

Ministry of Higher Education  
& Scientific Research  
Al Muthanna University  
College of Veterinary Medicine  
Branch of Microbiology



Subject: Microbiology II  
Grade: 3  
Lecture : 9

## Microbiology II/ ENTEROBACTERIACEAE

NAME: *Klebsiella* spp.

SYNONYM OR CROSS REFERENCE: Human pathogens include *K. pneumoniae* subspecies *pneumoniae*, *ozaenae*, and *rhinoscleromatis*; *K. oxytoca*; *K. granulomatis*; *K. variicola*; and *K. singaporensis*.

CHARACTERISTICS: *Klebsiella* spp. are Gram-negative, nonmotile, usually encapsulated rod-shaped bacteria, belonging to the family Enterobacteriaceae. These bacteria produce lysine decarboxylase but not ornithine decarboxylase and are generally positive in the Voges-Proskauer test. Members of the Enterobacteriaceae family are generally facultative anaerobic, and range from 0.3 to 1.0  $\mu\text{m}$  in width and 0.6 to 6.0  $\mu\text{m}$  in length. *Klebsiella* spp. often occur in mucoid colonies. The genus consists of 77 capsular antigens (K antigens), leading to different serogroups.

### PATHOGENICITY/TOXICITY:

*Klebsiella* spp. have been identified as important common pathogens for nosocomial pneumonia (7 to 14% of all cases), septicaemia (4 to 15%), urinary tract infection (UTIs; 6 to 17%), wound infections (2 to 4%), intensive care unit (ICU) infections (4 to

17%), and neonatal septicaemias (3 to 20%). *Klebsiella* spp. can also cause bacteremias and hepatic infections, and have been isolated from a number of unusual infections. They are also important opportunistic pathogens, particularly among the immunocompromised. Pathogenicity factors of *Klebsiella* spp. include adhesins, siderophores, capsular polysaccharides (CPLs), cell surface lipopolysaccharides (LPSs), and toxins, each of which plays a specific role in the pathogenesis of these species. Depending on the type of infection and the mode of infectivity, cells of *Klebsiella* spp. may adhere and attack upper respiratory tract epithelial cells, cells in gastrointestinal tract, endothelial cells, or uroepithelial cells, followed by colonization of mucosal membranes. Common underlying conditions include alcoholism, diabetes mellitus, chronic liver disease (cirrhosis), chronic renal failure, cancer, transplants, burns, and/or use of catheters.

#### Respiratory disease:

- *K. pneumoniae*; a leading cause of community-acquired and nosocomial pneumonia and lung abscesses. Infection of the upper lobe is more common. Symptoms include: fevers, chills, and leukocytosis with red currant jelly-like sputum. Rare complications include lung infection involving necrosis and sloughing of the entire lobe.
- *K. ozaenae* – causes ozena, a primary atrophic rhinitis (AR) which involves chronic inflammation of the nose.
- *K. rhinoscleromatis* – causes rhinoscleroma (RS), a chronic granulomatous infection which predominantly affects the cavity of the nose. Central nervous system (CNS) infections: *K. pneumoniae* and *K. oxytoca* – cause community-acquired meningitis and brain abscesses. Clinical symptoms include: headaches, fever, altered consciousness, seizures, and septic shock.

- *K. ozaenae* – associated with rare cases of cerebral abscess and meningitis. Urinary tract infections (UTIs):

*Klebsiella* spp. are a frequent cause of UTIs. Significant bacteriuria has been ascribed to *K. ozaenae*.

### Hepatic disease:

- *K. pneumoniae* – an important causative pathogen for pyogenic liver abscesses with symptoms including fever, right-upper-quadrant pain, nausea, vomiting, diarrhea or abdominal pain, and leukocytosis. Abscesses occur predominantly in the right lobe and are solitary.

### Other infections:

*K. granulomatis* – causes donovanosis or granuloma, a chronic ulcerative disease that primarily affects the genitalia. Symptoms include development of small papule or ulcer at the site of inoculation that later develop into large red ulcers (lesions) that extend along the moist folds of the genitalia.

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### EPIDEMIOLOGY:

*Klebsiella* spp. occur worldwide, particularly in tropical and subtropical regions, and are ubiquitous, including forest environments, vegetation soil, water, and mucosal membranes of host species. Although they are common pathogens for community-acquired pneumonias and bacteremias, the majority of the infections are nosocomial (hospital-acquired; ~56% of all *Klebsiella* infections). Adult males are more susceptible to infection with *Klebsiella* spp. than adult females; however, *Klebsiella* spp. demonstrate higher colonization rates among neonates and may survive up to months as compared to a few days to weeks in adults. Risk of infection and carriage rates of *Klebsiella* spp. increases with increase in duration of stay within a hospital. Infection and carriage rates also increase with antimicrobial use.

### **HOST RANGE:**

Humans, mammals (including horses, bovines, rhesus and squirrel monkeys, guinea pigs, muskrats, lemurs, and bats), aquatic animals (including elephant seals, California sea lions, and harbor seals), reptiles (including snakes, crocodiles, and American alligators), birds, insects, and plants (banana, rice sugar cane and maize).

### **INFECTIOUS DOSE:**

Unknown. According to one source, 10<sup>8</sup> Klebsiella organisms per gram of feces are required to produce damage.

### **MODE OF TRANSMISSION:**

Klebsiella spp. can be transmitted through skin contact with environmentally contaminated surfaces and/or objects. Fecal transmission has also been suggested for some cases of bacteremia caused by Klebsiella spp.

**INCUBATION PERIOD:** Not clearly understood.

### **COMMUNICABILITY:**

Members of Klebsiella spp. can be transmitted from person-to-person; however, the communicability period is unknown. Approximately one-third of people carry Klebsiellae in their stools. Hospital personnel have been shown to frequently carry Klebsiellae on their hands.

### **DISSEMINATION**

- RESERVOIR: Infected humans (with or without symptoms of disease) are the primary reservoir for *Klebsiella* spp. E.g., infected infants (usually asymptomatic) colonized with invasive strains of *Klebsiella* spp., and hospital patients (for nosocomial infections). Other sources include certain plants.
- ZONOSIS: None.
- VECTORS: None

## EXPOSURE CONTROLS / PERSONAL PROTECTION

- RISK GROUP CLASSIFICATION: Risk Group 2. The risk group associated with “*Klebsiella* spp.” reflects the genus as a whole, but does not necessarily reflect the risk group classification of every species within the genus.
- CONTAINMENT REQUIREMENTS: Containment Level 2 facilities, equipment, and operational practices for work involving infectious or potentially infectious materials, animals, or cultures. The containment and operational requirements may vary with the species, subspecies, and/or strains.
- PROTECTIVE CLOTHING: Lab coat. Gloves when direct skin contact with infected materials or animals is unavoidable. Eye protection must be used where there is a known or potential risk of exposure to splashes.
- OTHER PRECAUTIONS: All procedures that may produce aerosols, or involve high concentrations or large volumes should be conducted in a biological safety cabinet (BSC). The use of needles, syringes, and other sharp objects should be strictly limited. Additional precautions should be considered with work involving animals or large scale activities.

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