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Original research article

Study of Bacteriological Profile and Antibiogram of Infections in Intensive Care Units of A Tertiary Care Hospital

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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 biochemical tests. Antibiotic susceptibility testing was done on DMC Darbhanga, disc diffusion test. ESBL production was tested by disc diffusion method as in CLSI phenotypic method.

Conclusion: There is increase in number of infections in ICUs due 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 are associated 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 also been 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.[9] 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 most common site of infection, accounting for 64% of infections, followed by abdominal(19%) and bloodstream infections (15%). The risk of acquiring the infection in critically 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 nasogastric tube 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 care unit (ICU) is about 2 to 5 times higher than in the general inpatient hospital population.[8] 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 acute bacterial 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 . 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] Healthcare-associated infections (HAIs), also known as Nosocomial infections or hospital-acquired infection, are infections acquired by a patient during the process of receiving care in a healthcare facility and which were not present or incubating at the time of admission. It is estimated that over 1.4 million people worldwide suffer from HAIs.. More than 75% are accounted for device-acquired healthcare-associated infections (DA-HAIs).

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 Method

It is a prospective cross-sectional study of bacterial isolates from patients admitted to intensive care unit with clinical signs and symptoms of infection, Samples were taken from patients from patients admitted to intensive care unit with clinical symptoms and signs of infections admitted in intensive care units of all teaching hospitals Total 300 patients with infection as per clinical criteria attached to Darbhanga medical College and Hospital Darbhanga, Laheriasarai. Study duration Two years.

Inclusion criteria
Patients with clinical symptoms and signs of infections admitted in intensive care units 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-infections.
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.
Samples were sent to laboratory from intensive care units as per the infection involved, under aseptic precautions.

Paired blood sample of quantity 10-20 m1 inoculated in to BHI broth and are incubated 35°-37°C & routinely inspected twice a day for the first 3 days and are incubated Upto 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 37ºC 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.[91] The sample was then plated on 5% sheep blood agar, chocolate agar, and MacConkey agar and incubated for 18-24 hours at 37°C .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 Gram stain results.[14] Semi quantitative method with calibrated loop (0.001 ml loop, one colony equals to 1,000CFU/ml,0.01 ml loop, one colony equals to 1,00CFU/m) inoculated on to 5% sheep BA and MAC/CLED agar, Incubate plates for at least 24 hours at 35° to 37° .Growth is interpreted as $>10^5$ CFUs as significant bacteriuria. According to CLSI guidelines(81), HiMedia disks for the following antibiotics were used Gram negative organisms: Ampicillin (10 µg), Amoxicillin-Clavulanate (20/10 µg) Gentamicin (10 µg), Amikacin (30 µg), Piperacillin-Tazobactam (100/10 µg), Cefepime (30 µg), Cefoxitin (30 µg), Cefotaxime (30 µg), Ciprofloxacin (5 µg), Ceftriaxone (30 µg), Imipenem (10 µg), Ertapenem (10 µg), Cotrimoxazole (1.25/23.75 µg), Aztreonam (30 µg), Ceftazidime (30 µg), Chroramphenicol (30 µg), Tetracycline (30 µg), Tigecycline (15 µg), Levofloxacin (5 µg). Gram positive organisms: Penicillin (10 units),cefoxitin(30 µg),Tetracycline (30 µg), Ampicillin (10 µg), Ciprofloxacin (5 µg), Linezolide (30 µg).

Results
A total of 300 patients were admitted to the ICU Study duration of Two years , Mean age of the subjects was 45.7 ± 14 years demographic detailsin table 1.
There were 192 men (64%) and 108 women (36%)shown in Table .

Table 1: Demographic data of the study

Demographics	

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

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

Table 2: Showing Gender distribution in the study

Showing different isolates from the study group

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

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

Table 3: 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%).

Table 4: Organism isolated from Aerobic culture from sample

Organism	Number (n=112)	Percentage
Klebsiella sps	42	38%
Acinetobacter sps	29	26%
Escherichia coli	23	21%
Pseudomonas aeruginosa	12	11%
Staphylococcus aureus	6	5%

The following infections were seen in a descending order of frequency VAP (*n* =83), UTI (n=16), Soft Tissue Or Skin Infections (N=5), Bacteremia (N=5),

Most common Bacteriological isolates were Gram-negative bacteria followed by Gram positive bacteria . *38%* of *Klebsiella sp, 26%* of *Acinetobacter sp, 21%* of *Escherichia coli* and *11%* of *Pseudomonas aeruginosa, MRSA* were isolated in *5%* of total samples which yielded culture positive.

Table 5: Organism isolated from urine sample

	Numbers (n=16)	Percentage
E*scherichia coli*	10	62.5%
Klebsiella spp	5	31.3%
Staphylococcus aureus	1	6%

Bacteriuria was seen in 12%, with predominant organisms were, *Escherichia coli* (62.5%) followed by *Klebsiella pneumoniae*(31.3%).

Table 6: 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 in 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%).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 and gentamicin. 75% isolates were sensitive to imipenem, and ciprofloxacin and ceftazidime. *Staphylococcus aureus* were resistant to methicillin.

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.[14] 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 192men (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[15] which was higher than the present study, these findings may be due to the relatively small sample size of the present study.

Table 7: Prevalence of microbiologic isolates in ICU from different parts of India

Studyn(%)	Vincent et al [4]	Ghanshani etal)	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 done by Patwardhan et al.[16] 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.* [17] but other studies conducted by Lee *et al*., [18] Richards *et al.*19 and Mythri et al et al.,the incidence of UTI was most common followed by pneumonia and blood stream infections.

Table 8: Prevalence rates of infections in ICU reported from other studies.

	Pneumonia (%)	Bloodstream infection (%)	Urinary tract infection (%)
Vincent et al [4]	46.9	12.0	17.6
Kallel et al. [17]	58.2	18.2	14.5
Markogiannakis et al	25.3	36.1	9.5
In this study	74	6	12

In the present study, isolates showed resistant to Amoxy-clavulanate(100%)and Ciprofloxacin (74%). But were sensitive to aminoglycoside(60%) and imipenem(82%) and Tigecycline(100%).In the study by Goel et al, of the 27 isolates of *Acinetobacter sp*, 1 (3.70%) was resistant to all group of antibiotics, including carbapenems. All the 27 (100%) isolates of *Acinetobacter sp* were multidrug resistant (MDR) i.e. resistant to three or more class of antibiotics. In present study , most of the *Acinetobacter sp(100%) were* resistant to ciprofloxacin and 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.[17] 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 study population. Most of the ESBL strains were sensitive to amikacin and gentamicin. With the rise in the multidrug resistant strains and the emergence of ESBL producers it 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 and secondary 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 followed by CAUTI and blood stream infections. Increasing number of multidrug resistance organism infections in ICUs is a big public health threat and challenge both from the perspective of prevention and treatment.

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