### **Original Research Article**

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# Prevalence and antibiotic susceptibility pattern of Klebsiella species isolated from various clinical samples in a tertiary care hospital Coimbatore

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#### **ABSTRACT**

**Background:** The genus *Klebsiella* of *Enterobacteriaceae* family is ubiquitous in nature. They cause many nosocomial infections like pneumonia, urinary tract infections, wound infections, bacteremia and septicemia. Multidrug resistance is seen in *Klebsiella* which serves as the most common cause of increased morbidity and mortality. This study reveals the prevalence and antibiotic sensitivity pattern of *Klebsiella* species from various clinical samples. The primary objectives are as follows: To isolate and characterize *Klebsiella* species from various clinical samples. To study the antibiotic susceptibility pattern of *Klebsiella* isolates.

**Methods:** This prospective study was conducted in our tertiary care hospital during the period from August 2019 to October 2019. A total of 3521 samples were tested during this period. The samples include blood, sputum, urine, and pus.

**Results:** Out of the total samples tested,1106 samples were showing the growth of the organisms. Among this,351 were identified as *Klebsiella* species and the highest rate of isolation of *Klebsiella* species is from the sputum sample and also the same was reported high in medical wards. The study also shows that the isolation of *Klebsiella* species shows male preponderance when compared to females. The antibiotic sensitivity pattern was done by Kirby-Bauer's disc diffusion method and the sensitivity was noted to be higher to amikacin and ciprofloxacin.

**Conclusions:** Thus, this study shows the prevalence rate of *Klebsiella* species and sensitivity pattern of *Klebsiella*, which may help select appropriate antibiotics and prevent overuse and misuse of antibiotics.

Keywords: Klebsiella, Prevalence, Antibiotic sensitivity pattern

#### INTRODUCTION

The genus *Klebsiella* belongs to the ethnic group *Klebsiellae*, a family member of the Enterobacteriaceae. After Edwin Klebs, Friedlander, a 19<sup>th</sup> century Microbiologist, named the organism as Klebsiella in 1882. It was identified as a pathogen which causes life threatening disease called pneumonia. I *Klebsiella* is a nonmotile, rod-shaped, gram-negative bacteria with a prominent polysaccharide capsule. They are omnipresent in nature. In humans, they are the colonizer of the skin,

pharynx, and gastrointestinal tract. They may be regarded as normal flora in many parts of the colon, intestinal tract and biliary tract.<sup>2</sup>

Klebsiella species cause various infections like pneumonia, urinary tract infections, meningitis, wound infections, osteomyelitis, bacteremia, septicemia, and gastroenteritis.<sup>3</sup> It is estimated that Klebsiella species cause 8% of all nosocomial infections. In that, it accounts for 6% to 17% of nosocomial urinary tract infections. Klebsiella species that are isolated from paediatric wards

are often involved in neonatal sepsis, in early as well as late manifestation of infections.<sup>4</sup>

Eight species of *Klebsiella* are identified. In that, *K. pneumoniae*, *K. oxytoca*, and *K. granulomatis* are associated with human illness. *K. ozaenae* and *K. rhinoscleromatis* are related to specific diseases. *K. planticola*, *K. terrigena*, and *K. ornitholytica* are also associated with human infections and are now transferred to a new genus called *Raoultella*.

The antibiotic sensitivity is done in Mueller-Hinton agar by the modified Kirby-Bauer disc diffusion method. All *Klebsiella* species shows inherent resistant to ampicillin and multi drug resistant strains are also emerging. They tend to harbor antibiotic-resistant plasmids, which serves as the most important cause for multiple infections. *Klebsiella* pneumoniae was the first and foremost extended variety of beta-lactamase strain discovered in Germany during 1980. Both morbidity and mortality are increased when these drug-resistant organisms cause the infection. The updated knowledge of the drug resistance pattern in a particular region is necessary for clinical practice. The current study is undertaken to know the prevalence of *Klebsiella* associated with infections and the antibiogram pattern of the isolates.

#### **METHODS**

In the present study, 1322 urine samples, 179 sputum samples, 957 pus swabs, 340 miscellaneous samples (body fluids and tracheal aspirate), and 723 blood cultures were collected from inpatients and outpatients of various departments in the tertiary care hospital during the period from August 2014 to October 2014.

#### Sample collection and bacterial identification

Urine, sputum, pus swab, and miscellaneous samples collected were inoculated on blood agar and MacConkey agar and incubated overnight at 37°C. For blood culture, an appropriate volume of blood of about 10 ml to 20 ml was collected in blood broth, and incubated at 37°C for 48 hours, and then inoculated on blood agar and MacConkey agar. Colonies were read after overnight incubation.

Klebsiella species were large dome-shaped colonies on blood agar and lactose fermenting mucoid colonies on MacConkey agar. In gram staining, gram-negative, short, plump, straight rods were seen. The biochemical reactions identified were indole negative (*K. pneumoniae*), indole positive (*Klebsiella oxytoca*), positive citrate utilization test, positive urease test, triple sugar iron (TSI) media shows fermentation of all three sugars leading to acid/acid, and abundant gas production from glucose, lactose, sucrose, maltose, and mannitol sugar fermentation tests.<sup>7</sup>

Antimicrobial susceptibility testing was performed for all isolated organisms on Mueller-Hinton agar by the modified Kirby-Bauer disc diffusion method. The

antibiotic discs with appropriate content were used and interrupted according to clinical and laboratory standards institute guidelines.<sup>8</sup>

#### **RESULTS**

Table 1 represents the isolated positive cultures. Among the total 3521 samples tested, 1322 were urine samples, 723 were blood cultures, 179 were sputum samples, 957 were pus samples, and 340 were miscellaneous samples like body fluids.

Table 1: Culture positivity among various clinical samples.

Sample	Total number	Number of culture positivity
Urine	1322	326
Blood	723	90
Sputum	179	57
Pus	957	623
Miscellaneous	340	10
Total	3521	1106

Table 2: Prevalence of *Klebsiella* isolates among various clinical samples.

Sample	No. of culture positives	No. of Klebsiella pneumoniae	No. of Klebsiella oxytoca
Urine	326	89	-
Blood	90	32	2
Sputum	57	42	-
Pus	623	180	7
Miscellaneous	10	9	-
Total	1106	352	9

Table 3: Isolation of *Klebsiella* from various departments.

Department	No. of Klebsiella species	Percentage
Medicine	97	26.9
Paediatrics	55	15.2
Surgery	130	36
Obstetrics and Gynaecology	38	10.5
Orthopaedics	32	8.9
Outpatient	9	2.5
Total	361	100

In the 3521 samples received, 1106 (31.4%) were the total positive isolates identified. Among the 1106 positive cultures, 623 were isolated from the pus samples, making the maximum count. Next are the urine samples in which 326 positive cultures, 90 were from blood cultures, 57 were sputum samples, and ten were from other body fluids samples.

Antibiotics	Pus (n=1	187)	Sputum	(n=42)	Blood (1	n=34)	Urine (1	1=89)	Miscell (n=9)	aneous
	S	R	S	R	S	R	S	R	S	R
Amikacin	154 82.4%	33 17.7%	34 81%	8 19%	32 94.1%	2 5.9%	78 87.6%	11 12.4%	8 88.9%	1 11.1%
Gentamycin	78 41.7%	109 58.3%	34 81%	8 19%	13 38.2%	21 61.8%	63 70.8%	26 29.2%	8 88.9%	1 11.1%
Ciprofloxacin	154 82.4%	33 17.7%	38 90.5%	4 9.5%	32 94.1%	2 5.9%	74 83.1%	15 16.9%	8 88.9%	1 11.1%
Ofloxacin	116 62%	71 38%	35 83.3%	7 16.7%	30 88.2%	4 11.8%	-	-	5 55.6%	4 44.4%
Cephalexin	37 19.8%	150 80.2%	19 45.2%	23 54.8%	1 3%	33 97.1%	-	-	-	-
Ceftrioxone	41 21.9%	146 78.1%	26 61.9%	16 38.1%	5 14.7%	29 85.3%	45 50.6%	44 49.4%	2 22.2%	7 77.8%
Cotrimoxazole	47 25.1%	140 74.9%	27 64.3%	15 35.7%	6 17.6%	28 82.4%	39 43.8%	50 56.2%	2 22.2%	7 77.8%
Norfloxacin	-	-	-	-	-	-	52 58.4%	37 41.6%	-	-
Nitrofurantoin	-	-	-	-	-	-	76 85.5%	13 14.6%	-	-
Amoxycillin	6 3.2%	181 96.8%	6 14.3%	36 85.7%	-	-	7 7.9%	82 92.1%	-	-

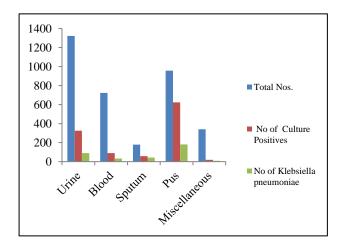


Figure 1: Prevalence of *Klebsiella pneumoniae* from various samples.

Table 2 shows the prevalence of *Klebsiella* species among 1106 positive culture samples. It is identified that 361 (32.6%) isolates were *Klebsiella* species. Among the 361 *Klebsiella* spp identified, *K. pneumoniae* was 352, and 9 were *K. oxytoca* species. In that, 352 *Klebsiella pneumoniae* were identified, 180 were from 623 pus samples, 89 were from 326 urine samples. Interestingly, in sputum samples though the positive cultures identified were less than 60 in number, about 42 were isolated as *Klebsiella pneumoniae*. Likewise, in 90 blood cultures, 32 were identified as *Klebsiella pneumoniae*.

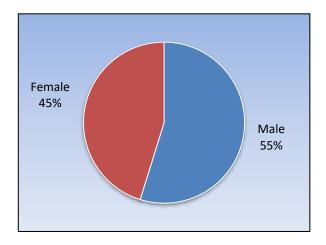


Figure 2: Sex prevalence of *Klebsiella pneumoniae* from various samples.

Figure 1 shows the chart representation of *K. pneumoniae* species from various samples. In this study, there were the highest isolation rates observed from sputum samples. On the other hand, out of nine *K. oxytoca* species, there were only two from 90 blood samples and seven from 623 pus samples. It was observed that there were nil *K. oxytoca* species in other culture-positive samples. Further, among the *Klebsiella* positive samples, 198 (54.8%) were from males, and 163 (45.2%) were from females showing male preponderance. Figure 2 illustrates the sex prevalence chart of *Klebsiella* isolates.

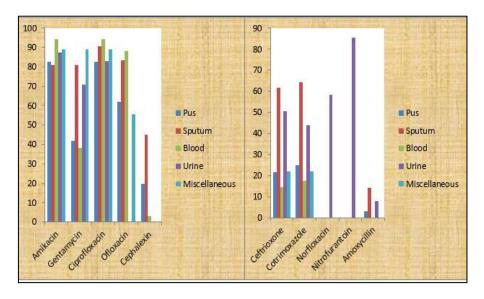


Figure 3: Antibiotic sensitivity pattern of Klebsiella isolates.

Table 3 represents the isolation rate of *Klebsiella* species from various departments. The highest isolation of species, about 26.9%, was in the department of Medicine, followed by Paediatrics, about 15.2%. The isolation rate of the surgery department was observed to be about 36%. There were about 10.5% in the department of Obstetrics and Gynaecology, followed by 8.9% species from the Orthopaedics department and 2.5% from the outpatient department.

Antibiotic sensitivity pattern of the *Klebsiella* isolated from various samples were depicted in Table 4. S represents sensitive and R represents resistance to various anti microbial drugs. Among pus samples, 82.3% were sensitive toamikacin and ciprofloxacin. 62% were sensitive to ofloxacin, 41.7% were sensitive to gentamycin, 25.1% were sensitive to cotrimoxazole and 22% were sensitive to ceftriaxone.

Among the sputum samples, 90.5% were sensitive to ciprofloxacin, 83.3% were sensitive to ofloxacin, 81% were sensitive to amikacin and gentamycin, 64.3% were sensitive to cotrimoxazole, 61.9% were sensitive to ceftriaxone and 45.2% were sensitive to cephalaxin.

Among urine samples, 87.7% were sensitive to amikacin, 85.4% were sensitive to nitrofurantoin, 83.1% were sensitive to ciprofloxacin, 70.8% were sensitive to gentamycin, 58.4% were sensitive to norfloxacin, 50.6% were sensitive to ceftriaxone, 43.8% were sensitive to cotrimoxazole.

Among blood samples, 94.1% were sensitive to amikacin and ciprofloxacin, 88.2% were sensitive to ofloxacin, 38.2% were sensitive to gentamycin, 17.6% were sensitive to cotrimoxazole, 14.7% were sensitive to ceftriaxone and 3% to cephalexin.

Among body fluids, 88.9% were sensitive to amikacin, gentamycin and ciprofloxacin, 55.6% were sensitive to ofloxacin and 22.2% were sensitive to ceftriaxone and cotrimoxazole. Figure 3 illustrates the chart of antibiotic sensitivity pattern of *Klebsiella* isolates with various drugs.

#### **DISCUSSION**

Klebsiella species are responsible for a broad spectrum of clinical infections in immuno-competent or immuno-compromised people. An extensive use of broad spectrum antibiotics in hospitalized patients has led to the increased prevalence as well as development of multidrug resistant strains of Klebsiella. This study reveals the prevalence and antibiotic sensitivity pattern of Klebsiella isolates.

The total number of *Klebsiella* isolates from various clinical samples in this study is 361 (32%). It is similar to the isolation rate seen in the study by Ravichitra. *Klebsiella oxytoca* isolated in this study is 2.5% which is lower compared to the study by Alves (15%). <sup>10</sup>

In this study, *Klebsiella* species were isolated more from males compared to females. This study is similar to the work conducted by Akter (males 57% and females 42%).<sup>11</sup>

The isolation of *Klebsiella* is maximum from sputum samples. This study is in accordance with the study by Ravichitra (30.9%).<sup>9</sup> In another study by Thosar, there is no significant difference in isolation of *Klebsiella* from various samples.<sup>12</sup>

The antibiotic susceptibility pattern of *Klebsiella* isolates from various samples showed higher sensitivity to amikacin and ciprofloxacin in similarity with the studies done by Sarathbabu, Sikarwar and Akter. 11,13,14 A study by Pavani showed that Klebsiella was more susceptible to amikacin but only moderate susceptibility to ciprofloxacin. 15

Urine samples showed higher sensitivity towards amikacin, nitrofurantoin, ciprofloxacin and the minor sensitivity towards ceftrioxazone and cotrimoxazole. The study done by Kumar showed a similar sensitivity pattern. <sup>16</sup>

In this study, samples from blood showed higher sensitivity towards amikacin, ciprofloxacin, ofloxacin and increased resistance towards ceftriaxone and cephalexin. A study conducted by Rajeevan showed similar results.<sup>17</sup>

#### **CONCLUSION**

Thus this study shows the prevalence rate of *Klebsiella* species and sensitivity pattern of *Klebsiella*, which may help select appropriate antibiotics and prevent overuse and misuse of antibiotics.

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Ethical approval: The study was approved by the

Institutional Ethics Committee

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