

# Microbiological and Clinical Characteristics of Klebsiella Pneumoniae Infection in Hyderabad, South India

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## ABSTRACT

**Introduction:** A new hypervirulent (hypermucoviscous) variant of *Klebsiella pneumoniae* has emerged. First described in the Asian Pacific Rim, it now increasingly recognized in Western countries. The dispute in the prevalence of *K. pneumoniae* with these hypervirulent characteristics between the infection and colonization condition are not well understood. The objective of this study was to contrast the clinico-microbiological characteristics of *K. pneumoniae* isolated from different samples.

**Material and methods:** This retrospective study was conducted at Department of Medicine, Osmania General Hospital, Hyderabad — a multi-speciality tertiary-care teaching hospital in Hyderabad, South India for the period of September 2016 to October 2017. 100 Patients whose sputum or urine tested positive for the presence of *K. pneumoniae* isolates were randomly included in the study. Collected patient data included age, sex, underlying disease and use of immunosuppressant drugs. The samples were defined as community isolates and hospital isolates depending upon certain criteria. The cases were divided into infection and colonization cases. All statistical analyses were performed using JMP Pro version 12 software.

**Results:** Of the 100 cases investigated, 55 and 45 cases showed the presence of *K. pneumoniae* in the sputum and urine, respectively. Of the 100 *K. pneumoniae* isolates, 21(21%) showed capsular serotype K1 or K2, whereas 28(28%) showed hypermucoviscosity. The prevalence of virulence genes *allS*, *magA*, *mrkD*, *rmpA*, *wabG*, *kfu-BC*, and *uge* was 16.3%, 13%, 81.9%, 18.6%, 90.3%, 38.5%, and 80.5%, respectively. Analysis of microbiological characteristics revealed that only *rmpA* was significantly more frequent in the infection cases than in the colonization/asymptomatic cases in both the sputum and urine groups.

**Conclusion:** The *rmpA*-positive *K. pneumoniae* isolates were dominant in the infection cases compared with those in the colonization/asymptomatic cases, suggesting that *rmpA* may play a crucial role in the development of UTI and pneumonia.

**Keywords:** *Klebsiella pneumoniae*, Hypermucoviscosity, Pneumonia, Urinary Tract Infection.

## INTRODUCTION

Gram-negative *Klebsiella Pneumoniae* is rod-shaped bacillus from the genus *Klebsiella* and family Enterobacteriaceae which are facultatively anaerobic *K. pneumoniae*, oxidase-negative, and produces acid and gas from lactose.<sup>1</sup> It is an enteric bacterium, which is present in the intestinal tract of 5% of healthy humans.<sup>2,3</sup> Which can also reside in the skin and mouth. *K. pneumoniae* causes pneumonia in guinea pigs male and female of all ages, although there are few reports of

natural infections of this animal species with this organism. The classic *Klebsiella pneumoniae* strain (cKP) is one such major pathogens causing hospital-acquired (HA) infection, particularly in immunocompromised patients. It is the another-commonest cause of Gram-negative bacteremia.<sup>4</sup> 20 years ago a new hypervirulent variant of *K. pneumoniae* (hvKP) was identified in Taiwan, and ever since it has been reported frequently in Asia. This new variant in agar plate colonies grown is hypermucoviscous different from the classic strain in appearance. Therefore, it is also called hypermucoviscous *K. pneumoniae*. In contrast to the cKP strain, the hypervirulent variant causes nosocomial infection in immunocompromised patients, but, more importantly, it causes life-threatening community-acquired (CA) infection in healthy individuals, which has caused a great concern worldwide.<sup>5,6,7</sup> This new strain on an agar plate colonies grown is hypermucoviscous on an agar plate colonies grown is hypermucoviscous on an agar plate colonies grown is hypermucoviscous also has the ability to spread infection to other parts of the body, which is an unusual feature for enteric Gram-negative bacilli in nonimmunocompromised hosts. Recently, hvKP infection is increasingly reported from Europe, South America, Australia, and North America. Despite the recent focus on the virulence factors underlying severe bacterial contagion and their relationship with infection intensity, the deviation in the preponderance of the hypervirulent *K. pneumoniae* strains the other strains and the characteristics between infection and colonization/asymptomatic status are still not clearly understood.<sup>8</sup> Therefore, the study investigates the prevalence of the hypermucoviscous phenotype and virulent *K. pneumoniae* strains in a tertiary care teaching hospital in Hyderabad, South India and to determine the differences in infection status with respect to patient background and microbiological characteristics.

## MATERIAL AND METHODS

This retrospective study was conducted at Osmania General

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Hospital — a multi-Specialty tertiary-care teaching hospital in Hyderabad, South India between September 2016 to October 2017. 100 Patients whose sputum or urine tested positive for the presence of K. pneumoniae isolates were randomly included in the study. The Collected patient data includes and use of immunosuppressant drugs in different age, sex and underlying disease. based upon certain criteria the samples were defined as community isolates and hospital

isolates . The cases were categorized as infection and colonization cases. JMP Pro version 12 software was used for statistical analysis.

## RESULTS

The sputum group comprised 20 pneumonia (infection) and 35 colonization cases. The patients' characteristics in the infection and colonization groups were similar (Table 1).

Variables	Total(n=55)	Infection(n=20)	Colonization (n=35)	P Value
Age				
Mean	67	64	70	0.456
Range	1-92	38-92	1-90	
Sex				
Male	30	12	18	0.376
Female	25	8	17	
Isolate				
Hospital	38	11	22	0.433
Community	17	9	13	
Comorbidity				
Diabetes Mellitus	17	7	10	0.998
Malignancy	29	8	21	0.398
Neutropenia	3	2	1	0.588
Collagen Disease	7	1	6	0.171
Cirrhosis	3	0	3	0.563
Chronic Kidney Disease	16	4	12	0.334
COPD'S	17	4	13	1.000
Immunosuppressant	7	2	5	0.408
Intra Vascular Device	39	15	24	0.978
Urinary Catheter	16	7	9	0.965
Patients staying at Nursing Home	6	2	4	0.657
Antibiotic use within a month	20	5	15	0.556

**Table 1.** Clinical Characteristics Of Pneumonia Patients

Variables	Total(n=45)	Infection(n=20)	Asymptomatic(n=25)	P Value
Age				
Mean	67	70	68	0.517
Range	1-90	48-90	1-88	
Sex				
Male	26	12	16	0.455
Female	19	8	9	
Isolate				
Hospital	21	7	14	0.301
Community	24	11	13	
Comorbidity				
Diabetes Mellitus	20	7	13	0.709
Malignancy	30	6	24	0.445
Neutropenia	2	1	1	1.000
Collagen Disease	8	3	5	0.487
Cirrhosis	2	0	2	0.221
Chronic Kidney Disease	13	2	11	0.056
Chronic Pulmonary Disease	7	4	3	0.599
Immunosuppressant	14	8	6	0.538
Intra Vascular Device	17	5	12	0.087
Urinary Catheter	17	7	10	0.865
Residence In Nursing Home	5	2	3	0.557
Antibiotic use within a month	14	6	9	1.001

**Table-2:** Clinical Characteristics Of Urine Tract Infection Patients

Characteristics	Total(n=55)	Pneumonia(n=20)	Colonization (n=35)	P Value
Serotype				
K1	7	2	5	0.991
K2	9	4	5	0.222
Hypermucoviscosity	21	9	12	0.167
Virulence Factor				
magA	6	1	5	1.001
rmpA	17	8	9	0.024
mrkD	48	20	28	0.786
Alls	6	2	4	0.599
Kfu	17	6	11	0.558
wabG	53	18	35	0.965
Uge	49	20	29	0.061

**Table-3:** Characteristics of *K. pneumoniae* isolated from pneumonia cases

Characteristics	Total(n=45)	Infection(n=20)	Asymptomatic(n=25)	P Value
Serotype				
K1	5	4	1	0.093
K2	3	1	2	0.989
Hypermucoviscosity	10	5	5	0.990
Virulence Factor				
magA	6	5	1	0.082
rmpA	3	3	0	0.041
mrkD	50	19	31	0.585
Alls	8	3	5	0.999
Kfu	28	12	16	0.348
wabG	52	17	35	0.511
Uge	46	22	24	0.741

**Table-4:** Characteristics of *K. pneumoniae* isolated from UTI cases

Three infection cases were complicated by bacteremia. No liver abscess accompanied pneumonia.

The urine group comprised 20 UTI (infection) and 25 asymptomatic cases, and the patients' characteristics were similar between the two groups (Table 2). Bacteremia was present in five cases. No liver abscess was detected in any of the UTI cases.

both the groups resemble in the prevalence of colonization/ asymptomatic cases in both the sputum and urine groups are less when compared with rmpA in the infection cases. There was no significant Prevalence of the other genes which differ between the infections.

## DISCUSSION

Klebsiella Pneumoniae (hv KP) causes Hypermucoviscous Klebsiella syndrome which is a life threatening condition caused by a hypervirulent strain that affects healthy individuals in the community unlike classic strain of KP. In mid 1990 This unique syndrome was first reported in Taiwan and was initially associated with the Asian Pacific Rim and is now increasingly been recognized in Western countries. Due to the propensity to metastasize to distant organs, even in non-immunocompromised hosts which is Unlike other gram negative organisms, it causes liver abscess (in the absence of biliary tract disease), endophthalmitis, pneumonia, meningitis and soft tissue infections. Intestinal colonization is crucial to its spread though the route of infection is not yet clearly identified.<sup>9,10</sup> From the gastro-intestinal tract, extra-

intestinal infection may occur from its spread to the bladder from the perineum, aspiration of oro-pharyngeal secretions, or even through the skin.<sup>11</sup> After gaining entry, infection may result due to a hypervirulent nature of the pathogen. This strain is different from the classic strain of Klebsiella pneumoniae in terms of its virulence which is due to the presence of rmpA gene (regulator of mucoid phenotype) and siderophore biosynthetic genes.<sup>12,13,14</sup> The rmpA gene increases capsule production making the organism resistant to phagocytosis and causing the Siderophore biosynthetic genes to secrete large amounts of siderophores (Aerobactin and salmochelin) which mediate iron acquisition from the host thus making them more virulent.<sup>15,16</sup> This study involved 100 Patients whose sputum or urine was tested positive for the presence of *K. pneumoniae* isolates. The results show sputum group comprised of 20 pneumonia (infection) and 35 colonization cases. of which three infection cases were found to be complicated by bacteremia. The results show that no liver abscess accompanied pneumonia. The urine group comprised 20 UTI (infection) and 25 asymptomatic cases. Bacteremia was present in five cases. No liver abscess was detected in any of the UTI cases. In both the sputum and urine groups, the prevalence of rmpA in the infection cases was significantly higher than that in the colonization/ asymptomatic cases. Prevalence of the other genes did not differ significantly between the infection and colonization/ asymptomatic cases in both the sputum and urine groups.

## CONCLUSION

In conclusion, the rmpA-positive *K. pneumoniae* isolates were dominant in the infection cases compared with those in the colonization/asymptomatic cases, suggesting that rmpA may play a crucial role in the development of UTI and pneumonia.

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