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THE SPECTRUM OF MORTALITY IN A PAEDIATRIC INTENSIVE CARE UNIT: A RETROSPECTIVE STUDY FROM A TERTIARY CARE HOSPITAL, WEST BENGAL, INDIA

Paediatrics

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ABSTRACT

Background: Aiming to know the mortality spectrum and death rate in a paediatric intensive care unit (PICU) in West Bengal's western region and to see whether it differed from previous studies, we conducted this retrospective study.
Aims And Objectives: To study spectrum of mortality and death rates in a tertiary care hospital's PICU.
Methods And Materials: A retrospective medical audit was undertaken on the deaths of 261 children aged one month to 12 years out of a total 1089 admission from January 1, 2020 to December 31, 2020. A predesigned proforma was used to gather information from PICU records. Those who were referred out, as well as those who left against medical advice (LAMA), were also recorded. Epi Info (version 3.1.5) software was used to analyse the information.
Results: During the study period, 261 children died out of a total of 1089 admissions. So our PICU's mortality rate was 23.97 %. Infants made up 75.10 % of all deaths. 32.18 % deaths occurred within 24 hours after admission. The most prevalent cause of mortality was infection (86.97%). Of which, pneumonia was the most common illness (38.70 %), followed by septicaemia (35.25%). Only 13.03 % of fatalities were due to non-infectious causes. The most common comorbidity was found to be protein energy malnutrition (42.53%).
Conclusion: The mortality rate in our PICU is lower than in previous West Bengal studies but higher than in other parts of our country as well as in developed nations. Infections of different organ system were found to be the most common cause of death and it needs special attention to reduce PICUs death rate.

KEYWORDS

paediatric intensive care unit, children, spectrum, mortality, infections, and non-infections.

INTRODUCTION

A paediatric intensive care unit (PICU) is a division of a hospital dedicated to treating critically ill children. A PICU should have one or more paediatric intensivists or PICU consultants [1] and be manned by nurses, paediatricians, and respiratory therapists who are trained and experienced in child critical care. In the PICU, the ratio of trained professionals to patients is often higher than in other areas of the hospital, reflecting patient acuity and the potential of life-threatening complications [2]. It is well equipped with a multichannel patient monitoring system, infusion pumps, and mechanical ventilators.

Since the first PICU in the world opened its doors in 1955 [3,] remarkable progress has been made in the field of paediatric intensive care, owing to advances in our understanding of the pathophysiology of critical disease and the invention of a range of patient-care medical equipment [4,5]. Still, we face challenges such as a lack of infrastructure in relation to population, manpower shortages, poor socioeconomic status, and a lack of health awareness among the public at large, particularly in developing nations like India. All of the deaths in the department of paediatric medicine occur in PICUs, because all the critically ill children or those who are at risk of deteriorating into critical condition have been admitted to the PICU/High Dependency Unit (HDU) for intensive care and monitoring [6]. According to the sample registration system in West Bengal, under five mortality was 27/1000 live births without identifying the cause of death in 2016 [7]. In order to learn about the spectrum of mortality or causes of death in the PICU of BSMCH, a tertiary health care institution located in the western region of West Bengal, we decided to evaluate the causes of death retrospectively to see whether they differed from others.

METHODS

The PICU of the Department of Paediatric Medicine, BSMCH, Bankura, a rural tertiary health care centre in West Bengal, India, was the setting for this retrospective analysis. A well-equipped six-bed PICU and a ten-bed HDU for step-down treatment are available at our department. We accommodate children in the PICU who require continuous monitoring and cardiac and hemodynamic assistance, ranging in age from one month to twelve years old. 1089 children were admitted to the PICU between January 1, 2020 and December 31, 2020, with 261 children dying. The age, gender, comorbidities, final diagnosis at the time of death, and length of hospital stay of 261 children were extracted from PICU records. Data on LAMA and referred-out patients was also recorded. All of the patients were treated according to standard protocol. When necessary, tests for typhoid, malaria, dengue, scrub typhus, and Japanese encephalitis were performed, as well as complete blood counts, blood cultures, serum electrolytes, liver function and renal function tests, capillary blood glucose tests, arterial blood gas analysis, urine analysis and culture sensitivity tests, cerebro-spinal fluid analysis. To rule out tuberculosis, gastric fluid test for acid-fast bacilli (AFB), cartilage-based nucleic acid amplification test (CBNAAT), Mantoux test (MT), and chest x-ray were done when necessary. When necessary, X-rays, ultrasonography (USG), computed tomography (CT), and magnetic resonance imaging (MRI) of various bodily parts were undertaken.

RESULTS

During the study period, 1089 children were admitted to PICU. Males accounted for 61.61 % (n = 671) of the children, while females accounted for 38.38 % (n = 418). A total of 261 deaths were documented over the study period, with a mortality rate of 23.97 %. Male and female children made up 59% (n = 154) and 41 % (n = 107) of the 261 deaths, respectively. 1.44:1 was the male-to-female child ratio (Figure 1).

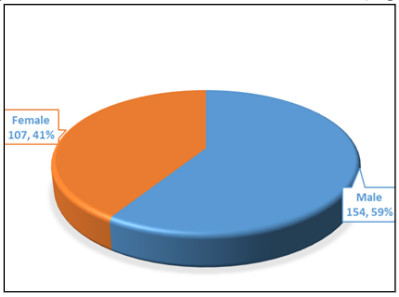

Figure 1: Pie chart showing gender-wise mortality.

Children under the age of one year constituted 75.10 % of our research subjects (n = 196). The remaining children were aged 1–5 years and

over 5 years, with 14.94 % (n = 39) and 9.96 % (n = 26) respectively (Figure 2).

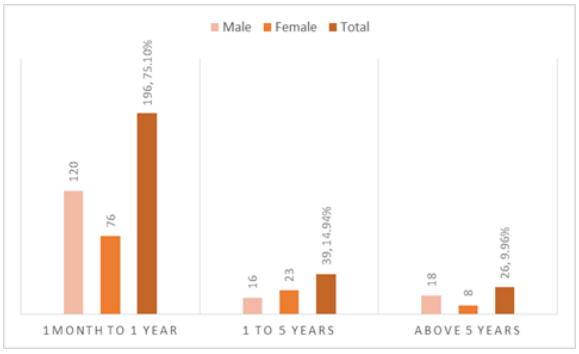

Figure 2: Bar diagram showing the *age and gender-wise distribution of mortality.

* The mean age of our cohort was 1.69 ± 2.77 years.

The causes of death are divided into two categories: infectious and non-infectious. Infections were the major cause of death and accounted for 86.97% (n = 227) of all deaths. Only 13.03 % (n = 34) of the cases were due to non-infectious aetiology. A total of 187 (95.40 %) (n = 187) children under the age of one year had died as a result of infections in the study group. 24 (61.54%) and 16 (61.54%) children died from infections when they were between the ages of 1 and 5 years and older than 5 years, respectively. It was 80.84 % (n = 211) if we consider children under the age of five (Figure 3).

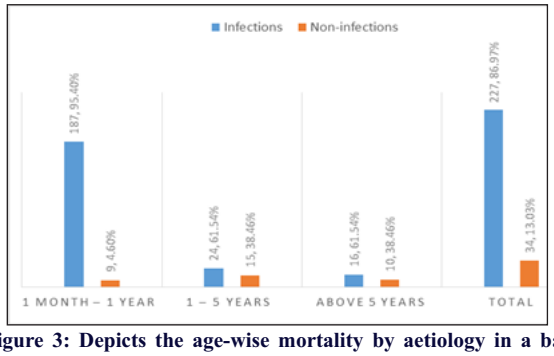

Figure 3: Depicts the age-wise mortality by aetiology in a bar diagram

Among infections, pneumonia, sepsis, meningitis, acute encephalitis syndrome, and viral hepatitis accounted for 38.70% (n = 101), 35.25% (n = 92), 7.66% (n = 20), 4.21% (n = 11), and 1.15% (n = 3), respectively. Neurological disorders were the most common non-infectious aetiology (n = 10, 3.83%), followed by congenital heart disease (CHD) (n = 8, 3.07%) (Table 1).

Table 1: Shows the mortality spectrum/causes.

Causes of mortality	Number	Percentages
A. Infections	**227**	**86.97**
[1]Pneumonia	101	38.70
[2]Sepsis	92	35.25
Meningitis	20	7.66
*AES	11	4.21
Viral hepatitis	3	1.15
B. Non-infections	**34**	**13.03**
Neurological disorder	10	3.83
*CHD	8	3.07
*CHA with *CCF	5	1.92
*DS with*CCF	1	0.38
Renal disorder	4	1.53
*ALL	3	1.15
Snake envenomation	1	0.38
Scorpion sting	1	0.38
Poison	1	0.38

[1] Nineteen children had congenital heart disease. [2] Three children had congenital heart disease. *AES – acute encephalitis syndrome, CHD – congenital heart disease, CHA – chronic haemolytic anaemia, CCF – congestive heart failure, DS – Down syndrome, ALL – acute lymphoblastic leukaemia.

The average length of stay in the intensive care unit (ICU) was less than 24 hours in 32.18% (n =84) of cases, with deaths occurring between 1 and 3 days, 3–5 days, and more than 5 days in 19.54% (n = 31), 13.79% (n = 36), and 34.48% (n =90), respectively (Table 2).

Table 2: Showing the length of stay in the PICU.

Duration of PICU stay	Number	Percentage
Less than 24 hours	84	32.18
1 – 3 days	51	19.54
3 – 5 days	36	13.79
More than 5 days	90	34.48

*The mean duration of the PICU stay was 5.3 ± 5.1 days, with a minimum of a few hours to a maximum of 25 days.

Comorbidities were found to be present in 54.79% (n = 143) of our cohort. Protein energy malnutrition (PEM) (n = 111, 42.53%) was identified as the most common comorbidity, followed by CHD (congenital heart diseases with pneumonia and septicaemia) (n = 22, 8.43%), chronic haemolytic anaemia (β-thalassemia major) (n = 5, 1.91%), cerebral palsy (n = 4, 1.53%) and chromosomal anomaly (Down syndrome) (n = 1, 0.38%) (Table 3)

Table 3: Showing gender-wise spectrum of comorbidities.

Spectrum of comorbidities	**Male**	**Female**	**Total (%)**
Protein energy malnutrition	58	53	111 (42.53)
Congenital heart diseases	8	14	22 (8.43)
Neurological disorder (*CP)	1	3	4 (1.53)
*CHA (β-thalassemia major)	1	4	5 (1.91)
Chromosomal anomaly (*DS)	0	1	1 (0.38)
Total	**68**	**75**	**143 (54.79)**

*CP – cerebral palsy, CHA – chronic haemolytic anaemia, DS – Down's syndrome.

LAMA and referred out patients constituted 5.97% of total admission and we didn't know the outcome of these children.

DISCUSSION

In order to learn about the spectrum of mortality or causes of death in the PICU of BSMCH, a tertiary health care institution located in the western region of West Bengal, we decided to evaluate the causes of death retrospectively to see whether they differed from others.

During the study period, we had a total of 1089 children admitted to our PICU. Male children accounted for 61.61 % (n = 671) of the total number of children, while female children accounted for 38.38 % (n = 418). Other studies by Haque et al., Sangeet et al., and Hao et al. reported that 60.90 %, 58.05 %, and 58.70 % were male, respectively [8,9,10].

A total of 261 deaths were documented during the study period, out of a total of 1089 admissions. So, the mortality rate was 23.97 %, which is comparable to studies done by Shashikala et al. from Telangana and Roy SM et al. from Kolkata, which reported 23.5 % and 24.31 % of PICU deaths, respectively [11,12]. The mortality rate in a PICU has been found to vary between studies, ranging from 2.1% to 34.6 % [13-20]. Variations in patient profile, parents' health-seeking behaviour, and socioeconomic status, delays in referral and delay in arrival to health-care facilities, poor infrastructure, and, last but not least, a lack of skill among health-care personnel in attempting to deal with critically ill children could all contribute to these differences. The mortality rate in PICUs in industrialized nations like the United States varies from 1.85% – 3.38%, which is significantly lower than our study [21].

Male contributed for 59% (n=154) of the 261 children who died, while female children accounted for 41% (n=107). The male-to-female ratio was 1.44:1. Sangeeth et al [9] and Siddiqui et al [15] also reported a male preponderance. As per Sangeeth et al. and Siddiqui et al., 57.4 % and 60.5 % were male, with male to female ratios of 1.35:1 and 1.3:1, respectively.

Our present study showed that 75.10 % (n = 176) of the overall deaths

occurred between the ages of one month and one year. It's comparable to a study by Ghaffari et al., which showed that 68% of children under the age of one year [22]. According to other studies, this age group had the greatest rate of PICU mortality [12, 23]. In terms of under-five mortality, excluding new-borns, our study found that 90.03 % (n = 235) of children were under the age of five, which is comparable to the 85.2 % reported by George I. O et al. [24]. Our present study's substantially higher under-5 death rate reflects the fact that children in this age group are more vulnerable and needs special attention.

In our present study, we observed that infections caused 86.97% (n = 227) of deaths, whereas the remaining 13.03% (n = 34) were non-infectious. According to several authors, infections are the most common cause of PICU admission and death in the same area [25]. Considering the age of the children, we observed that infections were the primary cause of mortality among infants (n = 187, 95.40%), as well as children aged one to five years (n = 24, 61.54%) and those aged over five years (n = 16, 61.54%). Our present study showed that 80.84% (n = 211) of under-5 deaths were due to infectious causes, and this is consonant with other studies conducted by different authors [7, 26, 27]. Our present study also showed that 61.54% (n = 16) of deaths were due to infection in the age group above 5 years, which is comparable to a study conducted by Morris et al. which showed 58.00% [28] but contrary to a study done by Sangeeth et al. which showed 65.50% of deaths from non-infectious aetiology in the same age group [7].

Our present study showed that the most common cause of mortality among the infections was pneumonia (n = 101, 38.70 %), followed by septicaemia (n = 92, 35.25%). In a PICU, pneumonia (23.4%) and septicaemia (18.6%) were the most common causes of mortality, as per Shah et al., Kapil and Bagga [14, 16]. The high infection rates in our study group, as well as the differences between our findings and those of Shah et al. and Kapil D. and Bagga, could be due to geographical differences in disease profiles, different cultural beliefs and practices among parents regarding child rearing, and a lack of hand-washing practise among health-care personnel.

Our study showed that 32.18 %(n=84) of children died within 24 hours of admission. Contrary to our study, Shashikala et al.reported 16% of deaths occurring within 24 hours of admission [11], whereas Kalraiya et al. reported 47.13% [29]. The early death might be attributed to three factors: a delay in deciding to seek treatment, a delay in getting to a health-care institution, and a delay in obtaining excellent care once there. It also indicates the patient's serious condition at the time of admission.

Longer hospital stays, significantly higher mortality, and higher costs were noted in patients who had comorbid illnesses [30]. Our present study showed that comorbid illness was present in 54.79% (n=143) of children. The most common comorbid illness in our study was protein energy malnutrition (PEM), which was present in 42.53% (n=111) of children. It is comparable to a study done by Schroeder et al. which showed 41% [31]. Protein energy malnutrition in children is widely prevalent in developing nations, including India, and it plays a significant role in under-five (U5) mortality directly or indirectly. More than 33% of U5 mortality is associated with malnutrition. So, when one's aim is to reduce child mortality, the issue of PEM should be addressed right from the womb. Another comorbidity, CHDs, was found to be present in 8.43% (n = 22) of the study population, and it is comparable to a study conducted by Rashma et al. which showed 6% of children had CHDs as comorbidities among PICU deaths [13]. This variation is probably due to the geographical variation in the prevalence of CHD.

Limitation of our study: Because this study is a retrospective one, it has some limitations. First, it may have some recall bias and incomplete data, leading to errors in interpretation. Second, we don't know the outcome of those children who have been referred to higher levels for super speciality care and those who have got LAMA.

CONCLUSION

Our present study revealed that the mortality rate in our PICU is lower than in previous West Bengal studies but higher than in other parts of the country as well as in developed nations. It was also observed that one third of the deaths (32.18%) occurred within 24 hours of admission and infections of different organ systems (86.97%) were the most common cause of death. Protein energy malnutrition (42.53%) and congenital heart disease (8.43%) were found to be the two most common comorbidities identified in our present study. To reduce child mortality in PICU, our recommendations, addressing the abovementioned issues, are: (i).Through regular training, we need to improve our knowledge of critical care medicine, (ii). The need to strengthen the existing infrastructure of health care facilities, (iii). Supervision of the ongoing IMNCI (integrated management of neonate and child illness) programme, (iv). Regular training of primary care physicians and/or paediatricians regarding management of common childhood illnesses, recognition of danger signs, timely referral and practise of hand washing, (v). The need to improve the nutritional status of a child through a nutritional programme and improve the socioeconomic condition of people belonging to the economically weaker section, (vi). Vaccination coverage should be increased to a desirable level against all vaccine-preventable diseases, (vii). Proper implementation of the Rastriya Bal Swasthya Karyakram (RBSK) programme, which successfully manages all congenital deformities in children, and finally (viii). To increase the health awareness among people through different mass media.

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