), Tube methodology (TM), acid-base indicator method (CRP), light assay, electricity sensors, and fluorescent examinations. To emphasise how they are immune to the deadly effects of antibiotics, this species is recognised as one of the six complex pathogens known as "ESKAPE". This Multi-drug resistant *Acinetobacter Sp.* has emerged as a very important healthcare facility pathogen.

Keywords: ESKAPE pathogens, super bugs, colonization, biofilm, pathogenicity.

Introduction:

The natural strategy of bacteria is to form biofilms on solid surfaces. In the initial stage of biofilm production, bacteria attach to a surface and form tiny colonies. These colonies later combine to form aggregates, leaving a conduit for nutrients. Sessile cells are protected from antibacterial agents as the biofilm ages by an exopolysaccharide polymeric matrix. *Acinetobacter* are aerobic, gram-negative, non-fermenting, non-fastidious, non-motile, catalase-positive, and oxidase negative coccobacilli that thrive in damp environments. To emphasise how they are immune to the deadly effects of antibiotics, this species is recognised as one of the six complex pathogens known as "ESKAPE" (*Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumonia, Acinetobacter baumannii, Pseudomonas aeruginosa,* and*Enterobacter species*) (Tiwari*et al*. 2018; Gedefie*et al*. 2021) and It is a member of the *Eubacteria* family Moraxellaceae of the *Proteobacteria* subclass.The genus

contains 34 species, of which 25 have names that are legitimate. The remaining 9 are called for their genomic group, which usually associates *Acinetobacter baumannii* with human diseases. Additionally, this species is a typical inhabitant of the intestinal, respiratory, and skin tract flora. Some *Acinetobacter* species (*A. baumannii, A. lwoffii, and A. haemolyticus*) are able to thrive in hospital environments due to their exceptional ability to grow at a wide range of temperatures and pH levels, to survive on moist and dry surfaces, and to tolerate exposure to various commonly used disinfectants(Kaur*et al*. 2018). Very few *A. baumannii* isolates have been found in food products, particularly meat, milk, and vegetables (Askari*et al*. 2020).

It is challenging to determine the mortality rate of multidrug-resistant *Acinetobacter baumannii* (MDRAB) because of its frequent association with co-infection by other pathogenic organisms(Ain *et al*.,2019).Acinetobacter's antibiotic susceptibility pattern may differ geographically and over time between various hospital units. To make an appropriate medication choice, it is necessary to periodically monitor these pathogens due to the fluctuations in Acinetobacter resisto-grams. Knowing the institutional common susceptibility profiles is crucial due to the clinical strains of Acinetobacter having unknown multidrug resistance patterns(Gupta *et al*., 2015).

A. baumannii was first isolated from soil in 1911 by Dutch biologist Beijerinck, who named it *Micrococcus calcoaceticus*(Beijerinck, 2019). It thrives on common laboratory media like MacConkey agar, bloodcrc agar, and chocolate agar. After 18 to 24 hours of incubation at 37°C, it develops colourless, non-haemolytic, shiny mucoid colonies on blood agar that are sleek in texture and have a diameter of 1-2 metric linear units. Its ability to ferment non-lactose is demonstrated by the production of colourless, glossy mucoid, grave-shaped colonies on MacConkey agar. When fully developed in the presence of supplement, it produces pink colour colonies on selective agar, urban centre Acinetobacter Medium(Almas Audi *et al*.,2018).

With increasing reports of community-acquired *A. baumannii* infections(Dijkshoorn*et al*.,2007), the ascribable mortality rates in patients with *A. baumannii* healthcare-associated infections, of which ventilator-associated disease and blood infections are the most common, can range from 5% in typical hospital wards to 54% in the intensive care unit (ICU) (Bianco*et al*.,2016). Additionally, evidence of extensively drug-resistant (XDR) and universally drug-resistant (PDR) isolates of *A. baumannii* is growing in many different nations (Goic-Barisic*et*

al., 2016; SmilineGirija*et al*.,2019; Assimakopoulos*et al*.,2019). *A. baumannii* has been designated as a high priority infectious pathogen by the World Health Organization (WHO), and new antibiotics are urgently needed to combat it(WHO publishes, 2017)

History:

The history of the genus Acinetobacter begins in the early 20th century, in 1911, when a Dutch scientist named Beijerinck introduced a bacterium called Micrococcus calco-aceticus that had been recovered from soil by enrichment in a minimal media that contained calcium-acetate(Beijerinck,2019) Acinetobacter, which means "immotile" in Greek, was initially proposed by Brisou and Prévot in 1954 to distinguish nonmotile microbes from motile ones under the genus Achromobacter (Brisouand Prevot,1954). It was not until 1968 that this genus classification gained wider acceptance. After conducting a thorough investigation, Baumann et al. (1968) concluded that the numerous species described above all belonged to the same genus, for which the name Acinetobacter was proposed, and that it was not possible to subclassify these species according to their compositional properties. These discoveries led to the Commission on the Taxonomy of Moraxella and Allied Bacteria's official recognition of the genus Acinetobacter in 1971(Lessel, 1971). Bergey's Manual of Systematic Bacteriology, 1974 edition (Lautrop, 1974.), the species Acinetobacter calco-aceticus, which serves as both the genus's and species' kind strain, was described along with the listing of the genus Acinetobacter, ATCC 23055 (Beijerinck, 2019).Two distinct species, A. calco-aceticus and A. lwoffii, were listed in the "Approved List of Microorganism Names," which corroborated the finding that some Acinetobacter were able to acidify aldohexose while others were unable to identified (Skerman,et al.,1980). The species A. calco-aceticus was split into two taxonomic groups or biovars, A. calco-aceticusbv. anitratus (formerly known as Herelleavaginicola) and A. calco-aceticusbv. lwoffii, based on an equivalent characteristic in the literature (formerly called Mimapolymorpha). Taxonomists, however, never legally approved these classifications.

Pathogenicity of Acinetobacter baumannii: *A. baumannii* has been known as a major causative agent responsible for spreading diseases throughout the world's hospitals, especially in intensive care units (ICUs). Healthcare facility outbreaks go hand in hand with this organism's capacity to permanently alter hospital surfaces (Shimose*et al*., 2016). It developed the capacity to spread infection across the population, not just among hospitalised patients. It imparts a 26th rate in medical facilities, rising to 43% in intensive care units (Greene *et al*.,2016).*A. baumannii* may be a major factor in ventilator-associated pneumonia, which affects roughly 15% of patients admitted to hospitals and has the lowest morbidity and fatality rates in

medical wards and ICUs. It represents about 50% of the total use of ancillary antibiotics in ICUs (Demirdal*et al*.,2016). Patients undergoing surgery are increasingly at risk from *A. baumannii*. It has a death rate of 70% and is responsible for 4% of all communicable diseases and shunt-related illnesses (Basri*et al*.,2015) 2.1% of ICU-acquired wound infections are caused by it, but it is more common (32%) in casualties from the conflicts of Afghanistan and Iraq. It is not a common cause of urinary tract infections (UTIs), but it can infect elderly patients who are weak and patients who have long-term catheter-related infections in intensive care units (ICUs), where it accounts for 1.6% of all UTIs. After using the lens linked with eye surgery, it may result in endocarditis, keratitis, and associated ophthalmitis (Peleg*et al*., 2008) Unless it is isolated from individuals with comorbidities comparable to infants with low birth weights and elderly patients with persistent illnesses like cancer, *A. baumannii* is thought to be a low-virulence pathogen. Long-term hospital stays, mechanical breathing, intravascular devices, advanced age, immunosuppression, prior broad-spectrum antibiotic medication, prior sepsis, unit stay, and enteral feedings are major risk factors for developing an *A. baumannii* infection (Islahi*et al*.,2015) Acinetobacter was formerly regarded to be a low-virulence bacteria. The frequency of explosive Acinetobacter respiratory disorder in the population suggests that these organisms may frequently be highly harmful and associated with invasive disease. Studies on the virulence factors of Acinetobacter are still in their early stages. In Acinetobacter, non-specific adhesion factors that resemble fimbriae are identified (Cendrero*et al*.,1999). Additionally, it is well known that in situations of low iron availability, organism growth occurs inside of an assembly of receptors and iron-regulated catechol siderophores, which in turn favours the growth of microorganisms and the production of virulence factors(Goel and Kapil, 2001).

Biofilm: For the first time ever, Antoine Von Leeuwenhoek discovered a type of critter on his own teeth in the seventeenth century. This finding is known as a biofilm (Percival*et al*.,2011). The encompassing sea water contain substantially less range of microorganism than on the surface (Zobell,1943). Investigations on the physical and chemical homes of biofilms ceased even between the end of 1960 and the beginning of 1970 (Wyatt,1987). Heukelekian and Heller discovered the "Bottle Effect" of marine microorganisms, which describes how their growth and activity increase when they are in contact with a surface (Heukelekian and Heller,1940). In contrast to light microscopy, the intriguing commentary of microbial biofilm, however, awaited the development of electron microscopy to investigate the biofilm in element with great resolution. In a wastewater treatment facility, the use of scanning and transmission electron microscopy allowed for the observation of biofilm on trickling filters. It was subsequently

determined that the biofilm's mobileular form was indicative of the bacterial dense aggregation (Harty,1989).

Microbial Biofilm Composition

A biofilm is a prepared mixture of microbes that are irrevocably bonded to a fetish or living surface so as to no longer wait till a fast rinse. They live inside an extracellular polymeric matrix that they make (Hurlow,2015; Costerton,1994) Extracellular polymeric substance (EPS) formation occurs at the level of a biofilm's adhesion to the floor. A microbial biofilm's ability to grow on an inert or stable surface depends on the presence of an exopolysaccharide matrix, which provides energy for the interaction of the biofilm's bacteria (Brandas,2005; Costerton,1994; Miron,2001). Typically, the EPS matrix has no thickness but the biofilm's length has been reduced to 10–30 nm (Sleytr,1997). 5 to 35% of the biofilm's total area is made up of microorganisms, with extracellular matrix making up the remaining portion. This extracellular matrix contains proteins primarily or in part. The extracellular matrix-created scavenging system is used to capture some vital vitamins and minerals from the surrounding environment. Forty-three Different styles of additives are found in extracellular polymeric substances: protein in majority (>2%); different constituents, along with polysaccharides (1–2%); DNA molecules (<1%), RNA (<1%); ions (bound and free), and finally 97% of water. The flow of essential nutrients inside a biofilm is attributed to the water content.

Biofilm in Acinetobacter: In addition to host epithelial cells, *Acinetobacter baumannii* has the capacity to form biofilms on a wide range of surfaces, including abiotic surfaces like stainless steel and polypropylene (Costerton,1995; Greene *et al*., 2016). Numerous virulence factors were linked to bacterial adhesion to surfaces, however the plasticity shown in the genomes of *A. baumannii* results in huge, strain-specific versions during biofilm development. The most fairly conserved genes in *A. baumannii* (Loehfelm*et al*., 2008; Badmasti*et al*., 2015; Zeighami*et al*., 2019) medical isolates were CsuE, the proposed tip subunit of the chaperone-usher pili (Csu), and OmpA, according to research into the presence of regarded biofilm-related genes in numerous publication (Lu and Collins, 2007) mentioned 81–100 section located in adherence and biofilm formation consist of Pap, Prp, Cup, and Type IV pili structures in addition to Acinetobacter trimeric vehicle mobile transporter (Ata)(Sutherland,2001; Gaddy and Actis, 2009; Eijkelkamp*et al*., 2014; Harding *et al*., 2018).