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Research Article

Species Distribution and Multidrug Resistance Profiles of Clinical Acinetobacter Spp. Isolated from Diverse Clinical Specimens Using the VITEK 2 Compact System

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Abstract

Introduction: Acinetobacter is a highly diverse bacterial genus comprising several clinically important species, including Acinetobacter baumannii, Acinetobacter lwoffii, and others. These organisms are associated with a wide spectrum of infections such as bacteremia, pneumonia, wound infections, and urinary tract infections in both community and hospital settings. Among them, A. baumannii is recognized as one of the ESKAPE pathogens because of its remarkable ability to develop multidrug resistance, making treatment increasingly challenging. Aim: To isolate Acinetobacter species from various clinical samples and to check their antimicrobial susceptibility pattern by VITEK 2 Compact in SGT Hospital, Gururam, Haryana, India. Results: A total of 6,673 clinical samples were processed, yielding 595 culture-positive isolates, of which 35 were identified as Acinetobacter species. The isolates were recovered from patients admitted to different hospital wards. The occurrence of Acinetobacter infection was higher among males (57.14%) than females (42.86%). Species identification revealed 31 isolates of A. baumannii, 3 isolates of A. lwoffii, and 1 isolate of A. haemolyticus. The majority of isolates were obtained from blood samples (48.57%), followed by pus (22.85%), endotracheal secretions (22.85%), tracheal secretions (2.85%), and eye swabs (2.85%). Antimicrobial susceptibility testing demonstrated complete resistance to piperacillin/tazobactam, ceftriaxone, amikacin, and gentamicin (100% each). High resistance was also observed against ciprofloxacin (91.42%), ceftazidime (91.42%), cefepime (88.57%), levofloxacin (88.57%), and trimethoprim/sulfamethoxazole (80%). Colistin remained effective against 88.57% of the isolates. Conclusion: Acinetobacter species, particularly A. baumannii, continue to be important opportunistic pathogens responsible for both hospital-acquired and community-acquired infections. The high level of antimicrobial resistance observed among the isolates highlights the importance of accurate species identification and routine antimicrobial susceptibility testing to support appropriate therapeutic decisions and strengthen infection control strategies.

Keywords

Acinetobacter, VITEK 2 Compact, Multidrug Resistance, Pathogenicity, ESKAPE Pathogens, Hospital Acquired Infections

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1. Introduction

Genus *Acinetobacter* from Moraxellaceae family is a highly diverse aerobic, Gram negative coccobacilli which is saprophytic, oxidase positive and can form biofilm. Although *Acinetobacter* genus is highly diverse, there are more than 50 species known till date. However most of the species are widely dispersed in natural and clinical environment, and are non-pathogenic but species A. baumannii, A. calcoaceticus and A. lwoffii are most commonly known for causing infections. Species; *A. haemolyticus, A. johnsonii, A. junii, A. nosocomialis, A. pittii, A. schindleri, and A. ursingii* have also been reported as pathogens occasionally [1, 2].

Most of the species of this genus are common pathogens causing community acquired infections as well as hospital acquired infections. Wound infections, urinary tract infections, pneumonia and bacteremia following trauma, urinary catheters, mechanical ventilators, and central venous access are among the infections associated with these species [3].

Acinetobacter species shoes resistance to wide variety of antibiotics because of low permeability of its outer cell membrane and it can also accumulate its resistance mechanisms encoded on integrons, plasmids and transposons [4, 5].

Acinetobacter baumannii is one of the ESKAPE organisms (Enterococcus faecium, Staphylococcus aureus, *Klebsiella pneumoniae, A. baumannii, Pseudomonas aeruginosa, and Enterobacter spp.)*, which was identified as priority 1 pathogen for new antimicrobial development by World Health Organisation (WHO) [4]. To emphasise that they escape the lethal action of antibiotics that pose a global threat to human health and a therapeutic challenge due to emerging and constantly increasing resistance [6, 7]. As a health concern infections caused by *Acinetobacter* are difficult to treat because of the multidrug resistant strains and different antimicrobial resistance mechanism [4]. The aim of the study was to assess the identification and antimicrobial susceptibility pattern of this genus in various clinical samples by using VITEK 2 compact.

2. Material and Methods

The study was reterospective cross sectional for over 1 year (1 Jan 2023 to 31 Dec 2023) and was conducted in the Department of Microbiology, Faculty of Medicine and Health Science, SGT University, Gurugram, India. A total of 6673 clinical specimens were received in the Microbiology laboratory of SGT Hospital for culture and antimicrobial susceptibility from IPD and OPD which were included in this study.

2.1. Inclusion Criteria

1) OPD, IPD, ICU, RICU, CICU, ICCU, NICU, HDU, BICU, PICU patients
2) Patients of all age groups
3) Both males and females were included

2.2. Exclusion Criteria

Patients who were identified with bacterial isolates other than *acinetobacter sp.*

Patients satisfying inclusion criteria were included with the consent and no personal information was disclosed and used during the study, only clinical specimens were used to study the identification, history, risk factors and antibiotic susceptibility testing by standard disc diffusion method based on CLSI.

3. Specimen Collection and Processing

Blood, respiratory tract specimens, urine, pus, cerebrospinal fluid (CSF), tissue sample, plural fluid and other biological specimens collected according to standard laboratory procedures which were included in this study and were processed according to standard routine microbiology laboratory procedures.

Urine and CSF, pus and body fluids were collected in a wide mouthed, sterile, leak proof, screw capped container and swabs were taken by sterile cotton/dacron swabs aseptically, Blood samples were collected in autamated culture bottels and sample were brought to the laborartory withouit any delay.

Urine (mid stream) samples were inoculated on CLED (cystein lysine electrolyte deficient) media, Blood specimens were processed in Bact/Alert for 5 days. Positive samples of blood further processed along with pus, eye swab, CSF, fluid and other clinical samples on Blood and MacConkey agar.

Identification of Gram negative bacteria was done by Gram's staining, colony morphology on Blood agar, MacConkey agar and other biochemicals as Gram negative cocobacilli, non motile on mannitol motility test medium, oxidase negative (did not produce oxidase) and catalase producing, citrate utilization and hemolysis on blood agar. *Acinetobacter* identification and antibiotic susceptibility was further confirmed by Vitek 2 compact. Piperacillin/Tazobactam, Ceftriazone, Cefoparazone/Sulbactum, Cefepime, Imepenem, Meropenem, Amikacin, Gentamicin, Ciprofloxacin, colistin and Trimethoprim/Sulfamethoxazole were the following antibiotics which were used to check the antimicrobial susceptibility of *acinetobacter* species, were used in VITEK card. From all 6673 clinical specimens 595 was culture positive isolates and out of 595 positive isolates 35 were reported as *acinatobacter.*

4. Results

4.1. Isolation of Positive Samples from Different Clinical Wards

A total of 6673 samples were received in microbiology laboratory of SGT Hospital from which only 595 were the positive isolates. Clinical samples were received from all the wards including IPD (49.24%), OPD (33.61%), ICU (5.8%), RICU (3.03%), SICU (2.86%), ICCU (2.02%), NICU (1.34%),

HDU (0.84%), BICU (0.67%) and PICU (0.50%). The maximum number of positive isolates were obtained from IPD (Table 1) (Figure 1).

Table 1. *Number of isolates and their percentage of the clinical samples obtained from all the wards.*

Location type	Number of isolates	Percentages (%)
IPD	293	49.24%
OPD	200	33.61%
ICU	35	5.885
RICU	18	3.03%
SICU	17	2.86%
ICCU	12	2.02%
NICU	8	1.34%
HDU	5	0.84%
BICU	4	0.67%
PICU	3	0.50%
Total	595	100%

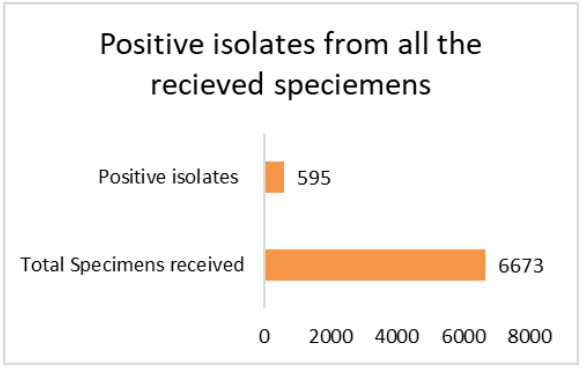

Figure 1. *Percentage of positive isolates from the total samples received.*

4.2. Positive Isolates for Acinetobacter in Different Clinical Specimen

A total of 35 Acinetobacter isolates were recovered from various clinical specimens during the study period. Blood samples constituted the predominant source of isolation, accounting for 17 isolates (48.57%). Pus and endotracheal (ET) samples each yielded 8 isolates (22.85% each), indicating substantial involvement of wound and respiratory tract infections. Tracheal aspirate and eye specimens contributed minimally, with one isolate each (2.85%). (Table 2) (Figure 2).

Table 2. *Positive isolates for acinetobacter in different clinical specimens.*

Speciemen type	No. Of positive isolates for acinetobacter	Percentage (%)
Pus	8	22.85%
Blood	17	48.57%
E. T	8	22.85%
Tracheal aspirate	1	2.85%
Eye	1	2.85%

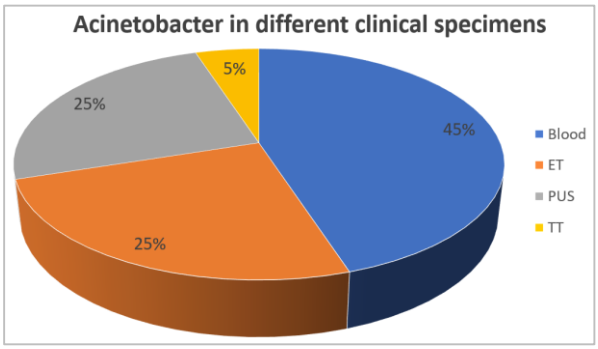

Figure 2. *Positive isolates for acinetobacter in different clinical specimens.*

Among the 35 Acinetobacter isolates recovered during the study period, 20 (57.1%) were obtained from male patients, while 15 (42.9%) were from female patients, indicating a slight male predominance (Table 3) (Figure 3).

Table 3. *Gender wise distribution of positive isolates of acinetocater.*

Gender wise distribution	No. Of positive isolates of acinetobacter	Percentage
Males	20	57.16
Females	15	42.84

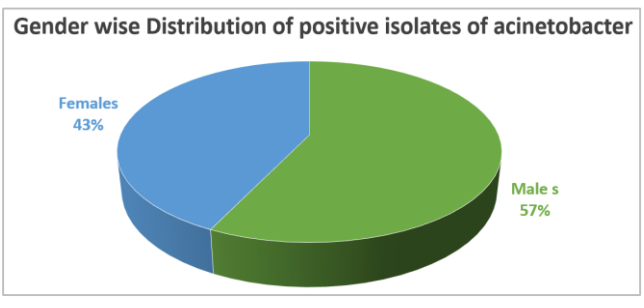

Figure 3. *Gender wise distribution of positive isolates of acinetocater.*

Species-level identification of the *Acinetobacter* isolates revealed a clear predominance of Acinetobacter baumannii. Out of a total of 35 isolates, 31 (88.57%) were identified as A. baumannii, followed by *Acinetobacter* lwoffii with 3 isolates (8.57%) and A*cinetobacter haemolyticus* with 1 isolate (2.85%). (Table 4) (Figure 4).

Table 4. *Species level distribution of acinetobacter isolates: (Table 4).*

Acinetobacter species	Number	Percentage
Acinetobacter baumannii	31	88.57%
Acinetobacter lwoffi	3	8.57%
Acinetobacter haemolyticus	1	2.85%

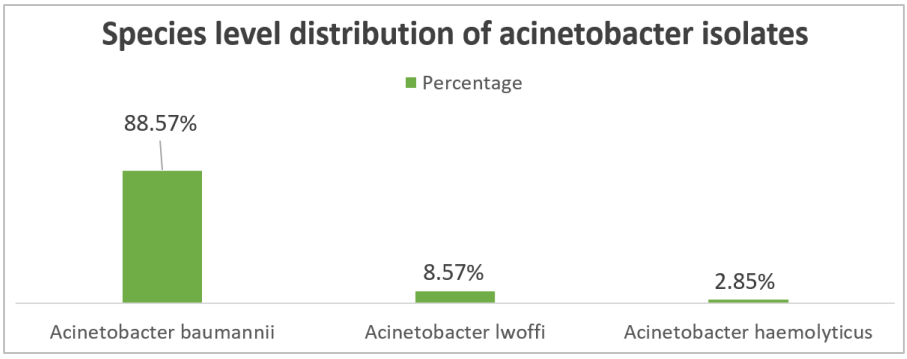

Figure 4. *Species level distribution of acinetobacter isolates: (Table 4).*

VITEK 2 Compact was used determination of antimicrobial resistivity and sensitivity pattern in *acinetobacter* species. Among all 35 isolates of *Acinetobacter* all shows 100% resistivity to piperacillin/tazobactam, ceftriazone, amikacin and gentamicin, High level of resistance were seen in ciprofloxacin (91.42%), ceftazidime (91.42%).0, cefepime (88.57%), levofloxacin (88.57%). (Table 5) (Figure 5).

Table 5. *Antibiotic susceptibiity profile of acinetobacter via VITEK 2 Compact.*

Antibiotic	Sesitivity no.	Sensitivity%	Resistance No.	Resistivity%
Piperacillin/tazobactam	0	0%	35	100%
Ceftriazone	0	0%	35	100%
Cefoperazone-sulbactam	6	17.14%	29	82.85%
Cefepime	2	5.71%	31	88.57%
Imepenam	3	8.57%	32	91.42%
Meropenam	3	8.57%	32	91.42%
Amikacin	0	0%	35	100%
Gentamicin	0	0%	35	100%
Ciprofloxacin	3	8.57%	32	91.42%
Colistin	31	88.57%	4	11.42%
Trimethoprim/sulfamethoxazole	9	25.71%	26	74.28%
ceftazidime	3	8.57%	32	91.42%

Antibiotic	Sesitivity no.	Sensitivity%	Resistance No.	Resistivity%
Levofloxacin	4	11.42%	31	88.57%
Minocyclin	13	37.14%	5	14.28%

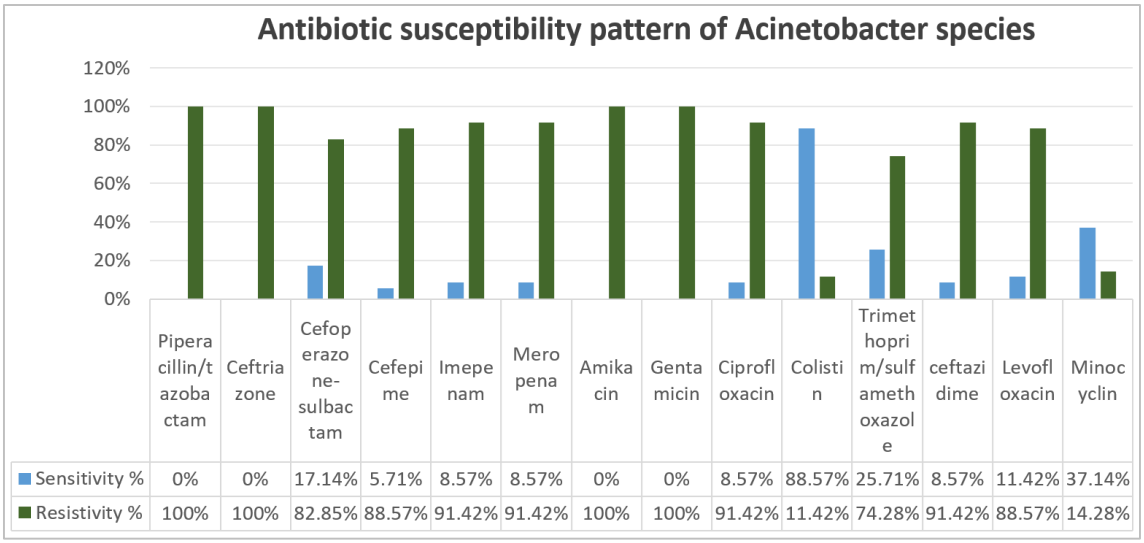

Figure 5. *Antibiotic susceptibiity profile of acinetobacter via VITEK 2 Compact.*

Among a total of 35 *acinetobacter* isolates 26 (74.28%) were MDR. All MDR isolates belonged to A. baumanii. Similar study was conducted in Nepal and Amatya et al reported 71.3% rate of MDR in Acinetobacter. Rajkumari S et al in her study reported 76.81% MDR Acinetobacter [8, 9].

5. Discussion

Acinetobacter is an nosocomial pathogen which is also an opportunistic pathogen commonly causing diseases in immnunocompromized patients and other patients. Genus *Acinetobacter* has become an important source of critical thinking due to its ability of showing resistance to most of the antibiotics present for treating the infections caused by this particular genus. *Acinetobacter* genus has emerged as a cause of ICU infections more overly.

We investigated the presence and antimicrobial susceptibility pattern of genus Acinetobacter and its species including *Acinetobacter baumannii, Acinetobacter lwoffii and Acinetobacter haemolyticus*; as these were the strains which were isolated from the different clinical samples which ere recived in the microbiology laboratory of SGT University, budhera, gurugram.

In our study we studied 35 isolates of *Acinetobacter* in which 31 were *Acinetobacter baumannii*, 3 were *Acinetobacter lwoffii* and 1 was *A. haemolyticus.*

In our study the prevalence of *Acinetobacter* was 5.88% which was comparable with a study done by RB Madhavi et al which was 8.9%. and Chitrabhanu et al who reported as 6.2% [10, 11].

Majority of *Acinetobacter* infections in our study was isolated from blood specimens (48.57%) and in a similar study SH Mohammed shows 36.9% prevalence of *Acinetobacter* in blood infections [12].

In our study, Infections due to *Acinetobacter* were seen more common in males (57.14%) as comparative to females (46.8%), similar findings were also observed by RB Madhavi *Acinetobacter* infections occurred significantly in male patients (65.7%) than in female patients (34.3%) [10].

In our study specimens which commonly yielding growth for *acinetobacteria* was blood (48.57%), pus (22.85%), Endotracheal (22.85%), tracheal aspirates (2.85%) and eye swab (2.85%).

In our study *Acinetobacter baumannii* (80%) is prominently present in most of the clinical specimens along with *A. lwoffii* shows 14.28% and *A. haemolyticus* shows 5.71% prevalence among all the isolates reported positive for *Acinetobacter*. Similar study was also conducted by R Kaur et al Acinetobacter spp. Reported in their study was, 91.6% were *Acinetobacter Baumanii* & 5.6% *Acinetobacter lwoffi*, 2.8% *Acinetobacter hemolyticus*. Therefore *A. baumannii* was prominent in all clinical specimens which were positive for *Acinetobacter*, this was possible due to three major factors which may contributing to the persistence a of *A. baumannii* i.e., because of high level of resistance to major antimicrobials, suitable environment and immunocompromised patients [13, 14].

High level of resistance were seen for piperacillin/tazobac-

tam (100%), ceftriazone (100%), amikacin (100%), gentamicin (100%) ciprofloxacin (91.42%), ceftazidime (91.42%), cefepime (88.57%), levofloxacin (88.57%) and trimethoprim/sulfamethoxazole (80%) in our study. Taneja et al in their study reported resistance of *Acinetobacter* towards Gentamicin and ciprofloxacin was 79.5% and 72.8% respectively [15].

Resistivity towards imepenam (62.85%), meropenem (54.28%) and minocycline (14.28%) were reported. Amardeep et al in a similar study reported the resistance of *Acinetobacter*, towards imipenem (42.6%) and meropenem (55.4%). High Sensitivity towards colistin (42.85%) were reported among all the isolates of *Acinetobacter* genus. Similar study was conducted by P Singh et al showing 92.6% sensitivity of *Acinetobacter* isolates towards colistin. [16, 17].

6. Conclusion

Our study showed the significant prevalence of *acinetobacter* in our area (SGT hospital, gurugram; Delhi NCR region). 5.88% prevalence along with 80.4% of resistance towards antibiotics were reported in our study which is a challenge for healthcare system to overcome because of high resistance towards commonly used antibiotics, however colistin is somehow showing an emerging sensitive effect on *acinetobacter*. Regular use of antibiotics without proper investigations is leading to resistance of commonly used antibiotics for treating infections. This indicates the role of *acinetobacter* in nosocombial and opportunistic pathogen causing a wide variety of infections.

Aim of our study was to isolate *acinetobacter* species and to report the antimicrobial resistance pattern of genus *acinetobacter* from various clinical samples in our hospital. Hence this study was conducted to strengthening hospital infection control and prevention control practices in health care settings and projecting attention to the use of antimicrobials accordingly which may helps in preventing the occurrence of MDR *acinetobacter* species.

Abbreviations

ESKAPE	Enterococcus Faecium, Staphylococcus Aureus, Klebsiella Pneumoniae, Acinetobacter Baumannii, Pseudomonas Aeruginosa, Enterobacter Species
WHO	World Health Organization
OPD	Outpatient Department
IPD	Inpatient Department
ICU	Intensive Care Unit
RICU	Respiratory Intensive Care Unit
CICU	Cardiac Intensive Care Unit
ICCU	Intensive Coronary Care Unit
NICU	Neonatal Intensive Care Unit
BICU	Burn Intensive Care Unit
PICU	Pediatric Intensive Care Unit
HDU	High Dependency Unit
CSF	Cerebrospinal Fluid
CLED	Cystine Lactose Electrolyte Deficient (agar)
ET	Endotracheal
MDR	Multidrug Resistant

Author Contributions

Pooja Rani: Conceptualization, Methodology, Investigation, Data curation, Writing – original draft

Nikhil Payal: Supervision, Formal analysis, Investigation, Validation, Writing – review and editing

Manisha Khandait: Resources, Supervision, Validation, Writing – review and editing

Swati Dixit: Project administration, Writing – review and editing

Conflict of Interest

The authors declare no conflict of interest.

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