Admission Patterns and Outcome of critically ill children admitted to the Pediatric Intensive Care Unit in Al-Mukalla District - Yemen

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Abstract

Background: Critically ill patients are those who experiences hemodynamic instability requiring frequent monitoring of vital signs and rapid titration of intravenous medication are admitted to the intensive care unit (ICU) to reduce morbidity and mortality. The trend of causes of admission to PICU is continuously changing from period to period.

Patients and Methods: A Cross sectional observational study conducted at the PICU of Hadhramout University Hospital for Mother and Child Health, and Al-Mukalla Maternity and Children Hospital at Al- Mukalla city-Hadhramout, included the admitted children to the PICU from January 2021 to June 2021.

Results: A total of 102 children enrolled, 57 males and 45 females**.** Most patients (41.1%) were < 1 year. Respiratory disorders were the most common cause of admission, followed by CVS, and CNS causes. Pediatric Emergency Department was the common source for admission to PICU in (44.1%).About 12.7% of critically patients needed mechanical ventilation.73.5 % of patients improved and 15.7 % died. The mortality was high among CVS with death of (30.8%) of admitted patients followed by the hematology/oncology (28.6%) and then CNS (20 %).

Conclusion: Early transfer of critically ill children to PICU and timely management is critically important to improve survival.

Keywords: Pediatric intensive care unit, Children, Mortality, Yemen.

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أنماط الترقيد و نتيجة المرض للأطفال المرقدين بحالة حرجة في وحدة العناية المكثفة للأطفال في مدينة المكلا - اليمن

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المقدمة: الأطفال بحالة حرجة هم الذين حالتهم قابلة للتدهور الى حالة حرجة معرضة للخطر وتستدعي الترقيد في وحدة العناية المكثفة للأطفال في المستشفى. أسباب الترقيد في العناية المكثفة تختلف من مرحلة لأخرى.

طريقة الدراسة: هي دراسة وصفيةاستعراضيه أجريت في وحدة العناية المكثفة للأطفال في مستشفى جامعة حضرموت للأطفال و النساء و الولادة و مستشفى المكلا للأمومة و الطفولة خلال الفترة من يناير 2021 الى يونيو 2021.

نتائج الدراسة: الدراسة شملت 102 من الاطفال المصابين بحالة حرجة،و كان عددهم 57 ذكر و45 أنثى. أغلب الحالات (41.1%) كان تحت عمر سنة. أكثر أسباب دخول العناية المكثفة كانت أمراض الجهاز التنفسي ثم أمراض القلب و بعد ذلك أمراض الجهاز العصبي. أغلب المرضى تحسنوا بنسبة 73.5% و كانت نسبة الوفيات هي 15.7% . كان أغلب مصدر الترقيد للعنايةهو وحدة الطوارئ بنسبة 44.1%، أحتاج 12.7% من الأطفال بحالة حرجة الى جهاز تنفس صناعي. كان معدل الوفيات عاليا في حالات القلب بنسبة 30.8% ثم في جهاز أمراض الدم والأورام بنسبة 28.6% ثم الجهاز العصبي بنسبة 20%.

الخلاصة: النقل المبكر للطفل المريض بحالة حرجة الى وحدة العناية المكثفة للأطفال في المستشفى يساهم في تقليل الوفيات و انقاذ حياة المرضى.

الكلمات المفتاحية: وحدة العناية المكثفة للأطفال، الأطفال، الوفيات، اليمن.

Introduction:

Critically ill patients are those who experiences hemodynamic instability requiring frequent monitoring of vital signs and rapid titration of intravenous medication are admitted to the intensive care unit (ICU) to reduce morbidity and mortality (1).

Pediatric emergency medicine and pediatric critical care medicine are well-established and mature disciplines in developed countries. As such they have shown positive impacts on clinical outcomes, having a pivotal role in the care of acutely ill or injured children (2-4).

The trend of causes of admission to PICU is continuously changing from period to period. Infectious diseases contributing majority admissions in the past especially in developing countries, but now non-communicable diseases are also in rise (5).

Since these patients are critically ill, the outcome of intervention is sometimes difficult to predict (6). Mortality is proportional to the underlying nature of the disease, physiological status on arrival and the quality of care of course (5).

A few reports have described various sources of admission in pediatric intensive care units in Arab countries with no published reports in Yemen. The objective of this study is to determine the frequency, indications and outcome of critically ill requiring admission to PICU at Al-Mukalla Hadhramout Yemen.

Patients and Methods:

A prospective observational study conducted at the PICU of Hadhramout University Hospital for Mother and Child Health and Al- Mukalla Maternity and Children Hospital, at Al-Mukalla city, Hadhramout, Yemen, and includes all pediatric patients from > 28 days (outside neonatal period) to <15 years of age who were admitted to the PICU during 6 months period from January 2021 to June 2021.

Inclusion criteria:

All Critically ill children admitted to the PICU were enrolled in the study. 'Critically ill children' were defined as having at least one of the following criteria;

1. Respiratory: Abnormal respiratory rate (> or ≤2SD – Standard Deviation expected for age and sex)/gasping/ not maintaining respiration.
2. Cardiovascular - Abnormal heart rate (> or ≤ SD expected for age and sex).
3. Or Shock (Blood pressure <5th percentile for age and sex) or Hypertension (Blood pressure >95thpercentile for age and sex).
4. Central Nervous System: Status epilepticus, Altered sensorium, Encephalopathy, Raised intracranial pressure.
5. Others: Sepsis, MODS (Multi Organ dysfunction Syndrome), Acute Kidney Injury, Hospital Acquired Infection (HAI), Ventilator Associated Pneumonia (VAP), nosocomial Urinary Tract Infection (UTI) and Catheter Related Blood Stream Infection (CRBSI) were defined as per standard definitions (4).

Exclusion criteria:

1. Children whose parents did not consent were excluded.
2. Patients with incomplete or missed data.

Patients were referred to PICU either from the admitted inpatient other pediatric departments or directly from the emergency pediatric unit when there was indication of direct admission to PICU.

All patients admitted to PICU were treated according to the written standard operating protocol by the pediatricians working in the hospital. Relevant investigations including: complete blood count (CBC), blood sugar, electrolytes, urea, creatinine were done at admission and subsequently whenever required. Cerebrospinal fluid analysis for cell counts, protein, sugar, Gram and culture sensitivity was done in all children with suspected central nervous system infection.

Empiric antibiotics were started as the protocol wherever indicated, and it was subsequently changed depending upon the culture and sensitivity pattern. Vasopressors (dopamine and/or dobutamine and epinephrine) were used when needed. Seizures were controlled with anti-epileptic drugs (midazolam, diazepam, phenytoin, valproate) and raised intracranial pressure was managed by administering mannitol 20%.

Ethical consent:

The study protocol was conducted according to principles of the Declaration of Helsinki, as well as reviewed and approved by the Ethical Research Committee at Hadhramout University /College of Medicine and Health Sciences. Approval from the institutional ethical committee of Al- Mukalla Maternity and Children Hospital was taken.

Statistical methods:

Demographic and clinical details were recorded onto a predesigned data collection pro forma and data was later entered into an MS-Excel 2010 spreadsheet. Continuous data was represented as Mean and SD, while discrete data was represented as frequencies. The data were processed and analyzed by using computer and analyzed by proportion and percentage. A p-value <0.05 was considered significant.

Results:

A total of 102 children were admitted during the 6 month period from January 2021 to June 2021, with ages range from 1.2 months to 13.6 years .The mean age was 1.98± 1 years, where most cases(41.1%%)were in the age group (>28 days-1 year), while minority of cases (9.8%) were in the age group (>10 – <15 years).There were 57 males and 45 females, with a male to female ratio of 1.26:1(Table 1).

Table 2 shows the system wise cause of admission of patients to PICU, and the respiratory system (n = 44, 43.1%) was the commonest system among the top 5 system/ cause involved. Next system was cardiovascular system (CVS) (n = 13, 12.8%).Third system was the Central nervous system (CNS)(n = 10, 9.8%), and the fourth was Gastro intestinal system/Diarrhea (n = 9, 8.8%), while Infection/sepsis and Hematology/ Oncology has the fifth in order with similar percentage (n = 7, 6.9%).

Table 3 shows clinical conditions of patients, where there is a slight predominance (56.9%) of ≤ 6 days duration of illness before PICU admission. Pediatric Emergency Department was the common source for admission to PICU in 44.1%.About 12.7% of critically patients need mechanical ventilation. Length of stay in PICU of 2-7 days was the common finding in 47% of cases. About 30.4% of cases has Comorbid illness.

Figure 1 shows the outcome of cases where (n = 75, 73.5%) of patients improved and subsequently discharged, (n = 16, 15.7%) died, and (n = 5, 4.9%) discharged against medical advice (DAMA), while (n = 6,5. 9%) were referred.

Regarding the outcome of critically ill patient according to the system/causes involved, the majority of improved cases were who had a respiratory system cause(n=33, 75 %)with mortality (n=6, 13.6 %), while in the CVS: the improved were (n=8,61.5%), with mortality (n= 4, 30.8 %),and in the CNS: improved (n=8, 80 %), with mortality (n= 2, 20%). The rest of data are shown in table 4.

Table 1: Distribution of critically ill patients according to age and sex (n = 102)

Age groups	Sex		Total	Ratio (M:F)
	Male	Female		
>28 days - <1 year	23(22.5%)	19(18.6%)	42(41.1%)	1.2:1
1 - <5 years	17(16.7%)	13(12.8 %)	30(29.5 %)	1.3:1
5 - <10 years	11(10.8 %)	9(8.8%)	20(19.6 %)	1.22:1
10 - <15 years	6(5.9%)	4(3.9%)	10(9.8%)	1.5:1
Total	**57 (55.9 %)**	**45(44.1%)**	**102(100%)**	**1.26:1**

Table 2: Frequency of cases of disease categories requiring PICU admission in relation to the system/causes involved (n= 102)

System /causes	Frequency	Percent %
Respiratory system	44	43.1
Cardiovascular system	13	12.8
Central nervous system	10	9.8
Gastro intestinal system/Diarrhea	9	8.8
Infection/sepsis	7	6.9
Hematology/ Oncology	7	6.9
Endocrine/metabolic	5	4.9
Renal	4	3.9
Others	3	2.9
Total	**102**	**100**

Table 3: Clinical conditions of patients

Characteristics	Frequency	Percentages
Duration of illness before PICU admission in days		
▪ ≤6 days	58	56.9
▪ >6 days	44	43.1
Sources of admission		
▪ Pediatric Emergency Department	45	44.1
▪ Pediatric Department	44	43.1
▪ Referred from other hospitals or health center	13	12.8
Need mechanical ventilation		
▪ Yes	13	12.7
▪ No	89	87.3
Length of stay in PICU in days		
▪ ≤ 1	7	7
▪ 2-7	48	47
▪ >7	47	46
Presence of Comorbid illness		
▪ Yes	31	30.4
▪ No	71	69.6

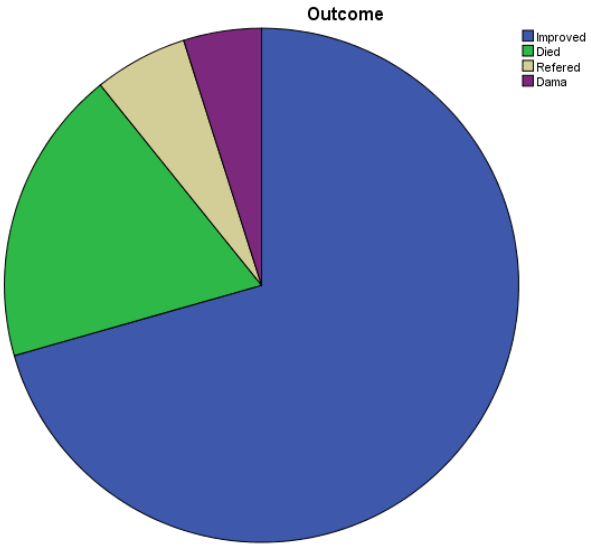

Figure 1: outcome of the critically ill children admitted to the PICU

Table 4: Outcome of critically ill patient according to the system/causes involved

System/causes	Improved n (%)	Died n (%)	DAMA n (%)	Referred n (%)
Respiratory system (n=44)	33(75)	6(13.6)	3 (6.8)	2 (4.6)
Cardiovascular (n=13)	8(61.5)	4 (30.8)	0	1 (7.7)
Central nervous system (n=10)	8(80)	2 (20)	0	0
Gastro intestinal system/Diarrhea (n=9)	6 (66.7)	1 (11.1)	0	0
Infection/sepsis (n=7)	5(71.4)	0	0	2 (28.6)
Hematology/ Oncology (n=7)	5 (71.4)	2 (28.6)	0	-
Endocrine/metabolic (n=5)	4 (80)	0	0	1 (20)
Renal (n=4)	3 (75)	1 (25)	0	0
Others (n=3)	3 (100)	0	0	0

Regarding survival outcome, there is more death in males (n=10, 62.5%) comparing to females (n=6, 37.5%).The age group >0.28 - <1 year was the most affected, where (n=10, 62.5 %) died. Duration of illness > 6 days before admission to PICU was associated with more death cases (n=10, 62.5 %) than other age groups.

Source of admission from Pediatric Emergency Department to PICU was associated with more death incidence (n=8, 50 %).Death incidence among cases that need mechanical ventilation were higher (n=9, 64%). Length of stay in PICU 2-7 days was associated with more incidence of death rates (n=7, 44%), and the presence of comorbid illness was a risk factor for death (n=9, 64%) (Table 5)

Table 5: Survival outcome Socio-demographic and clinical variables following admission of critically ill patients.

Characteristics	Outcome following Admission (n)		P-value
	Survival	Death	
Sex			
• Male	47	10	0.383*
• Female	39	6	
Age group (years)			
• >0.28 -<1 year	32	10	
• < 5 years	29	1	0.127†
• 5-<10 years	17	3	
• 10- <15 years	8	2	
System /causes			
Respiratory system	38	6	
Cardiovascular	9	4	
Central nervous system	8	2	
Gastro intestinal system/Diarrhea	8	1	0.817†
Infection/sepsis	7	-	
Hematology/ Oncology	5	2	
Endocrine/metabolic	5	-	
Renal	3	1	
others	3	-	
Duration of illness before PICU admission in days			
• ≤6 days	52	6	0.369*
• > 6 days	34	10	
Sources of admission			
• Pediatric Emergency Department	37	8	
• Pediatric Department	41	3	0.020†
• Referred from other hospitals or health center	8	5	
Need Mechanical ventilation			
• Yes	4	9	0.000*
• No	82	7	
Presence of Comorbid illness			
• Yes	24	7	1.66*
• No	62	9	
Length of stay in days			
≤ 1	5	2	
2-7	44	4	0.131†
> 7	37	10	

Note: †chi-square test, *fisher's exact test.

Discussion:

Caring for the critically ill children is a challenge in developing countries where resources and trained manpower is limited. Management of critically ill patients requires significant human, infrastructural and financial resources. These resources are typically limited in low-income countries like Yemen.

In our study, most cases were in the age group (>28 days-1 year) followed by the age group 1-<5 years, so both groups constitute 71.1% of cases. This because the age groups of infants (1 month to 1year) and children up to 5 years were the most vulnerable age group and representing the majority of admitted patients to PICU. This finding is in accordance with several other studies (1-8).

There was slight predominance of males over females, with male to female ratio was 1.26:1. Similar male predominance at admission was found in other studies (3,5,6,9,10,11) this may be to male preference as in parental health-seeking behavior in Yemen and other developing countries where some non-educated fathers prefer males over females in which they brought their male sons early to hospital than their daughters, there might be an epidemiological reason for male susceptibility to infection or other conditions requiring admission.

In this study, respiratory system was found to be the commonest system involved. Next system was cardiovascular system (CVS), followed by central nervous system (CNS), the gastrointestinal system/Diarrhea, while infection/sepsis and hematology/oncology had the fifth order. This was in accordance with other studies that found that the most common cause of admission was respiratory problems at any age (9,10,11,12).However, in another studies it found that central nervous system disorders were the most common cause for admission to PICU (3,5,8).

Source of admissions to PICU differs from time to other. However, pediatric emergency department was the common source for admission to PICU in our study. In this study, 12.7% of critically patients need mechanical ventilation, the majority of them due to respiratory disorders. Other studies report high percentage, where in a study done in Pakistan, most patients (34.8%) required invasive mechanical ventilation for respiratory support (3).

In this study pre-existing chronic comorbidities was found in 30.1% of admitted cases including cerebral palsy, malnutrition, genetic abnormalities and other conditions. Preexisting comorbid condition plays role in increasing morbidity and mortality in critically ill children (11). In a study conducted in Pakistan, similar percentage found, while in other study there were 24% had comorbid conditions (3).

Regarding outcome of cases, 73.5% of patients improved while 16 patient died this corresponds to mortality rate of 15.7%. The mortality rate in PICUs of developing countries varied considerably. In a study in Pakistan the mortality rate of children admitted in PICU was 20% (3), while in a study done in Ethiopia, the death rate was highest (51.9%) among children above five years of age (13). In Nepal, a study there identified a mortality rate of 12.6% (10). In Vietnam, the mortality rate was 5.03% (14), while a study in USA identified a very low PICU mortality rate (3%) (11). Inadequate staffing, limited resources, and delay in care provision, as in many low resource developing countries, may contribute to the relatively high number of deaths in this study.

Respiratory system was responsible for most mortality admission causes, followed by the CVS then CNS. Similar results was found in a study in Vietnam, where the top causes of mortality in PICU were respiratory, CVS, and CNS causes respectively, while in a study in India, the top four causes of death are sepsis, respiratory, CVS, and CNS disorders respectively (12).

In this study, there was a slight predominance of death among males than females. This male vulnerability to death in compare to females was also observed in similar studies (3,12,14). The majority of deaths occurred in children less than 1 year of age. Similar findings found in other studies (3,12,14). This possibly because most admitted cases lies in this group.

The majority of children who need mechanical ventilation were died because of seriousness of the diseases that necessitates mechanical ventilations. Most of patients who were ventilated developed respiratory failure. This association of mechanical ventilation with mortality is statistically significant (p-value 0.000*).Similar results seen in a study done in India, where the mortality rate was 55.35% among mechanically ventilated children (15).

In this study, the mortality rate among patients with comorbid illness is 22.6% out of 31 patients with comorbid illness. A study in India reported a higher percentage of mortality (41%) among children with comorbid conditions admitted to PICU (16).

Conclusion:

The highest number of admissions into PICU was due to respiratory disorders followed by cardiovascular disorders, neurologic disorders, gastro intestinal system/diarrhea disorders, and then Infection/sepsis, hematology/ oncology, endocrine/ metabolic, and renal disorders. Early transfer of critically ill children to PICU and timely management is critically important to improve survival.

Limitations of this study:

Low sample because neonates are excluded as they grouped into separate intensive care unit named neonatal intensive care unit (NICU) and because of a relatively short period of the study and difficulty on follow up of the cases.

Final confirmed diagnosis is not reached in a reasonable number of patients, therefor we divided patients according to system involvement as previous literatures guide.

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