“Analysis of Mortality in PICU of A Tertiary Care Teaching Hospital, Telangana– An Introspection”.

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Abstract
Background: Paediatric critical care medicine is a challenging contemporary subspecialty. The development of paediatric intensive care has contributed to the improved survival of critically ill children.
Aim: To study and analyse the deaths occurring over a period of one year in a Pediatric Intensive Care Unit (PICU) of a tertiary care teaching hospital.
Methods: A prospective observational cohort study of deaths in PICU was conducted over a period of one year. Data collected was demographic profile, co morbidities, length of stay, diagnosis, ICU therapies like use of inotropes and mechanical ventilation (MV).
Results: There were a total of 990 admissions to the PICU of which 233 died with a mortality rate of 23.5%. The mean age of deaths was 2.84 years with 72% of deaths occurring under five years of age (excluding neonates). 16% of deaths occurred within 24 hours of admission and 10% deaths had prolonged stay (>14 days). Pneumonia constituted for almost one third of deaths followed by sepsis. Mechanical ventilation rate was only 34.8%.
Conclusion: By their very virtue, ICUs are resource intensive with respect to both technology and the need for skilled health care providers. A large percentage of hospital costs are attributed to the ICU. As the cost of health care increases, the need to manage the resources of the ICU as efficiently and effectively as possible increases in importance as well.
Keywords: Causes, length of stay, pediatric intensive care unit, mortality.

I. Introduction

Jacob Javits, 1986 (United States Senator) rightly quoted that “In critical care, it strikes one that the issues are three: realism, dignity, and love.”

The development of paediatric intensive care has contributed to improved survival rates in children with critical illnesses¹,². The goal of PICU is the surveillance and support of vital organ function in critically ill or injured children who are at risk for organ dysfunction³. There are references that support better outcome of PICU patients in tertiary centres, which led to the development of a centralized system of PICUs worldwide⁴. Collection, analysis, and interpretation of relevant objective data on the utilization of ICU beds will help plan for reducing the length of ICU stay and facilitate covering more patients who require this care.

Niloufer hospital for women and children has a thirteen bedded paediatric medical intensive care unit (PICU). Whenever a critically ill or a traumatic child presents to the Emergency Services Room, evaluation and management will be initiated by the Emergency Room team and then the PICU team will be immediately consulted for smooth transition and continuity of care. After stabilization, the patients will be moved to the PICU or to the pediatric surgical department. On recovery, children would be transferred to step down unit. The average number of patients admitted in the PICU ranges from 80 to 100 per month. Research on Intensive Care Unit (ICU) outcomes provides valuable inputs in developing more improved models for patient-centred outcomes, more robust predictions of resource use, better individual outcome prediction and alternative outcome predictions under different treatment paradigms⁵. We, therefore, analysed the data of our PICU to find out the demographic profile of the mortality cases which would help in proper resource allocation and better management of critically ill children.

II. Materials And Methods

A prospective observational cohort study was conducted in the PICU from January to December 2015 for a period of twelve months. We consecutively collected data from the case sheets of paediatric patients who succumbed to death. The following data were collected: age, gender; final diagnosis, co morbidities, treatment
characteristics and length of stay in hospital. Serial clinical and radiological assessments of patients included thorough physical examination, pulse oxymetry, arterial blood gas analysis and chest roentgenograms. Along with this the patients were investigated and treated for the primary diagnosis as per requirement of the case. ICU stay was calculated as the number of calendar days from ICU admission to discharge, and was considered prolonged if it exceeded 14 days. This cut-off point is consistent with other studies.  

2.1 Statistical Analysis:

Data was collected on a pre-designed structured proforma and entered into Excel sheet. SPSS version 19 was used for statistical analysis. Descriptive statistics like mean, median, standard deviation and proportions were calculated for all the variables. To study the association of outcome with other variables, chi square test was used and p-value < 0.05 was considered significant.

III. Results

At Niloufer hospital an average of 2000 cases per month were admitted in the emergency services room, of which majority of cases were shifted to step down unit and rest of the critical cases stayed in the Emergency unit or shifted to PICU. Admission in the PICU was subjected to the availability of the vacancy. Over the one year study period, there were 990 admissions to the PICU, with 233 deaths and a mortality rate of 23.5%. 54.5% (127) were males and 45.5% (106) were females. The mean age of deaths was 2.84 years (34.08 months). Descriptive analysis of age of deaths in PICU children is shown in Table 1.

Table 1: Descriptive statistics of age in the study group (n=233)  

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>0.08</td>
<td>13.00</td>
<td>2.8486</td>
<td>3.44438</td>
</tr>
</tbody>
</table>

It was found that 51% deaths of total PICU deaths were infants and 21% belonged between 1 to 5 years age thus, under-fives constituted the major quota of PICU deaths (72%) in the study.

Table 2: Relationship between age and sex in the distribution of study cases

<table>
<thead>
<tr>
<th>Age</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 month - 1yr</td>
<td>70 (55.1%)</td>
<td>48 (45.3%)</td>
<td>118 (51%)</td>
</tr>
<tr>
<td>1yr - 5yr</td>
<td>26 (20.5%)</td>
<td>23 (21.7%)</td>
<td>49 (21%)</td>
</tr>
<tr>
<td>5yr - 10yr</td>
<td>25 (19.7%)</td>
<td>24 (22.6%)</td>
<td>49 (21%)</td>
</tr>
<tr>
<td>&gt;10yr</td>
<td>6 (4.7%)</td>
<td>11 (10.4%)</td>
<td>17 (7%)</td>
</tr>
<tr>
<td>Total</td>
<td>127 (100%)</td>
<td>106 (100%)</td>
<td>233 (100%)</td>
</tr>
</tbody>
</table>

Chart 1: Distribution of Admissions & Deaths over one year period

There was a surge of admissions from August to October due to dengue epidemic.

The mean duration of PICU stay in the mortality (study) group was 5.9 days, ranging from 2 hours to 30 days. Of the 233 deaths, 15.5% of cases presented in gasping state to the Emergency Services Room. Mechanical ventilation rate was 34.8% (81 cases) and inotropic support was required in 81% (188 cases). Out of 233 deaths, 38 (16%) cases died within 24 hours of admission into PICU reflecting very poor status at admission itself and 23 (10%) cases had prolonged stay (> 14 days) before they succumbed to death.
Out of 38 cases which died within 24 hours, 16 (42%) were females and 22 (58%) were males and pneumonia constituted 40% of deaths. 17 (45%) cases were infants and 15 (39%) cases were 1 to 5 years old and 6 (16%) cases were more than 5 years.

Chart 3: Diagnosis for Deaths which occurred within 24 hours

*Others include cases of Scorpion sting (1), DKA (1), Pyomeningitis (1), Dengue Shock Syndrome (1), VME (1), AML (1) and Dilated Cardiomyopathy (1).

Of the 23 deaths that required prolonged stay, 11 (48%) were males and 12 (52%) females. 65% of these cases were infants. Neurological cases, children with congenital heart disease with pneumonia and sepsis each accounted for 26% (6) of cases requiring prolonged stay.

Chart 4: Aetiology of deaths with prolonged stay (>14 days) in PICU

Neurological cases include ADEM (1), Stroke (1), TBM (1), IC Bleed (1), Refractory Status Epilepticus (2).
Analysis of deaths occurring in relation to time, 111 (48%) deaths occurred in morning and evening shifts (8AM -8PM) and 122 (52%) deaths occurred in night shift (8PM - 8AM). Out of 122 deaths in the night, 47 (38.5%) deaths occurred during 12AM to 5AM. This early morning deaths accounted for 20% of total deaths. It was also shown that 57(24%) deaths occurred in weekends (Saturday and Sunday) because most of the cases admitted during these days were in poor condition.

Analysis of the causes of PICU Mortality: Pulmonary causes which included bronchopneumonia, bronchiolitis, lobar pneumonia with effusions and hydro pneumothorax were broadly classified under pneumonia which constituted for almost one third of deaths. Congenital heart diseases which were complicated either by pneumonia or congestive cardiac failure or cardiogenic shock constituted for 15% of deaths. Therefore it stands as a major comorbid condition in the PICU deaths. Infections resulting in septicemia and meningitis still constitute for 13% of total deaths. All the cases were on broad spectrum antibiotics and when required even anti-fungal medication, indicating that these cases were either of non-bacterial origin or resistant bugs or child was brought in the end stage MODS. Hepatic encephalopathy constituted 14 cases, only one case was acute on chronic liver disease and rest of 13 cases were acute liver failure and all these cases received herbal medication and were admitted in terminal stages. Poisonings constituted 11 cases which included snake bite (4), Toddy ingestion (2), Kerosene poisoning (2), Scorpion Sting (1), OP poisoning (1) and Corrosive alkali poisoning (1).

<table>
<thead>
<tr>
<th>Causes*</th>
<th>Frequency</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumonia</td>
<td>68</td>
<td>29</td>
</tr>
<tr>
<td>Congenital Heart Disease</td>
<td>34</td>
<td>15</td>
</tr>
<tr>
<td>Septicaemia</td>
<td>29</td>
<td>12</td>
</tr>
<tr>
<td>Meningitis</td>
<td>26</td>
<td>11</td>
</tr>
<tr>
<td>Hepatic Encephalopathy</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>VME</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>Poisonings</td>
<td>11</td>
<td>4.7</td>
</tr>
<tr>
<td>Dengue Shock Syndrome</td>
<td>10</td>
<td>4.3</td>
</tr>
<tr>
<td>Refractory Status Epilepticus</td>
<td>9</td>
<td>3.8</td>
</tr>
<tr>
<td>Complicated Gastroenteritis</td>
<td>8</td>
<td>3.4</td>
</tr>
<tr>
<td>Renal Failure</td>
<td>6</td>
<td>2.6</td>
</tr>
<tr>
<td>IC Bleed</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>GBS</td>
<td>4</td>
<td>1.7</td>
</tr>
<tr>
<td>DKA</td>
<td>4</td>
<td>1.7</td>
</tr>
<tr>
<td>TB Meningitis</td>
<td>4</td>
<td>1.7</td>
</tr>
<tr>
<td>Others*</td>
<td>24</td>
<td>10.3</td>
</tr>
</tbody>
</table>

*Children had more than one diagnosis

♦ Others include EHBA, IEM, RHD, Hematological causes, ADEM etc.

In the study, it was observed that the maximal and minimal distance travelled was 10 & 415 Kilometres respectively. Substantial numbers of cases were referred from neighbouring districts like Nalgonda (16%), Mehboobnagar (15%) and Medak (7%) indicating the lack of critical care services in these areas.
In the present study the mortality rate of PICU was 23.5% which was in par with the mortality rates reported in developing countries that varied from 9.8-35%13-16. Often these patients arrived late with multiple complications leading to mortality despite the best available therapy. A study conducted by Campos Mino et al. in 2012 showed 13.29% mean mortality rate in PICU in Latin American countries; 5.2% in Cuba, 25% in Honduras, 4% in Spain and 6% in Portugal17. A study conducted in Argentina revealed a lower mortality of 2.6%.18 Gemke in a multi center study showed mean 7.1% mortality rate (range 1-10%) in PICU patients. One of the reasons of variant rate of mortality related the different severity of disorders5.

The mean age of deaths was 2.84 years (34.08 months) in the present study which was similar (3 years) in Sands study19 and it varied between 8 months to 2.6 years in other studies17,20, 21. In the present study, 51% of total PICU deaths were infants a similar figure (68%) was shown in the study conducted by Ghaffari et al21; but infant deaths accounted for only 27.9% in Sands study19. However, it is expected that mortality rate is more common in infant than older children17,22.

The commonest condition leading to death was pneumonia (29%) which was similar to the study conducted in Nepal in 201423. But a study from Greece revealed neurological causes (23%) and sepsis as major causes of death with pneumonia accounting for only 11% cases24. In the present study congenital heart disease were seen in 11.58% of cases, similar to the study conducted by Ghaffari et al21 which revealed 11% of deaths had congenital heart disease. Naghib’s study25 presented that 28% had congenital heart disease. Sands et al.26 showed infections and trauma, each with 19.6% were common aetiology of death in PICU, however as trauma cases would be shifted to surgical department, the present study did not have any trauma cases enrolled. Duration of stay is important because serious cases succumb early and in the present study, 71% of total deaths occurred in first 7 days which was also revealed in other studies21,26,27. In the present study, 10% of patients had prolonged stay and a very similar figure (11%) was identified in a prospective study conducted on prolonged study by Yaseen Arabi et al28. Prolonged ICU stay can adversely affect the health status by increasing the risk of infection, complications and possibly, mortality29. The present study also revealed prolonged stay was associated with significant mortality (Chi-square statistic is 35.8369; p-value is < .05).

Mechanical ventilation was only 34.8% which was in the lower range of reference values of 31.5-67%.9,26. This reflects on severe dearth of ventilators when compared to the patient load dealt in PICU of one of the biggest government tertiary care teaching hospital in South India. The fate of other small PICUs canwell be comprehended.

IV. Discussion

In the present study the mortality rate of PICU was 23.5% which was in par with the mortality rates reported in developing countries that varied from 9.8-35%. Often these patients arrived late with multiple complications leading to mortality despite the best available therapy. A study conducted by Campos Mino et al. in 2012 showed 13.29% mean mortality rate in PICU in Latin American countries; 5.2% in Cuba, 25% in Honduras, 4% in Spain and 6% in Portugal. A study conducted in Argentina revealed a lower mortality of 2.6%. Gemke in a multi center study showed mean 7.1% mortality rate (range 1-10%) in PICU patients. One of the reasons of variant rate of mortality related the different severity of disorders.

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V. Conclusion

People working in PICU in developing countries face many problems like lack of resources, knowledge and the support system. A trained paediatric intensivist may help by working closely with general paediatricians, training residents and nurses in advanced procedures, developing and updating unit protocols taking into consideration the existing human, logistic and financial resources. The intensivist may also be helpful for training peripheral units on stabilization and transportation of sick children. Nightingale provided the definition of nursing as “helping the patient to live” and thus the role of Nurses in PICU cannot be overemphasized. The nursing staff and patient ratio is 1:4 indicating the urgency of recruitment of nursing staff by the government. There is also a need for optimizing an efficient distribution and use of ICU beds.

In addition to improvement in resource utilization, Regionalization can also be recommended as a way to improve the care of critically ill or injured adults and children. Regionalization is the tendency to form de-centralized regions. Regionalization can effectively put limited resources together to maximize the effectiveness and availability of these resources to a greater number of patients.
These facts highlight the necessity to strengthen the existing health care system and develop facilities for proper transportation and treatment of critically ill children.

References