e-ISSN: 0975-1556, p-ISSN:2820-2643
Available online on www.ijpcr.com
International Journal of Pharmaceutical and Clinical Research 2024; 16(1); 1469-1474

Original Research Article

Study of Bacteriological Profile and Antibiogram of Infections in Intensive CareUnits of a Tertiary Care Hospital

Kumari Jyoti[1], Sunanda Kundu[2], Namrata Kumari[3], Kumar Saurabh[4]

[1]Medical Lab Technologist, Department of Microbiology, IGIMS, Patna
[2]Multidisciplinary Research Unit, IGIMS, Patna
[3]Professor & HOD, Department of Microbiology, IGIMS, Patna
[4]Assistant Professor, Department of Microbiology, IGIMS, Patna

Received: 14-11-2023 / Revised: 27-12-2023 / Accepted: 19-01-2024
Corresponding Author: Dr. Namrata Kumari
Conflict of interest: Nil

Abstract:

Background and Objective: The intensive care unit (ICU) often called as the epicentre of infections, due to its vulnerable population. It has been reported that the incidence of nosocomial infections in the intensive care unit (ICU) is about 2 to 5 times higher than in the general inpatient hospital population. The present study aims to know the causative organisms and antibiotic susceptibility of infections in intensive care units.

Methods: It is a prospective study with 300 patients with suspected infections included were included. Samples were processed as per standard guidelines and the colonies were identified according to standard bio-chemical tests. Antibiotic susceptibility testing was done on Muller Hinton agar using Kirby Bauers's disc diffu-sion test. ESBL production was tested by disc diffusion method as in CLSI phenotypic method (2017).

Conclusion: There is increase in number of infections in ICUsdue to multidrug resistance organism, which is the big public health threat and challenge for both prevention and treatment of infections. Thus, the incidence rates, the causative agents and their susceptibility play a vital role in the management of infections in ICU.

Keywords: Endotracheal aspirate, ESBL, ICU.

Introduction

Infections are a common problem for patients in intensive care units (ICUs) and areassociated with substantial morbidity, mortality, and costs. [1] The intensive care unit (ICU) often is called the epicentre of infections, due to its vulnerable population and increased risk of getting infections through multiple procedures ,use of invasive devices such as endotracheal intubation, central venous cannulations, mechanical ventilation (MV), and urinary catheterisation distorting the anatomical integrity. [2] ICU population has one of the highest occurrence rates of nosocomial infections (20– 30% of all ICU-admissions). [3] The European Studies on Prevalence of Infections in ICU (EPIC-1 and EPIC-2) reported a high prevalence of infections in a number of European countries. [4,5] High prevalence of infections, especially nosocomial, has alsobeen reported from medical ICUs in the United States. [6] The elderly age group, APACHE-2 scores and high prevalence of co-morbid conditions are associated with infections in ICU. [4] In a study by Divatia JV et al. on Infections in Intensive Care in India showed,35.9% of culture positive isolates within the positive isolates,68.9% were Gram- negative organisms, 15.9% were Gram-positive organisms, 7.5% fungi, 2.4% mycobacteria, 1.7% viruses, and 1.1% malarial parasites. The EPIC-II showed, 69.6% culture positive isolates, within the culture positives 47% were Gram positive, 62% were Gram negative, Anaerobes were 4.4%, Fungi were 18.5%, Viral/parasite 2.6%, Others 2.2%. [4] Infections in the intensive care unit (ICU) are classified into Community-acquired, Hospital-acquired, ICU acquired. The EPIC-2 study showed that lungs were the mostcommon site of infection, accounting for 64% of infections, followed by abdominal(19%) and bloodstream infections (15%). The risk of acquiring the infection incritically ill patients in the ICU is around 18%. [4] The three likely portals of entry are more importantly is inhalation, ingestion, and contact. Spread of infection through contacts is by intubation and use of nasogastrictube in-situ, physical contact with the patient or with the patient's devices. [7] It has been reported that the incidence of nosocomial infections in the intensive careunit (ICU) is about 2 to 5 times higher than in the general inpatient hospital population. [8,9] As infection in ICU can be both Community acquired and hospital acquired. Community acquired Infection such as meningitis and pneumonia may cause potentially life threatening infection. Even with the availability of

potent newer antibiotics, the mortality rate due to acutebacterial meningitis remains significantly high in India and other developing countries, which is nearly 22%. [10] The common causes of bacterial meningitis in adults are *Neisseria meningitides*, *Streptococcus pneumoniae* and *Listeria monocytogenes*, and *staphylococci and Haemophilus influenzae* is rarely seen in an adult, in case Hib vaccination during childhood[10]. Community acquired pneumonia (CAP) defined as pneumonia not acquired in a hospital or a long-term care facility. The overall annual incidence of CAP ranges from 5 to 11 per 1,000 persons, with more cases occurring in the winter months. [11] Survey of 16 studies of severe CAP showed, *S. pneumoniae* in 12–38%, *Legionella* sp., in 0–30 %; *Staphylococcus aureus* in 1–18% and Gram negative enteric bacilli was seen in 2– 34%. [12] But in India *Str. pneumoniae* (35.3%) is the most common isolate, followed by Staphylococcus aureus (23.5%), *Klebsiella pneumoniae* (20.5%), and *Haemophilus influenzae* (8.8%). [13] There is a great need for local resistance prevalence data in order to guide empirical prescription and to identify areas in which medical need for new agents is needed. Hence, this study is undertaken to determine the bacteriological profile of organisms causing infections in intensive care units.

Objectives

- To study the antibiotic susceptibility patterns of the isolated organisms.
- To screen for ESBL (extended spectrum beta lactamase) producing bacterialisolates.
- To screen for MRSA (Methicillin Resistant Staphylococcus Aureus) producing bacterial isolates.

Material and Methods

It is a prospective cross-sectional study of bacterial isolates from patients admitted tointensive care unit with clinical signs and symptoms of infection, Total 300 patients with suspected infections included were included. Samples were processed as per standard guidelines and the colonies were identified according to standard biochemical tests. Antibiotic susceptibility testing was done on Muller Hinton agar using Kirby Bauers's disc diffusion test. ESBL production was tested by disc diffusion method as in CLSI phenotypic method. Department of Microbiology, Indira Gandhi Institute of Medical Sciences Patna, bihar. Study duration of Two Years.

Inclusion Criteria: Patients with clinical symptoms and signs of infections admitted in intensive careunits are included in study.

Exclusion Criteria

- Paediatric and neonatal intensive care units.
- Cases referred to the hospital from outside.
- Patient with HIV, HCV, HBV Co infection

Fungal Infection: Gram stain was performed on the samples (endotracheal aspirate, pus) and interpreted for the presence and numbers of WBCs and bacterial and fungal elements and presence of bacteria.

Processing and Identification: Samples were sent to laboratory from intensive care units as per the infectioninvolved, under aseptic precautions. Blood Paired blood sample of quantity 10-20 m1 inoculated into BHI broth and are incubated 35°-37°C & routinely inspected twice a day for the first 3 days and are incubated Up to 7 days. Subcultured on MacConkey's and 5% sheep blood agar plates after 24, 48 and 72 hr. The plates will be incubated for 24hr at 37^0C and also the bottles were examined daily for visible sign of growth in the bottle. Further processing of positive blood cultures Gram-stain a thin smear from the broth or agar in case growth. Subculture to agar media and biochemical tests were performed based on the Gramstain Results.

Antibiotic Susceptibility Testing: According to CLSI guidelines (81), HiMedia disks for the following antibiotics were used Gram negative organisms: Ampicillin (10µg), Amoxicillin-Clavulanate (20/10µg) Gentamicin (10µg), Amikacin (30µg), Piperacillin-Tazobactam (100/10µg), Cefepime (30µg), Cefoxitin (30µg), Cefotaxime (30µg), Ciprofloxacin (5µg), Ceftriaxone (30µg), Imipenem (10µg), Ertapenem (10µg), Cotrimoxazole (1.25/23.75µg), Aztreonam (30µg), Ceftazidime (30µg), Chroramphenicol (30µg), Tetracycline (30µg), Tigecycline (15µg), Levofloxacin (5µg).

Gram positive organisms: Penicillin (10units), cefoxitin (30µg), Tetracycline (30µg), Ampicillin (10µg), Ciprofloxacin (5µg), Linezolide (30µg).

Results

Demographic Data of the Study

Table 1:

Demographics	
Age (years)	45.7 ± 14
Male (n=%)	192(64%)
ICU (days)	8.3 ± 5.6

Male(n=%)	Female(n=%)
192(64)	108(36)

Showing Gender distribution in the study

Pie chart showing distribution of gender distribution study.

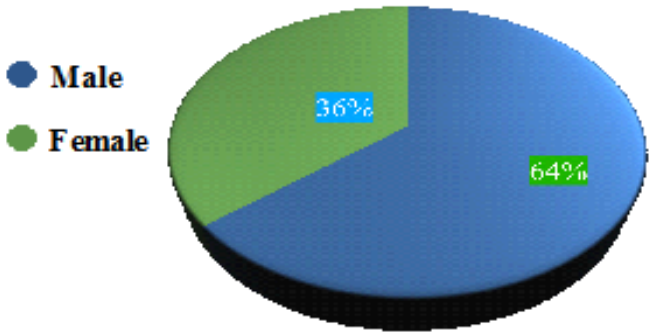


Chart 1:

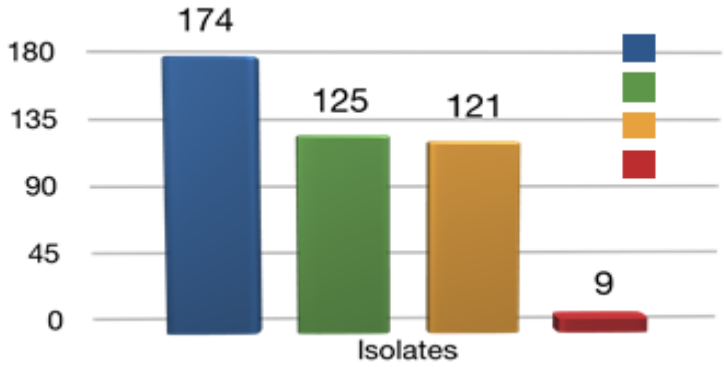
Showing different isolates from the study group

Table 2:

Name	N=429	Percentage
Endotrachealaspirate	174	40.4%
Blood	121	28%
Urine	125	29%
Pus	9	2.1%

Graph showing different samples from study group

Endotracheal aspirateUrine BloodPus



Endotracheal aspirate(40%) was the commonest sample followed by,urine(27%),blood(28%) and pus(2%) total culture positive among isolates

Culture positive	Culture negative
26%(112)	74%(317)

Total of 429 clinical samples were collected from 300 patients. Among 429 samples,112 (26%) samples were culture positive, and predominantly culture was positive from endotracheal aspirate (74%), followed by urine (14%), 9.6% from blood (9.6%) and skin and soft tissue (5%).

Growth from aerobic culture of endotracheal aspirate sample

	Number (n=174)	Percentage
Culture negative	91	52%
Culture positive	83	48%

Total number of 174 samples were processed and aerobic culture was positive I 48%(n=83).

Most common organism isolated from aerobic culture were Klebsiella sp(40%)followed by Acinetobacter sps (35%), Escherichia coli(13%),Pseudomonas aeruginosa(9%), Staphylococcus aureus(1%).

Antibiotic resistant pattern seen in of Klebsiella Spp endotracheal aspirate sample .

	Amc	Gen	Cot	Pit	Imp	Cip	CTR	Tgc	C	At	Te
Sensitive	0	21	14	12	27	9	14	19	18	14	16
Resistant	33	12	19	21	6	24	19	0	3	19	3

Total of 33 Klebsiella sp (both Klebsiella oxytoca and Klebsiella pneumoniae)

Almost all the isolates were resistant to amoxycillin-clavulanate (100%). 44% of Klebsiella sp were sensitive to 3rd generation cephalosporins.,65% Klebsiella sp. was sensitive to amikacin . Highest sensitivity was seen in imipenem(82%), and tigecycline(100%)

Organism isolated from blood sample.

	Numbers (n=8)	Percentage
Klebsiella pneumoniae	3	37.5%
Pseudomonas aeruginosa	3	37.5%
Staphylococcus aureus	2	25%

In Total of 121 blood samples were processed and 8 (6.6%)samples were culturepositive which yielded Klebsiella pneumoniae and Pseudomonas aeruginosa, Staphylococcus aureus.

total of 9 samples were received and among them 5 (55.5%) samples were culture positive and organism isolated were Escherichia coli (n=2), Klebsiella sps. (n=1), Pseudomonas aeruginosa(n=1), and Staphylococcus aureus (n=1). All the isolates from skin and soft tissue were sensitive to amikacin andgentamicin.

Phenotypic Detection of ESBL by CDT

Total of 65 isolates were screened for aztreonam and cefotaxime and cetazidime and 34 isolates were sensitive.

Rest of 32 isolates were tested with cefotaxime and cefotaxime clavlunic acid and ceftazidime and ceftazidime clavulinic acid by CDT. 12(38%) samples were showed positive for ESBL by combined disk diffusion

Discussion

Infections are one of the most important causes of mortality in the world, more so in low and lower-middle income countries. The intensive care units constitute less than 10% of total hospital beds but they harbour up to 30% of the nosocomial infections in the hospital. Infections in ICU consists of both community acquired and hospital acquired. With the emergence of multidrug resistant strains the early identification and diagnosis are of utmost concern. Hence, understanding the bacteriology and antibiogram of infections in ICU is of immense importance for better management. In this study the mean age of the patients were 45.7 ± 14 years and there were 192 men (64%) and 108 women (36%).

Prevalence of microbiologic isolates in Intensive Care Units

A total of 429 samples were received from 300 patient, total culture positive among samples were 26% (112) which is similar to the study done by Ghanshani, et al where culture positive was 28% (623). But the culture positive seen in study by Vincent et al [4] showed 38.3%, 35.9% culture was positive in Divatia JV et a whichwas higher than the present study, these findings may be due to the relatively small sample size of the present study.

Prevalence of microbiologic isolates in ICU from different parts of India

Studyn (%)	Vincent et al.	Ghanshani et al.	In this study
Culture positive	505(38.3%)	623(28%)	112(26%)
Gram negativeorganism	376(74.5%)	475(76%)	106(95%)
Gram positiveorganism	168(33.3%)	99(16%)	6(5%)

Gram-negative bacteria were predominant and included 38% of *Klebsiella spp*, 26% of *Acinetobacter spp*, 21% of *Escherichia coli* and 10% *Pseudomonas aeruginosa*, *Staphylococcus aureus* was isolated in 5%. The findings are similar to the study doneby Patwardhan et al.

The study conducted by Ghanshani, et al showed similar organisms but most frequently isolated were *Acinetobacter baumannii* (20.9%), *Klebsiella pneumoniae* (19.7%), *Escherichia coli* (18.3%), and *Pseudomonas aeruginosa*(14.0%).

Prevalence rates of infections in ICU

The infections rate was maximum in the skin and soft tissue infections (55%), pneumonia (48%) followed by UTI (12%), bloodstream infection (6%). VAP (74%) followed by urinary tract infection (14%) were the most commonly seen HAIs in present study, and is similar to study conducted by EPIC II [4] and Michael *et al*. [14] but other studies conducted by Lee *et al*., [15] Richards *et al*. [16] and Mythri et al [17] et al., the incidence of UTI was most common followed by pneumonia and blood stream infections.

Prevalence rates of infections in ICU reported from other studies.

	Pneumonia (%)	Bloodstreaminfection (%)	Urinary tractinfection (%)
Vincent et al.	46.9	12.0	17.6
Kallel et al.	58.2	18.2	14.5
Markogiannakis et al.	25.3	36.1	9.5
In this study	74	6	12

Different isolates obtained from urine samples in various studies.

Study	Organisms isolated
Mojtahedzadeh et al.	*K. pneumonia* (4%), followed by *E.* Coli (21%), *CoNS* (18%), and *P. Aeruginosa* (18%)
Vinoth M *et al.*	*Escherichia coli* (22%), *Klebsiella sp* (18%), *Enterobacter* (8%), *Staph. Aureus* (6%)
In this study	*Escherichia coli (*62%), K*lebsiella spp* (31%), *Staphylococcus aureus* (6%).

12% occurrence of catheter-associated UTI (CAUTI) with *Escherichia coli(62%),* followed by *Klebsiella sp(31%), MRSA (5%)* similar findingswere seen in study conducted by Vinoth M *et al* and Prajapati *et al.* 28% was occurrence of CAUTI in Mojtahedzadeh et al. which was higher thanthe present study this was due to definition of bacteriuria was $>10^4$ CFU/ml. Gender was not a risk factor for catheter-associated bacteriuria in present study.

Showing incidence of antibiotic sensitivity for isolated organism

	Our study	Shalini et al 2009	Prajapati et al
Amikacin	66.66%	87.41	85.7
Nitrofurantoin	74%	81.12	78.57
Norfloxacin	33%	72.73	71.42

In present study , most of the *Acinetobacter sp(100%) were* resistant to ciprofloxacinand 70% to Gentamicin, 58% to Imipenem. Maximus number of Acinetobacter sp. were sensitive to levofloxacin(65%) and ceftazidime(60%). In study conducted by Goel et al. [95] Showed *Pseudomonas aeruginosa* was resistant to Gentamicin (100%), Aztreonam (88.23%), Ciprofloxacin and Amikacin (82.35%), Imipenem (47.06%), Ceftazidime (35.29%) and Piperacillin-tazobactam (23.53%). in the present study, *Pseudomonas aeruginosa* was showed 85% sensitive to Imipenem, 72% sensitive to amikacin, pipercillin tazobactum and ceftazidime ESBL screening was done on Escherichia coli (36%)and Klebsiella(54%) and It was found that 38% of isolates showed ESBL production. These findings were similar to the study conducted by Vasumathi A et al. (39.5%). But study conducted by Deepti et al. showed prevalence of 11.7% in their studypopulation. Most of the ESBL strains were sensitive to amikacin and gentamicin. With the rise in the multidrug resistant strains and the emergence of ESBL producersit is essential to treat the infections in ICU.

Conclusion

Infections are a common problem for patients in intensive care units (ICUs) and are associated with substantial morbidity, mortality, and costs. Both primary infections andsecondary infections rates are high in ICUs. In the present study all the patients with clinical signs and symptoms of infections in ICUs are included. The study showed VAP was the most common infections followedby CAUTI and blood stream infections.

The majority of the samples obtained from patients yielded cultures of

Enterobacteriaceae and Non Fermenters: In present study, most common organism associated with infection were *Klebsiella sp.and Acinetobacter sp, Escherichia coli and* other species like*, Pseudomnas aeruginosa Staphylococcus aureus,* were less frequently isolated.

References

1. Vincent J, Marshall J, Anzueto A, Martin CD, Gomersall C. and Outcomes of Infection in

Intensive Care Units. 2009;302(21):2323–9.
2. Marwick C, Davey P. Care bundles: The holy grail of infectious risk management inhospital? Curr Opin Infect Dis. 2009;22(4):364–9.
3. Hanberger H, Garcia-Rodriguez J-A, Gobernado M, Goossens H, Nilsson LE, Struelens MJ, et al. Antibiotic Susceptibility Among Aerobic Gram-negative Bacilli in Intensive Care Unitsin 5 European Countries. JAMA [Internet]. 1999 Jan 6 [cited 2018 Sep 14]; 281 (1):67. Available from: http://jama.jamanetwork.com/article.aspx?doi=10.1001/jama.281.1.67
4. Vincent J, Rello J, Marshall J, Silva E, Anzueto A, Martin CD, et al. The ExtendedPrevalence of Infection in the ICU Study: EPIC II. Crit Care. 2009.
5. Hageman JC, Fridkin SK, Mohammed JM, Steward CD, Gaynes RP TFA proficiency testingof NNISS hospital laboratories. Antimicrobial proficiency testing of National Nosocomial Infections Surveillance System hospital laboratories. Infect Control Hosp Epidemiol. 2003; (24):356–361.
6. Richards MJ, Edwards JR, Culver DH GRN infections in medical intensive care units in the USN nosocomial infections surveillance system. Nosocomial infections in medical intensive care units in the United States. National nosocomial infections surveillance system. Crit CareMed. 1999;(27):887–92.
7. Donald E. Craven, Philip E. Grgurich, Kathleen Steger Craven, Henri Balaguera, In: Bennett and Brachman's Hospital Infections. Sixth Edition. Philadelphia: Lippincott Williamsand Wilkins; 2014;490.
8. Ewans TM, Ortiz CR, LaForce FM. Prevention and control of nosocomial infection in the intensive care unit. In: Irwin RS, Cerra FB RJ. Prevention and control of nosocomial infection in the intensive care unit. Intensive Care Med 4th ed New York Lippincot-Ravan.1999;074–80.
9. Divatia JV, Amin PR, Ramakrishnan N, Kapadia FN, Todi S, Sahu S et al. Intensive care in India: The Indian Intensive Care Case Mix and Practice Patterns Study. Indian J Crit Care Med. 2016;(4):12–21.
10. Mathew JL, Patwari A K GP. Acute infection and pneumonia in India A systemic review oflitterature foradvocacy and action: UNICEF-PHFI series on India. Indian pediatr. 2011;48 :191–218.
11. Lim WS, Baudouin SV, George RC et al. Pneumonia Guidelines Commi ee of the BTS Standards of Care Committee. BTS guidelines for the management of community acquiredpneumonia in adults: update 2009. Thorax 2009;64 Suppl 3:1-55. Thorax 2009. 3:1–55.
12. Ewig S TA. Severe community-acquired pneumonia. Clin Chest Med. 1999; 20:575–87.
13. Sonawane J, Kamnath N, Shetty K SR. Bacteriological Profile and Antimicrobial Susceptibility Testing of Blood Culture Isolates from a Tertiary Care Hospital, Navi Mumbai.JMSCR; 2016;4(10):13116–13124.
14. Vinoth M, Prabagaravarthanan R, Bhaskar M. Prevalence of microorganisms causing catheter associated urinary tract infections (CAUTI) among catheterised patients admitted ina tertiary care hospital. 2017;5(6):2367–72.
15. Abrahamsen SK, Haugen CN, Rupali P, Mathai D, Langeland N EG et al. Fever in tropics:aetiology and case fatality a prospective observational study in a tertiary care teaching hospital in South India. 13:355. BMC Infect Dis. 2013; 13:355.
16. Goel V, Hogade SA KS. Ventilator associated pneumonia in a medical intensive care unit:Microbial aetiology, susceptibility patterns of isolated microorganisms and outcome. Indian J Anaesth. 2012; 56558-62. 2012; 56:558–62.