The Pantoea Species: An emerging human pathogen of concern.

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Abstract:

Pantoea species, a gram negative miscellaneous bacteria previously known for their association with Plants. Currently they are gaining attention as an emerging opportunistic pathogen of human .This chapter explore versatile nature of pantoea species by focusing of different aspects like its historical background, ecological distribution & current burden, Pathogenic potential, different clinical manifestations, diagnostic challenges & management protocols in context of human infections.

Keywords: Pantoea species, emerging human pathogen

1. Introduction

The Pantoea species are gram-negative bacteria from the Enterobacteriaceae family, generally associated with plants, either as epiphytes or as pathogens. Since last decade Pantoea species are re-emerging pathogens /etiological agent in various diseases affecting rice plants also important cause of Bacterial apical necrosis of mango trees. (1, 2, 3) The Pantoea species are isolated from a variety of soil and water environments, as well as in association with different hosts like aphid, beetle fleas and various livestock's. The Pantoea species had many beneficial traits like as therapeutic agent Malenoma therapy, to produce bio surfactant and they also act as bio control agent against various plant diseases and capability to produce antimicrobial agents (4, 5)

Despite of these good strengths of Pantoea species it is emerged as opportunistic human pathogen & grouped into a biosafety level 2 (BL2) organisms based on recent case reports from different part of globe.(6) This chapter aims to elucidate the emergence of Pantoea species as human pathogen shedding light on their pathogenicity & clinical implications.

2. Historical background

Pantoea species previously has been known as *Enterobacter agglomerans* or *Erwinia herbicola*. The genus Pantoea was introduced in 1989 by Gavini et al. till date more than 25 species belong to this genus. Pantoea species are gram-negative, non-capsulated, non-sporing aerobic motile bacilli of the Enterobacteriaceae family. (7,8,9)

3. Ecological distribution

The Pantoea species has tendency to colonize a wide range of habitats; As It is ubiquitous in nature, commonly found in plants (rice /paddy), flowers (such as roses), fruits Mango strawberry, and vegetables and also in the oral cavity and faeces of animals as well as humans. Once colonize it can exhibit both beneficial and harmful behaviours. It is known opportunistic pathogen rarely affect healthy immune competent individuals. It's potential to cause human infections known since 1970. Potential of Pantoea species to cause Humans and animal infections reported in various studies. (10,11)

Source of infection (12, 13,14& 15):

Pantoea species are ubiquitous agricultural organism that inhabits soil, water & plant. They are frequently isolated from hospital as well community environment. Probable sources of Pantoea species are shown below.

In Community	In Hospital Environment
Water	contaminated parental nutrition
Soil	contaminated intravenous solutions
Thorns & plant vegetation's	stored blood products
Grain dust during harvesting	Toys in the Playrooms of Hospitals
Cotton	contaminated caps on bottles of liquid for infusions
Dust in Animal sheds	
Wood dust in saw mills	

Table 1: Environmental sources of Pantoea species

Risk factors

The Pantoea species are primarily agricultural & environmental organisms. They are seldom associated with infection in healthy persons but in presences underline comorbid conditions & suppress immunity; they are emerging as leading cause of various infections neonates as well as in adults.

RISK FACTORS & CO MORBID CONDTIONS	
Neonates	**ADULTS**
Respiratory Distress Syndrome, Meconium aspiration syndrome	Cancer, haematological disorders, HIV/AIDS
Prematurity , Low birth weight	Chronic illness Chronic kidney disease, Asthma, diabetes etc
Intrauterine growth retardation	Indoor Patient with invasive devices like centre line , catheter etc
Prolong rupture of membranes	Patient of immune suppressive agents
Necrotizing entrocolitis, congenital heart diseases like patent ductus arteriosis.	Occupational in farmers ,gardeners

Table 2: Different risk factors & comorbid conditions responsible for infections due to Pantoea species (16, 17, 18 & 19)

4. Pathogenicity (20)

The Pantoea species showed cross kingdom pathogenesis which means plants pathogen infecting Human beings.

Route of transmission (21,22):

Route of transmission of Pantoea species is not clear but according to different studies .They are capable to enter inside human body through different routes like Ingestion of contaminated vegetables fruits, percutaneous exposure or thorn prick, Inhalation agricultural dust, wood dust etc .In hospital settings through exposure to contaminated devices, contaminated toy's & parenteral nutrition & formula feed. Different virulence factors like adhesion molecules, Lipopolysaccharides (LPS) present on bacterial cell wall, endotoxins produce by of strains of Pantoea species are helping them to evade host immune response and help them establish infection under favourable conditions. As per analysis of whole genome sequence of Pantoea it is found that genetic factors are responsible for this phenomenon

Clinical features /manifestations (23, 24, 25, 26 & 27)

Clinical pathogenicity of Pantoea species has not been precisely verified as they are unable to fulfil Koch's postulates. The genus *Pantoea* is classified into 25 different species .The Pantoea species associated with human infections are *Pantoea agglomerans*, *Pantoea dispersa*, *Pantoea septica*, *Pantoea calida*, *Pantoea ananatis* and *Pantoea eucalyptii*.

As per various clinical reports Pantoea species predominantly involve septicemia following penetrating trauma or nosocomial infections. The Pantoea species were isolated routinely from plenty of samples like human wounds, urine, blood skin and soft tissue, abscesses, as well as from, tracheal and oropharyngeal swab, synovial fluid etc.

Pantoea species known to affect all systems of human body, depending on site of involvement clinical feature may vary.

System	**Clinical presentation**
Respiratory system	Acute Respiratory distress, Pneumonia , Hypersensitivity Pneumonitis
Circulatory system	Blood stream infection/sepsis
Bone and joints	Septic Arthritis
Gastrointestinal	Peritonitis
Nervous system	Meningitis, febrile convulsions
Skin & soft tissue	Allergic contact dermatitis

Table 3: Different systems affected and clinical manifestation due Pantoea infections

5. Diagnostic challenges (28, 29 & 30)

Accurate diagnosis of Pantoea infections poses challenges to due to their taxonomical closeness & resemblances in biochemical properties with different genus of Enterobacteriaceae family. Pantoea species are easily isolated by using routine culture media like Blood agar, MacConkey agar & nutrient agar. On blood agar non-haemolytic colonies produce by them, On MacConkey agar Lactose fermenting colonies are produced after incubation at appropriate conditions. *Pantoea* genus-specific agar (PGSA) is can be used as a semi-selective medium to isolate and purify it. Automated identification system VITEK 2 compact plays important role in preliminary identification of this organism but species level identification is not possible by using Vitek-2 compact system. So in current era of molecular diagnostics species level identification is carried out by using molecular techniques like Polymerase Chain Reaction, Nucleic acid sequencing methods. Sophisticated instrument like "Matrix-Assisted Laser Desorption Ionization-Time of flight (MALDI-TOF) is also used to identify Pantoea at species level. Antimicrobial susceptibility testing on isolate is carried out by disc diffusion method and interpreted using CLSI norms.

Biochemical Properties of Pantoea Species	
Gram nature	Gram Negative
Nitrate Reduction	Positive
Oxidase	Negative
Indole	Negative
Methyl Red	Positive
Citrate	Utilized
Voges–Proskauer	Positive
Maltose & sucrose	Fermented
Motility	Motile

Table 4: biochemical properties of Pantoea species

6. Management Strategies 31

Effective management of Pantoea infections involves a multidisciplinary approach. As infections due to Pantoea species often associated with hospital environment and had potential to cause outbreaks. Appropriate infection prevention & control measures are essential to prevent outbreaks. Antimicrobial susceptibility testing and local anti-biogram analysis helps to treat infections with right drug at right dose. Emergence of drug resistance in Pantoea species is now current concern which affects management strategies of infections caused by them.

7. Future implications:

The emergences of Pantoea species as human pathogens underscore need for continued research on different environmental pathogens. Understanding the genetic basis of virulence elucidating host pathogen interactions and studying the factors triggering their transitions to pathogenicity are focus area which needs exploration. Use of Pantoea species bio-control against different plant diseases and their association with human pathogenicity need to be evaluated.

8. Conclusion

Pantoea species have transitioned from being recognised solely plant pathogen to rising opportunistic human pathogens. These infections are increasing reported since last decades mainly in coastal areas and rural health care setups, their clinical significance should not be underestimated particularly in neonates and patients with immunosuppression. By comprehensively understanding ecological, clinical and genetic aspect of Pantoea species we can better manage and prevent their impact on health.

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