

Nosocomial infections in the pediatric intensive care unit in children between 1 month to 12 years

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Abstract

The incidence of nosocomial infections in Intensive Care Units (ICU) is showing a rising trend mainly because of increasing invasive procedures performed in the ICU. The therapeutic interventions that have been recognized as associated with infectious complications include indwelling urinary catheters, sophisticated life support, intravenous fluid therapy, cardiovascular prosthetic devices, implantable orthopedic prosthesis, immunosuppressive therapy etc. All the patients in the age group of 1 month to 12 years admitted in PICU with stay of more than 48 hours were daily monitored for fever or any other symptoms or sign suggestive of any infection. The patients who developed the same 48 hours after admission, which was not present at the time of admission, were included. Centers for Disease Control and Prevention definitions of nosocomial infections, used as criteria for diagnosis of infections. The most common site of nosocomial infections was blood stream infection (62.1%) followed by ventilator associated pneumonia (17.2%), skin infection (6.9%), urinary tract infection (6.9%) and surgical site infection (6.9%).

Keywords: Nosocomial infections, the pediatric intensive care unit, children

Introduction

The pediatric intensive care unit (PICU) is a unit in which patients aged from one month to 18 years who need intensive care are admitted and observed, basic vital signs are monitored and supportive treatments such as fluid and blood transfusion, hemodialysis, resuscitation, antibiotic therapy and mechanical ventilation are provided and advanced pediatric surgical, and diagnostic procedures are carried out.

Health care-associated infections is a real endemic problem which usually doesn't receive enough public attention. Despite many efforts, no institution or country can claim to have solved this problem ^[1].

Intensive Care Units are those areas of the hospital where the most upto date therapeutic services are provided to critically ill patients. In an ICU (Intensive Care Unit) patients are often subjected to various invasive procedures, pumped with antibiotics which alter normal flora and at times many virulent organisms are transferred from one patient to another. Despite having a prominent role in the care of patients with infections, ICU's cause some complications and death and increases the costs imposed on patients and society ^[1]. The incidence of Nosocomial Infections related to mechanical ventilation, catheter insertion and

some invasive procedures are in ICU compared to other hospital wards, which do not carry such procedures^[2].

Healthcare-associated infections (HAI) are defined as infections not present and without evidence of incubation at the time of admission to a healthcare setting. As a better reflection of the diverse healthcare settings currently available to patients, the term healthcare-associated infections replaced old ones such as nosocomial, hospital-acquired or hospital-onset infections^[3].

Within hours after admission, a patient's flora begins to acquire characteristics of the surrounding bacterial pool. Most infections that become clinically evident after 48 hours of hospitalization are considered hospital-acquired. Infections that occur after the patient is discharged from the hospital can be considered healthcare-associated if the organisms were acquired during the hospital stay.

The incidence of nosocomial infections in Intensive Care Units (ICU) is showing a rising trend mainly because of increasing invasive procedures performed in the ICU. The therapeutic interventions that have been recognized as associated with infectious complications include indwelling urinary catheters, sophisticated life support, intravenous fluid therapy, cardiovascular prosthetic devices, implantable orthopedic prosthesis, immunosuppressive therapy etc.^[3] At other times hospital staff caring for such patients inadvertently transfer virulent organisms from one patient to another through their hands.⁴ In such a setting, hospital infection will certainly occur if preventive measures are not taken appropriately.

Methodology

A hospital based prospective study was conducted with 100 patients to evaluate nosocomial infections in the pediatric intensive care unit in children between 1 month to 12 years.

Study design: A hospital based prospective study.

Study Duration: 12 months (Jan 2020 to Dec 2020).

Study area: The study was done at our tertiary care centre in the department of Paediatrics, Paediatric intensive care unit.

Study population: Children diagnosed to have Community acquired nosocomial infections in the pediatric intensive care unit stay of more than 48 hours between the age group of 1 month to 12 years admitted in PICU of Tertiary care Hospital, who fulfilled the inclusion criteria.

Sample size: 100 patients.

Inclusion criteria

- All the patients in the age group of 1 month to 12 years admitted in PICU with stay of more than 48 hours were daily monitored for fever or any other symptoms or sign suggestive of any infection.
- The patients who developed the same 48 hours after admission, which was not present at the time of admission, were included.
- Centres for Disease Control and Prevention definitions of nosocomial infections, used as criteria for diagnosis of infections.

Exclusion criteria

- Patients with any clinical feature or laboratory investigation, suggesting concerned infection being prior to the admission to the PICU.
- Blood culture positive at the time of admission.

- Children discharged or died within 48 hours of admission.
- Attendants of those children not interested/not willing to participate in the study.

The study was done at our tertiary care centre in the department of Paediatrics on children diagnosed to have Community acquired nosocomial infections in the pediatric intensive care unit with stay of more than 48 hours between the age group of 1 month to 12 years admitted in PICU of Tertiary care Hospital, after due permission from the Institutional Ethics Committee and Review Board and after taking Written Informed Consent from the patients. After approval from the Institutional Ethics Committee a valid informed consent was taken. Once the patients were enrolled for the study, a thorough history and physical examination was done as per proforma. An informed consent was taken in written from patients or patient's attendant.

Detailed demographic, laboratory investigations and outcome were recorded in the prestructured questionnaire format.

Patients suspected to have developed nosocomial infections in the PICU, if they developed any one of the following clinical features 48 hours after admission to the PICU.

Results

Majority of the patients (52%) were from the age group of 1-4 years followed by 21% from the age group of 5-8 years, 19% from the age group of 1 month-1 year and 8% from the age group of 9-12 years.

Table 1: Distribution of patients according to Age

Age	N	%
1 month-1 year	19	19%
1-4 years	52	52%
5-8 years	21	21%
9-12 years	8	8%
Total	100	100%

58 (58%) patients were male and 42 (42%) patients were female. The M:F ratio was 1.38:1.

Table 2: Distribution of patients according to Sex

Sex	N	%
Male	58	58%
Female	42	42%
Total	100	100%
M: F Ratio	1.38:1	

33 (33%) patients resided in rural areas while 67 (67%) patients were from urban areas.

Table 3: Distribution of patients according to Residential Area

Residential Area	N	%
Rural	33	33%
Urban	67	67%
Total	100	100%

According to the IAP classification of nutritional status, 20 (20%) patients were in Grade I, 26 (26%) patients were in Grade II, 18 (18%) patients were in Grade III and 5 (5%) patients were in Grade IV. 31 (31%) patients were of normal nutritional status.

Table 4: Distribution of patients according to Nutritional status

Nutritional status	N	%
Grade I	20	20%
Grade II	26	26%
Grade III	18	18%
Grade IV	5	5%
Normal	31	31%
Total	100	100%

16 (16%) patients had no anaemia while 19 (19%) patients had mild anaemia. 62 (62%) and 3 (3%) patients had moderate and severe anaemia respectively.

Table 5: Distribution of patients according to Incidence of Anaemia

Incidence of Anaemia	N	%
No	16	16%
Mild	19	19%
Moderate	62	62%
Severe	3	3%
Total	100	100%

On analysis of the underlying disease, it was observed that majority of the patients with nosocomial infections had been admitted to PICU for respiratory causes (45%) followed by Central Nervous System (CNS) disorders (22%), congenital heart diseases (7%), renal condition (6%), viral haemorrhagic fever (5%), diarrhea (2%) and road traffic accident (2%). The remaining 11 (11%) patients had other underlying disease.

Table 6: Distribution of patients according to Underlying disease

Underlying disease	N	%
Respiratory	45	45%
Central Nervous System	22	22%
Congenital heart diseases	7	7%
Renal	6	6%
Viral haemorrhagic fever	5	5%
Diarrhea	2	2%
Road traffic accident	2	2%
Others	11	11%
Total	100	100%

The duration of PICU stay in 27 (27%) patients was <7 days while the duration of PICU stay in 73 (73%) patients was ≥ 7 days. The mean duration of PICU stay was 8.32 ± 8.39 days.

Table 7: Distribution of patients according to Duration of PICU Stay

Duration of PICU Stay	N	%
<7 days	27	27%
≥ 7 days	73	73%
Total	100	100%
Mean \pm SD	8.32 \pm 8.39	

29 (29%) patients developed nosocomial infections.

Table 8: Distribution of patients according to Incidence of nosocomial infections

Nosocomial infections	N	%
Yes	29	29%
No	71	71%
Total	100	100%

The most common site of nosocomial infections was blood stream infection (62.1%) followed by ventilator associated pneumonia (17.2%), skin infection (6.9%), urinary tract infection (6.9%) and surgical site infection (6.9%).

Table 9: Distribution of patients according to Site of nosocomial infections

Site of Nosocomial infections	N	%
Blood stream infection	18	62.1%
Ventilator associated pneumonia	5	17.2%
Urinary tract infection	2	6.9%
Surgical site infection	4	13.8%
Total	29	100%

Discussion

In the present study, majority of the patients (52%) were from the age group of 1-4 years followed by 21% from the age group of 5-8 years, 19% from the age group of 1 month-1 year and 8% from the age group of 9-12 years. 58 (58%) patients were male, and 42 (42%) patients were female. The M:F ratio was 1.38:1. This is similar to the studies of Akinkugbe O *et al.* [5], Venmugil P *et al.* [6] and Behzadnia S *et al.* [7].

Akinkugbe O *et al.* [5] retrospective cohort study examining the prevalence and antimicrobial susceptibility patterns of three types of HCAI in critically ill children found a total of 1930 admissions to the PICU, of which 44% were female with a median age was 38 months (10-118).

Venmugil P *et al.* [6] prospective, descriptive, observational study assessing the incidence of HAI in the PICU found mean age of the study population was 2.01years. Of these, 26 (38%) were female and 42 (62%) were male children, the male: female ratio being 3:2.

Behzadnia S *et al.* [7] retrospective cross-sectional study of under 12 hospitalized children assessing nosocomial infections found 61 (0.17%) patients were children under age 12 with NIs, from whom 31 were girls (50.81%) and 30 were boys (49.18%). The average age was 6 ± 4.32 (range 1 day, 12 year) years old.

In our study, 33 (33%) patients resided in rural areas while 67 (67%) patients were from urban areas. According to the IAP classification of nutritional status, 20 (20%) patients were in Grade I, 26 (26%) patients were in Grade II, 18 (18%) patients were in Grade III and 5 (5%) patients were in Grade IV. 31 (31%) patients were of normal nutritional status. This is comparable to the studies of Venmugil P *et al.* [6] and Deep A *et al.* [8].

Venmugil P *et al.* [6] prospective, descriptive, observational study showed according to the IAP classification of nutritional status, about 22 children (32%) were of normal nutritional status. Of the remaining, 18 children (27%) were in Grade 2, 13 children (19%) in Grade 1, 10 children (15%) in Grade 3 and 5 children (7%) in Grade 4 malnutrition respectively.

Deep A *et al.* [8] study assessing clinical and microbiological profile of nosocomial infections in the PICU reported higher incidence of HAI in malnourished children and that 64.2% of malnourished patients developed nosocomial infection compared to 52.8% in normally nourished.

It was observed in the present study that 16 (16%) patients had no anaemia while 19 (19%) patients had mild anaemia. 62 (62%) and 3 (3%) patients had moderate and severe anaemia

respectively.

Venmugil P *et al.* [6] prospective, descriptive, observational study found as per WHO guidelines 42 (61.7%) had moderate anaemia, followed by 14 (20.6%) with mild anaemia and 2 (3%) with severe anaemia.

On analysis of the underlying disease, it was observed in our study that majority of the patients with nosocomial infections had been admitted to PICU for respiratory causes (45%) followed by Central Nervous System (CNS) disorders (22%), congenital heart diseases (7%), renal condition (6%), viral haemorrhagic fever (5%), diarrhea (2%) and road traffic accident (2%). The remaining 11 (11%) patients had other underlying disease. Akinkugbe O *et al.* [5] and Venmugil P *et al.* [6] noted similar observations in their studies.

Akinkugbe O *et al.* [5] retrospective cohort study showed respiratory conditions accounted for the largest primary diagnostic group, followed by surgical conditions.

Venmugil P *et al.* [6] prospective, descriptive, observational study found majority of the HAI patients had been admitted to the PICU for primary respiratory cause 30 (44%) patients, followed by CNS disorders-15 (22%), congenital heart diseases 4 (6%), viral haemorrhagic fever 4 (6%), renal condition 2 (3%), diarrhoea 2 (3%) and road traffic accident 2 (3%). The remaining 9 (13%) patients had their own individual diagnosis that was not included in any of the aforesaid disease groups.

In the present study, the duration of PICU stay in 27 (27%) patients was <7 days while the duration of PICU stay in 73 (73%) patients was ≥7 days. The mean duration of PICU stay was 8.32 ± 8.39 days. This is concordant to the studies of Akinkugbe O *et al.* [5], Venmugil P *et al.* [6], Urrea M *et al.* and other v study [9, 10] and Behzadnia S *et al.* [7].

Conclusion

On analysis of the underlying disease, it was observed that majority of the patients with nosocomial infections had been admitted to PICU for respiratory causes (45%) followed by Central Nervous System (CNS) disorders (22%), congenital heart diseases (7%), renal condition (6%), viral haemorrhagic fever (5%), diarrhea (2%) and road traffic accident (2%). The remaining 11 (11%) patients had other underlying disease.

The duration of PICU stay in 27% patients was <7 days while the duration of PICU stay in 73 (73%) patients was ≥7 days. The mean duration of PICU stay was 8.32 ± 8.39 days. Out of 100, 29 (29%) patients developed nosocomial infections.

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