INTRODUCTION

The genus *Klebsiella* falls under the *Enterobacteriaceae* family is a non-motile, encapsulated Gram-negative bacterium characteristically lactose fermenting and facultative anaerobe in nature [1]. Eight species of *Klebsiella* are identified. In that, *Klebsiella pneumoniae*, *Klebsiella oxytoca*, and *Klebsiella granulomatis* are associated with human illness. Out of which, *K. pneumoniae* are a clinically important species accounting for 86% of human infections [2].

*Klebsiella* species are reported as an important member among hospital-acquired infections. Infection caused by *K. pneumoniae* is pneumonia, urinary tract infections, meningitis, wound infections, septicemia, etc. In the case of nosocomial infections, colonization of *Klebsiella* is due to presence of virulence factors and drug resistance [3]. Pathogenicity factors in *Klebsiella* species are acquisition ability for iron, presence of fimbriae, lipopolysaccharide, etc., *Klebsiella* with Types 1 and 3 fimbriae enhances the urinary tract infections, whereas the presence of lipopolysaccharide and capsule escapes phagocytosis, resulting sepsis and septic shock [4].

They are nearly always naturally resistant to ampicillin. Overuse and misuse of drugs have led to drug resistance as a result of which, 1980 in Germany extended spectrum of beta-lactamase (ESBL) strain was first and foremost isolated in *K. pneumoniae*. Now these strains of *Klebsiella* have become resistant to a wide group of antibiotics such as quinolones and aminoglycoside also. These multidrug-resistant (MDR) *Klebsiella* are responsible in increase surge of morbidity and mortality.

With the emergence of the MDR strain of *K. pneumoniae*, a great threat has evoked to public health and we are left with few therapeutic options, so updated knowledge of the drug resistance pattern in a particular region is necessary for clinical practice [5]. The current study was undertaken to know the prevalence of *Klebsiella*-associated infections and their antibiogram and resistance pattern in our region.

METHODS

Study design

This cross-sectional analytic study was carried out in the Department of Microbiology, People’s College of Medical Sciences and Research Centre, Bhopal, Madhya Pradesh after obtaining ethical approval from the institutional ethics committee.

Sample collection

Various clinical samples received in the microbiology laboratory for culture and sensitivity testing from inpatients and outpatients of various departments in the tertiary care hospital during the study period of 18 months, from January 01, 2014, to June 30, 2015 were considered.

Inclusion criteria

All lactose fermenting mucoid colonies on MacConkey agar, further confirmed as *Klebsiella* species were included in the study.

Exclusion criteria

Other than *Klebsiella* species isolates were excluded from the study.

Sample processing

Sputum, pus swab, and miscellaneous samples collected by aseptic precaution along with requisition form received by the department of microbiology were processed as per standard bacteriological techniques for aerobic cultures. After performing Gram-staining samples were inoculated on blood agar and MacConkey agar. Urine samples were inoculated on cystine lactose electrolyte deficient agar (CLED) and incubated overnight at 37°C. For blood culture, an appropriate volume of blood about 08–10 mL was collected in blood broth, and incubated at 37°C for 48 h, and then inoculated on blood agar and MacConkey agar. Colonies were read after overnight incubation.

RESULTS

During the study period, 332 *Klebsiella* species were isolated in various samples and out of which 98.7% were *Klebsiella pneumoniae* and were predominately from urine samples (37%). All isolates were processed to determine their antibiogram. The highest antimicrobial resistance was observed for third and fourth-generation cephalosporines (more than 85%).

Conclusion: It is concluded from our study that multidrug resistance *K. pneumoniae* are the emerging superbugs which require close monitoring and should be reported regularly which will guide clinicians in effective management and thus help in preventing the spread of multidrug resistance Klebsiella and future threat.
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**Kaur and Awari**

*Klebsiella* species were identified by colony characteristic of large dome-shaped colonies on blood agar and lactose fermenting, mucoid colonies on MacConkey agar. Gram staining showed Gram-negative, thick, and stout rod. *K. pneumoniae* were indole negative, whereas *K. oxytoca* was indole positive. Other biochemical tests observed were citrate utilization test and urease test positive, triple sugar iron (TSI) test showed acid/acid reaction with abundant gas production and glucose, lactose, sucrose, and mannitol sugar fermentation tests positive [6].

Antimicrobial susceptibility testing was performed for all isolated organisms on Mueller–Hinton agar by the Kirby–Bauer disk diffusion method. The antibiotic disks were used and interpreted according to the Clinical and Laboratory Standards Institute (CLSI) guidelines 2015 [7].

**Statistical analysis**

Data were collected in Microsoft Excel and result was analyzed and expressed in frequency and percentage.

**RESULTS**

In our study, *Klebsiella* species among positive culture samples were 332 in number, maximum positivity of *Klebsiella* species was observed in urine samples 125 (37.6%), followed by pus samples 116 (34.9%), sputum samples 60 (18%), then blood samples 26 (7.8%), and minimum were miscellaneous 05 (1.5%) which included body fluids, swab, tissue, etc.

Among the 332 isolate species, identification was as follows *K. pneumoniae* 328(98.7%) and *K. oxytoca* 04(1.2%). Maximum percentage of *K. pneumoniae* was isolated in urine culture positive samples 125 (37%). Similarly, in pus samples, 115 (34.6%), sputum and blood samples *K. pneumoniae* isolated were 59 (17.7%) and 26 (7.8%), respectively. Similarly, in miscellaneous samples, 5 (1.5%). In our study, out of four isolates of *K. oxytoca* ca 02 (6.5%) in urine samples and 01 (0.3%) in pus and sputum samples, respectively, as shown in Fig. 1.

Fig. 2 shows gender-wise positivity for *Klebsiella* species out of total 332 isolates female preponderance was observed in our study with 179 (54%), whereas male gender showed 153 (46%) positivity.

Fig. 3 represents the isolation rate of *Klebsiella* species from various departments. The highest isolation 36.10% (120) was observed in the department of surgery, followed by medicine 24.40% (81). The isolation rate in the obstetrics and gynecology department was observed to be 13.20% (44). There were about 11.70% (39) in the department of pediatrics, followed by 6.30% (21) from the orthopedics department and outpatient department and only 1.80% (6) from the ENT department.

Antibiogram of the *Klebsiella* species isolated from various samples is depicted in Table 1. Among various samples, the highest sensitivity was 81% toward amikacin and imipenem followed by more than 40% to meropenem, piperacillin–tazobactam, and ofloxacin and nearly 40% ceferazone sulbactum, ciprofloxacin, and Amonyclav. Less than 15% sensitivity was seen for cefotaxim, ceftriaxone, and ceftazidime in the urine sample sensitivity observed for nitrofurantoin and norfloxacin were 63% and 45%, respectively.

Based on different clinical samples (Fig. 4), it was noted that strains isolated from urine were 100% resistant to ampicillin and more than 90% resistant to third and fourth-generation cephalosporine. β-lactam/β-lactamase-inhibitor showed more than 70% resistance, whereas the weakest resistance was detected in cases of amikacin (18.4%) and imipenem (21.6%).

**DISCUSSION**

*K. pneumoniae* are an important member of ESKAPE and are considered most frequently isolated Gram-negative bacteria in the hospitalized patient [8]. Due to the wide use of antibiotics in hospitalized patients, the prevalence of the MDR *K. pneumoniae* is increasing. This study aims to reveals the prevalence and antimicrobial pattern of *Klebsiella* isolates.
Out of the total

Mutations in the chromosomal genes encoding

Resistant (%)

Ampicillin

Amikacin

Ciprofloxacin

Ofloxacin

Cefotaxim

Ceftazidim

Amoxycilav

Cefperazone-sulbactum

Piperacillin-tazobactum

Meropenem

Imipenem

Norfloxacin (in urine sample only)

Nitrofurantoin (in urine sample only)
CONFLICT OF INTEREST
Authors declare no conflict of interest.

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REFERENCES