Original Research Article

Klebsiella Pneumoniae, an Important Uropathogen: Prevalence and Antimicrobial Susceptibility Pattern

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Abstract

Introduction: Urinary Tract Infections (UTIs) are amongst the 2nd most common infections after respiratory tract infections in community and healthcare settings (Hospital acquired infections). Klebsiella pneumoniae is the 2nd most common uropathogen after Escherichia coli. Klebsiella is known to have several virulence factors and resistant strains are rising which includes Extended-spectrum Beta-lactamase (ESBL) producing and Carbapenem-resistant strains. Aim of the study is to assess the prevalence of Klebsiella pneumoniae as an Uropathogen and their antimicrobial susceptibility pattern at a tertiary care hospital, Valsad. **Material and Methods:** Retrospective study is conducted including isolates of Klebsiella pneumoniae from urine samples received in microbiology laboratory at a tertiary care hospital, Valsad, Gujarat, India from January 2018 to December 2018. Processing of samples, isolation and identification of Klebsiella pneumoniae strains with Antimicrobial susceptibility testing were done using standard microbiology techniques. **Result:** Out of 576 urine samples received in 2018, 209 (36.28%) showed significant growth. Prevalence of Klebsiella pneumoniae as Uropathogen is 9.72% (n=576) and their antimicrobial susceptibility pattern shows higher resistance to β-lactum group (Penicillin, Cephalosporins and Carbapenem). Susceptibility is maximum against Chloramphenicol (87.5%) followed by Nitrofurantoin (64.29%), Amikacin (62.5%), Imipenem (60.71%), Meropenem (60.71%), Levofloxacin (57.14%) and Piperacillin/Tazobactum (57.14%).**Conclusion:** Klebsiella pneumoniae remains an important Uropathogen both in community and Hospital acquired infections. Resistance among Klebsiella pneumoniae strains shows upward trends over last few years. Increasing prevalence of ESBL producing and Carbapenem resistant strains creates alarming situation for healthcare system.

Key words: Klebsiella pneumoniae, Antimicrobial susceptibility pattern, Uropathogen

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Introduction

Klebsiella species are commensal in human intestines and saprophyte in soil. *Klebsiella pneumoniae*, an opportunistic pathogen, is responsible for lobar pneumonia, urinary tract infections, meningitis, septicemia and pyogenic infections in community and health care settings [1,2]. Urinary Tract Infections (UTIs) are amongst the 2nd most common infections after respiratory tract infections in community and healthcare settings (Hospital acquired infections), which is responsible for increased morbidity and economic burden to the community. *Klebsiella pneumoniae* is the 2nd most common uropathogen after Escherichia coli [3,4]. Capsular polysaccharides, lipopolysaccharide (LPS) and siderophores are important virulence factor associated with Klebsiella [5]. *K. pneumonia* strains can acquire a variety of β-lactamase enzymes, which can destroy the chemical structure of β-lactam antibiotics such as penicillins, cephalosporins and carbapenems, which are most widely used antibiotics [6]. *Klebsiella pneumoniae* is identified as one of the ESKAPE (*Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter, Pseudomonas aeruginosa and Enterobacter*) pathogens by the Infectious Diseases Society of America (IDSA) in 2004, which are considered as greatest threat, due to the emergence of strains that are resistant to all or most available antibiotics [2,7].

According to Center of Disease Control (CDC), Extended-spectrum Beta-lactamase (ESBL) producing and Carbapenem-resistant Enterobacteriaceae (CRE) are considered as serious and urgent threat for the whole world [8].

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Based on current scenario, it is of prime importance to know about prevalence of *Klebsiella pneumoniae* and its antimicrobial susceptibility pattern at local level to deal with it effectively.

Aim of the study is to assess the prevalence of *Klebsiella pneumoniae* as an Uropathogen and their antimicrobial susceptibility pattern at a tertiary care hospital, Valsad.

Material and Method

Setting: Tertiary care hospital, Valsad, Gujarat, India

Type of study: Retrospective study

Study duration: January 2018 to December 2018

Inclusion criteria: All samples of urine received in microbiology laboratory in sterile container which shows growth of Klebsiella pneumoniae.

Exclusion criteria: All samples of urine which shows growth other than *Klebsiella pneumoniae* or no growth.

Sample processing: Cultures of urine samples were done on Blood agar (Semi-quantitative method) and MacConkey agar. 10^5 Colony forming unit count is considered as significant growth. *Klebsiella pneumoniae* strains were identified using standard microbiology techniques [9].

Antimicrobial susceptibility testing of *Klebsiella pneumonia* strains were performed on Muller Hinton agar using disk diffusion (modified Kirby-Bauer) method as per Clinical laboratory Standard Institute guideline 2018 [10]. Standard strains used were ATCC *E. coli* 25922, ATCC *S. aureus* 25923 and ATCC *P. aeruginosa* 27853.

Data analysis: Data were entered in excel sheet and analyzed using Microsoft Excel.

Result

Out of 576 urine samples received in 2018, 209 (36.28%) showed significant growth.

Table-1: Frequency and percentage positivity of different organisms isolated from urine samples (n=209)

Sr. No.	Organism	Frequency (Out of 209)	Percentage positivity (%)
1	Escherichia coli	83	39.71
2	Klebsiella pneumoniae	56	26.79
3	Enterococcus spp.	28	13.40
4	Pseudomonas aeruginosa	14	6.70
5	Acinetobacter spp.	11	5.26
6	Proteus spp.	8	3.83
7	Staphylococcus aureus	5	2.39
8	Other	4	1.91

Table-1 shows *Escherichia coli* as commonly isolated organism followed by *Klebsiella pneumoniae* and other organisms.

Table-2: Age and sex wise distribution of *Klebsiella pneumoniae* strains (n=56)

Age in years	Male	Female	Total
1-18	6	7	13
18-55	8	28	36
> 55	5	2	7
Total	19	37	56

The chi square statistic is 7.4586. The p-value is 0.024 < 0.05. (Significant difference)

Table-2 shows age and sex wise distribution of *Klebsiella pneumoniae* strains. Age group 18-55 years is more common followed by age group 1-18 and > 55 years.

Females are more affected than male except in age group >55 years, where males are more affected. This difference is statistically significant according to chi square test.

Table-3: Location wise distribution of *Klebsiella pneumoniae* strains (n=56)

Location	No.
Outdoor Patient Department (OPD)	18
Indoor Patients Department (IPD)	38

Table-3 shows location wise distribution which shows higher isolation in indoor patients.

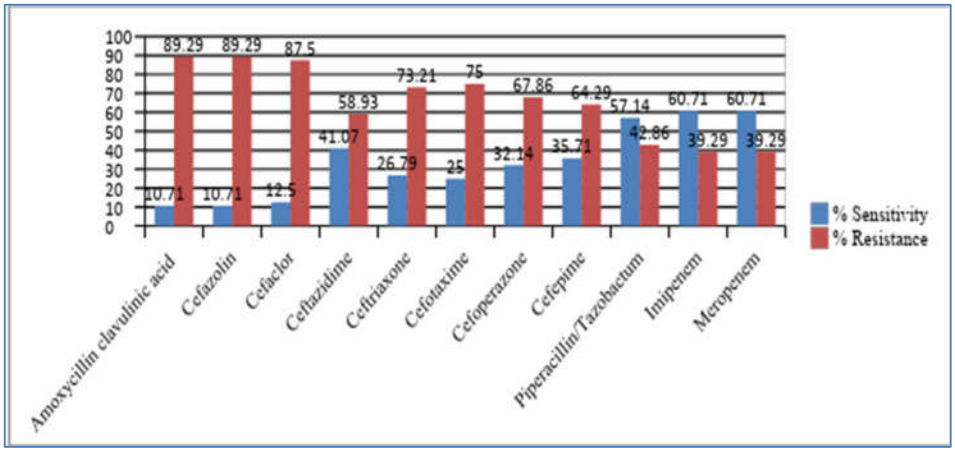

Figure-1: Antimicrobial susceptibility pattern (β-lactam group) of *Klebsiella pneumoniae* (n=56)

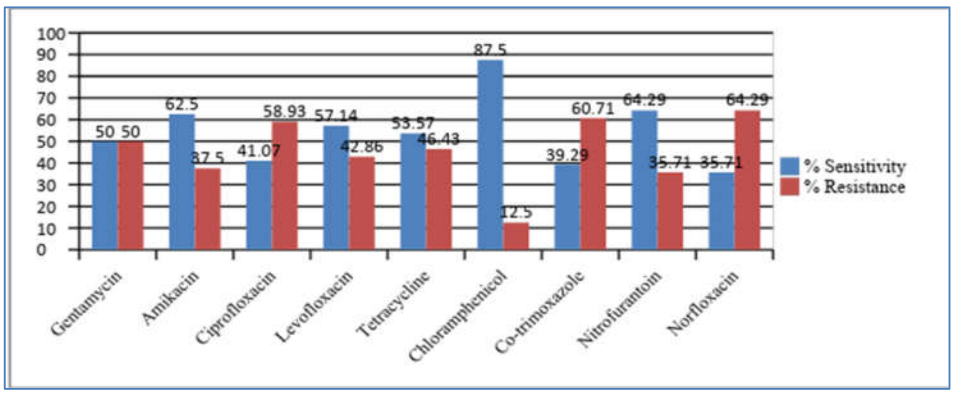

Figure-2: Antimicrobial susceptibility pattern (Other than β-lactam group) of Klebsiella pneumoniae (n=56)

Figure-1 and 2 shows antimicrobial susceptibility pattern of *Klebsiella pneumoniae* strains. Susceptibility to Chloramphenicol is 85.5% followed by Nitrofurantoin (64.29%), Amikacin (62.5%), Imipenem (60.71%) and Meropenem (60.71%), Piperacillin-Tazobactum (57.14%) and Levofloxacin (57.14%). Cephalosporins shows higher resistance.

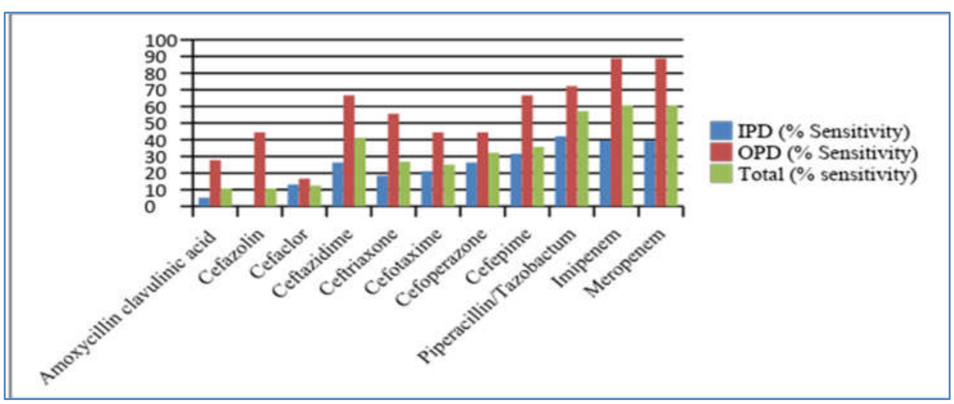

Figure-3: Comparison of % susceptibility of OPD (n=18), IPD (n=38) and Total (n=56) isolates (β-lactam group)

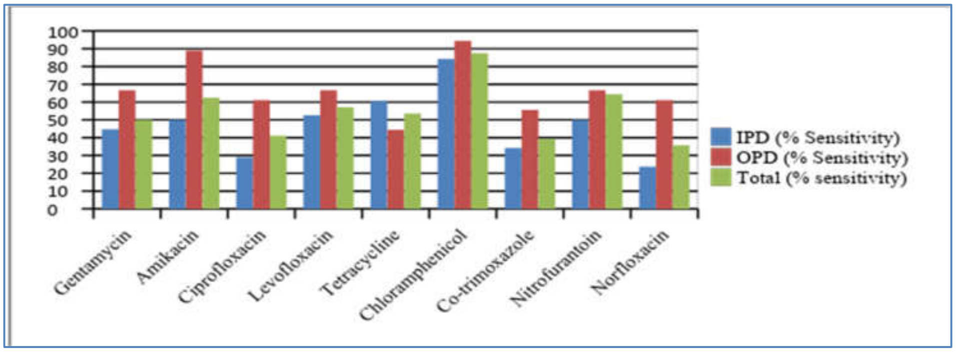

Figure-4: Comparison of % susceptibility of OPD (n=18), IPD (n=38) and Total (n=56) isolates (Other than β-lactam group)

Figure-3 and 4 show comparison between susceptibility of OPD, IPD and Total strains. OPD strains show good susceptibility to antimicrobial agent as compare to IPD strains.

Discussion

Prevalence of *Klebsiella pneumonie* as Uropathogen is 9.72% (n=576) and their antimicrobial susceptibility pattern shows higher resistance to β-lactam group (Penicillin, Cephalosporins and Carbapenem). Susceptibility is maximum against Chloramphenicol (87.5%)followed by Nitrofurantoin (64.29%), Amikacin (62.5%), Imipenem (60.71%), Meropenem (60.71%), Levofloxacin (57.14%) and Piperacillin/ Tazobactum (57.14%).

Table:1 shows frequency of different organisms isolated from urine samples. *Escherichia coli* (39.71%) is commonly isolated bacteria which is comparable with similar study conducted by Vicky Gandhi et al [11] which shows 36.75% and Harshkumar B. Patel et al [12]. which shows 36.11% prevalence of the same, followed by *Klebsiella pneumoniae* (26.79%) which is higher as compare to similar study conducted in Gujarat by Vicky Gandhi et al [11] which shows 18.21%, Harshkumar B. Patel et al. [12] which shows 18.06%, Parevee Dalalet al [13]. which shows 14.22%, Disha Sharma et al [14]. Which shows 9.04% and Nilofar R. Sodagar et al [15]. which shows 18.3% prevalence of *Klebsiella pneumoniae.* Table: 3 shows location wise distribution of *Klebsiella pneumoniae* strains. Increased prevalence of *Klebsiella pneumonia* in Indoor patients may suggest increasing nosocomial infection which creates alarming situation.

Table: 2 shows age and sex wise distribution, which is statistically significant (p value: 0.024). Higher prevalence in sexually active females of 18-55 years age group is because of shorter urethra, proximity of urethral meatus to anus and reinfection [1]. In male of age group >55 years, prevalence is high due to age related prostatic enlargement which interferes with emptying of bladder [1].

Figure: 1 and 2 shows Antimicrobial Susceptibility pattern of *Klebsiella pneumoniae*against different antimicrobial agents. 42.86% were ESBL producer. 39.29% strains were resistant to Carbapenem. Susceptibility pattern is comparable with similar study conducted in Ahmedabad, Gujarat by Harshkumar et al [12] and Parevee Dalal et al [13].

In present study, Susceptibility to Imipenem (60.71%), Levofloxacin (57.14%) and Cephalosporins (10-30%) is lower as compare to similar study conducted in Valsad by Niraj kumar Biswas et al [16] in 2014 (Imipenem 91.82%, Levofloxacin 66.70% and Cephalosporins 40-60%) and Vicky Gandhi et al [11] in 2016 (Imipenem 87%, Levofloxacin 60% and Cephalosporins 20-40%). Study conducted by Shankar Srinivasan et al [17] in 2014 at Mumbai shows Susceptibility of 89-90% for Carbapenems and Levofloxacin. Susceptibility to Nitrofurantoin is 64.29% which is comparable with study conducted at Udaipur by Ritu Bhatnagar et al [18] (68.57%).

This scenario suggests growing resistance among bacterial strains against commonly used flouroquinolones and cephalosporins as well as last resort drug, carbapenems. Resistances against commonly used antimicrobials create selective pressure on last resort drug. Selective pressure along with over the counter drugs, lack of regulations and unnecessary uses of antimicrobials are important factors responsible for increased resistance in developing country like India [19].Change in susceptibility pattern suggests increasing trend of resistance among *Klebsiella* strains. Antimicrobial policy should be made according to the susceptibility pattern. Hospital infection control measures should be followed stringently to control this situation.

Klebsiella pneumoniae is important nosocomial infections with higher chances of infection in immunocompromised patients, patients on mechanical ventilation, intravenous catheters, urinary catheters or on long course of immunosuppressant drugs [20]. Figure: 3 and 4 shows Comparison of % Susceptibility of OPD (n=18), IPD (n=38) and Total (n=56) isolates against different antimicrobial agents. Strains isolated from OPD patients shows higher Susceptibility even to Cephalosporins as compare to strains isolated from IPD strains. This may suggests increasing prevalence of nosocomial infections by resistant strains. Community acquired strains still have good Susceptibility against commonly used antimicrobials. Nitrofurantoin, an age old oral drug, can be used as an alternative for OPD patients.

Klebsiella pneumonie can acquire resistance against Carbapenem and other antimicrobial by various mechanisms which includes enzymatic inactivation, target site modification, efflux pump etc. Carbape-namase enzymes have significant impact on usages of antimicrobials in gram negative infections. These resistances are plasmid coded and can be transferred to other bacteria also, which increases chance of resistance among other bacteria in health care settings [21].

Further classification of Carbapenem resistant *Klebsiella pneumoniae* strains can be done based on Ambler classification [22]. Phenotypic and Molecular methods can detect different enzyme and its corresponding genes, which can help to evaluate prevalent resistant strains. Due to lack of testing facility at present study setup, it remains limitation for this study.

Conclusion

In community and Hospital acquired infections, Klebsiella pneumoniae remains an important Uropathogen. Resistance among Klebsiella pneumoniae strains shows upward trends over last few years. Increasing prevalence of ESBL producing and Carbapenem resistant strains creates alarming situation for healthcare system. Phenotypic and Molecular level gene analysis should be done to identify prevalence of resistant strains. Active surveillance system and stringent hospital infection control measures should be implemented to control further rise.

This study provides prevalence and Antimicrobial susceptibility pattern of *Klebsiella pneumoniae* as Uropathogen at local level to create antibiogram for Hospital infection control policy to deal with it effectively.

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