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Original article

Outcome of PICU in Benha University in Last 2 Years

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Abstract

Background: Patterns of admission and treatment outcomes in the pediatric intensive care unit (PICU) vary in different regions of the globe. The most common admission reason for pediatric cases to the PICU are trauma, postoperative treatment, complicated meningitis, cardiovascular, neurological, acute respiratory distress syndrome (ARDS), and septic shock. **Methods:** This prospective observational study was conducted on children aged less than 18 years old, both sexes and patients fulfilled the criteria of pediatric PICU admission and discharge criteria of American academy of Pediatrics (AAP). admitted at PICU at Benha University Hospitals. All patients underwent complete history taking, clinical examination, routine laboratory investigations and specific investigations. **Results:** most of admitted cases due to respiratory system infection followed by CNS infection. There was statistical significant negative correlation between age and length of hospital stay. Odds ratio of Recovery rate was Duration of stay (days), with a significant logistic regression relationship between the two variables (p= <0.001). Odds ratio of Mortality rate was Duration of stay (days), with a significant logistic regression relationship between the two variables (p= <0.001). **Conclusions:** Morbidity following pediatric intensive care occurs frequently and appears to be increasing as mortality decreases. There was a strong negative relationship between age and duration of stay while there was a significant logistic regression relationship between either the recovery rate or the mortality rate and duration of stay.

Keywords: Outcome; PICU; Acute respiratory distress syndrome; Benha University.

Introduction

One pediatric population of special interest is critically ill children since these children are at an increased risk of death. A pediatric intensive care unit (PICU) is an area within a hospital specializing in the care of critically ill infants, children, and teenagers [1].

Admission to intensive care unit (ICU) may be required if the patient experiences hemodynamic instability requiring frequent monitoring of vital signs, invasive hemodynamic monitoring, rapid titration of intravenous medication with concurrent monitoring, and respiratory support in the ICU. This may significantly improve the quality of care and outcomes of critically ill and injured patients, predominantly in high-resource settings [2].

However, critical care practice is very difficult in developing nations where health needs frequently exceed available resources, and most critical health care institutions are still in their early stages of development [3].

Patterns of admission and treatment outcomes in the PICU vary in different regions of the globe. The most common admission reason for pediatric cases to the PICU are trauma, postoperative treatment, complicated meningitis, cardiovascular, neurological, acute respiratory distress syndrome (ARDS), and septic shock [4].

The major purpose of the pediatric intensive care unit is to reduce death by closely monitoring and treating severely ill children who are considered to be at high risk of death. The effectiveness of therapy will be determined by evaluating the outcomes of medical treatments. The mortality determinants have varied across the globe and even this may be serious in our study [5].

The last decade has witnessed marked progress in advancing pediatric intensive care to the developing world. However, many PICUs in low- and middle-income countries, where there is a higher percentage of pediatric population, still require a higher number of qualified health care staff as well as rapid access to necessary medication, supplies, and equipment to participate effectively in reducing childhood mortality [6].

However, this improvement should be maintained through continued organized policies that address and overcome the challenges in the context of limited resources. Hence, the information about the characteristics and outcome of patients admitted to the PICUs is valuable from health policy perspectives [7].

The aim of this study is to assess the PICU outcomes in Benha University Hospital, including mortalities, morbidities and causes of death also, to evaluate possible risk factors in relation to diagnostic categories, admission source, length of hospital stay, recurrent PICU admission and other demographic factors.

Patients and methods

This prospective observational study was conducted on children aged below 18 years old, both sexes, patients fulfilled the criteria of pediatric PICU admission and discharge criteria of American academy of Pediatrics (AAP)[8] .The patients provided

informed written consent before participating in the study. The research was conducted at Faculty of Medicine, Benha University after the approved guidelines of the institutional Ethical Committee of Benha University Hospitals **(Approval code: MS 41-3-2023)** during the period from January 2020 to December 2022.

Patients who needed invasive monitoring: arterial and central venous catheters, pulmonary arterial lines, ICP (intracranial pressure) catheters, patients with evidence of [respiratory impairment of failure, cardiovascular compromise: shock, hypotension, hypertensive crisis, acute neurologic deterioration: coma, status epilepticus, increased ICP, acute renal failure requiring dialysis or CVVH and bleeding disorders that necessitate massive transfusions admitted at PICU at Benha University Hospitals, Egypt.

Patients with missing data and patients who died during the first two hours of admission, because their PICU stay was too short to be connected to the outcome were excluded from this study.

Proper and detailed history taking [primary admission diagnosis, presenting complaint history of present illness, history of past illness including all significant illness since infancy, previous PICU or NICU admission, antenatal history, natal history, dietetic history, developmental history and immunization history]. and thorough clinical examination included General examination including [vital signs: pulse, blood pressure, capillary filling time, respiratory rate and temperature, developmental milestones, nutritional state classification, body mass index, by using percentiles developed for Egyptian children], Systemic examination including [cardiovascular System: For detection of any abnormal heart sounds or murmurs, respiratory System: [For detection of any abnormal breath sound, adventitious sounds and respiratory distress], gastrointestinal Tract (GIT) and abdomen presence of organomegaly or ascites and central Nervous System (CNS) and musculoskeletal system assessment of [Glasgow coma score, pupillary reaction, examination of motor system including power, tone and reflexes, Signs of meningeal irritation, Presence of abnormal movement].

Routine laboratory investigation, including [complete blood count (CBC), C-reactive protein (CRP), prothrombin time (PT), partial thromboplastin time (PTT) and international normalized ratio (INR), alanine aminotransferase (ALT) and aspartate aminotransferase (AST), serum urea and creatinine, arterial blood gases (ABG) and serum electrolytes (Na, K, Ca)].

Specific investigation for detection of infection [urine analysis and culture, Chest X-ray and cerebrospinal fluid analysis and blood culture].

The outcome included follow up until death in the PICU, or discharge with or without morbidity) PICU length of stay (LOS), and readmission to PICU.

Sample size

Assuming the mean Hb was 13.3 +_1.6 vs 14+_1.5 in PDB VS NON PDB at 80% power and 95% CI so the estimated sample was 156 cases (Open epi).

Statistical analysis

Statistical analysis was done by SPSS v26 (IBM Inc., Armonk, NY, USA). Quantitative variables were presented as mean and standard deviation (SD). Qualitative variables were presented as frequency and percentage (%). Logistic regression was also used to estimate the relationship between more independent variables (multivariate).

Results

Table 1 showed demographic data among the study population. Age (years) in the study population with mean ± SD = 8.82 ± 3.72. Number of male patients in the study population was 956 (57.76%). Regard physical data among the study population. Weight (Kg) in the study population with mean ± SD = 29.14 ± 13.12 and mean ± SD percentile was41.9±30.1. Height (cm) in the study population with mean ± SD = 131.15 ± 22.42 and mean ± SD percentile was 33.3±25.1. BMI in the study population with mean ± SD = 16.06 ± 2.59. Regarding vital data among the study population and mean ± SD percentile was 54.16±21.2. The Pulse in the study population with mean ± SD = 100.45 ± 8.73. The Respiratory rate in the study population with mean ± SD = 25.79 ± 2.61. The Temperature in the study population with mean ± SD = 37.49 ± 0.45.

Regarding laboratory investigations included liver function test results among the study population. ALT (U/L) in the study population with mean ± SD = 31.17 ± 10.71. AST (U/L) in the study population with mean ± SD = 28.13 ± 8.87, Kidney function test results among the study population. Urea (mg/dl) in the study population with mean ± SD = 26.76 ± 5.88. Creatinine (mg/dl) in the study population with mean ± SD = 0.88 ± 0.15 **Table 2.**

Table 3 showed affected system and duration of stay among the study population. Number of patients who had a condition that affected the respiratory system in the study population was 719 (43.44%). Duration of stay (days) in the study population with mean ± SD = 6.42 ± 6.14. PICU outcomes among the study population. Number of patients who had recovered in the study population was 1399 (84.53%). Number of patients who died in the study population was 173 (10.45%).

Table 4 shows Pearson's correlation coefficients (r) between Age (years) and Duration of stay. Pearson's correlation coefficients (r) between Age (years) and Duration of stay were - 0.093, with a strong negative relationship between the two variables.

Logistic regression analysis with odds ratios and 95% confidence intervals (CI) predicting Recovery rate. Odds ratio of Recovery rate was Duration of stay (days), with a significant logistic regression relationship between the two variables (p= <0.001) **Table 5.**

Table 6 showed logistic regression analysis of most of admitted cases due to respiratory system infection followed by CNS infection. There was statistically significant negative correlation between age and length of hospital stay. Odds ratio of Recovery rate was Duration of stay (days), with a significant logistic regression relationship between the two

variables (p= <0.001). Odds ratio of Mortality rate was Duration of stay (days), with a significant logistic regression relationship between the two variables (p= <0.001).

Table 1: Demographic, physical and vital data among the study population**.**

		Study population (n = 1655)
Age (years)		8.82 ± 3.72
Gender	**Male**	956 (57.76%)
	Female	699 (42.24%)
Weight (Kg)	29.14 ± 13.12	
Weight (Percentile)	41.9±30.1	
Height (cm)	131.15 ± 22.42	
Height (Percentile)	33.3±25.1	
BMI	16.06 ± 2.59	
BMI (Percentile)	54.16±21.2	
Pulse	100.45 ± 8.73	
Respiratory rate	25.79 ± 2.61	
Temperature	37.49 ± 0.45	

Data presented as mean ± SD *: statistically significant as P value <0.05, BMI: body mass index

Table 2: Liver function tests, kidney function tests among the study population

		Study population (n = 1655)
ALT (U/L)	**31.17 ± 10.71**	
AST (U/L)	**28.13 ± 8.87**	
Urea (mg/dL)	**26.76 ± 5.88**	
Creatinine (mg/dL)	**0.88 ± 0.15**	

Data presented as mean ± SD, *: statistically significant as P value <0.05, ALT: Alanine aminotransferase, AST: aspartate aminotransferase

Table 3: Affected system and duration of stay among the study population

		Study population (n = 1655)
Affected system		
Respiratory system		719 (43.44%)
CNS		224 (13.53%)
Haematology		180 (10.88%)
Traumatic		113 (6.83%)
Renal		108 (6.53%)
Endocrine		105 (6.34%)
GIT		101 (6.10%)
CVS		66 (3.99%)
Post-operative		39 (2.36%)
Duration of stay	6.42 ± 6.14	
Recovery rate	**Recovered**	1399 (84.53%)
	Not recovered	256 (15.47%)
Mortality rate	**Died**	173 (10.45%)
	Lived	1482 (89.55%)

Data presented as mean ± SD, *: statistically significant as P value <0.05, CNS: central nervous system, GIT: gastrointestinal tract, CVS: cardiovascular systems.

Table 4: Pearson's correlation coefficients (r) between Age (years) and Duration of stay

	Duration of stay	
	Pearson's correlation coefficients (r)	**P**
Age (years)	**- 0.093**	**<0.001**

*: significant as P value ≤ 0.05.

Table 5: Logistic regression analysis with odds ratios and 95% confidence intervals (CI) predicting Recovery rat

	Recovery rate			
	OR	**95% CI**		**P**
		Lower	**Upper**	
Age (years)	0.981	0.947	1.017	0.303
Gender (male)	0.942	0.719	1.235	0.667
BMI	0.959	0.912	1.008	0.100
Duration of stay (days)	0.959	0.940	0.978	**<0.001***

OR: odds ratio, CI: confidence interval, *: significant as P value ≤ 0.05.

Table 6: Logistic regression analysis with odds ratios and 95% confidence intervals (CI) predicting Mortality rate

	Mortality rate			
	OR	**95% CI**		**P**
		Lower	**Upper**	
Age (years)	**1.003**	**0.962**	**1.047**	0.876
Gender (male)	**1.029**	**0.747**	**1.416**	0.862
BMI	**1.021**	**0.962**	**1.084**	0.489
Duration of stay (days)	**1.063**	**1.040**	**1.087**	**<0.001**

OR: odds ratio, CI: confidence interval, *: significant as P value ≤ 0.05.

Discussion

Children who are critically ill are one paediatric population of special attention since they have a higher chance of dying. A hospital's paediatric intensive care unit (PICU) is a dedicated space for the treatment of very sick newborns, kids, and teenagers [9].According to diverse parts of the world have diverse PICU admission and treatment results patterns. Adverse respiratory distress syndrome (ARDS), septic shock, complex meningitis, trauma, surgical treatment, and neurological conditions account for the majority of paediatric PICU admissions [10].

Our results revealed that 43.44% of patients had a condition that affected the respiratory system. Duration of stay (days) ranged from 1 to 25 with mean ± SD (6.42 ± 6.14). Regarding PICU outcomes, 84.53% of patients had recovered and 10.45% of them died. There was a strong negative relationship between age and duration of stay while there was a significant logistic regression relationship between either the recovery rate or the mortality rate and duration of stay.

On the contrary to the present study's results, and in a similar study, 56% improved, 15% did not change, 9% developed a new morbidity, and 21% died. The shortest median follow-up time was 1.4 years for those who died and the longest was 4.0 years for those who improved. Patient characteristics except age at follow-up, and the diagnoses of

trauma and cancer did not differ among the long-term outcome groups. Notably, long-term outcome was not associated with hospital discharge functional status. Remarkably in the same previously mentioned study, 70% of the survivors had significant improvement after a median follow-up time of 4.0 years. Of these, 82% improved to normal or mild dysfunction, 11% improved to moderate dysfunction, and 7% improved to severe dysfunction. There was little to distinguish these patients from the other outcome groups except that their baseline functional status was more frequently normal or mildly dysfunctional and they tended to be patients with traumatic illness [11].In agreement with our study found that the majority of PICU diagnoses were respiratory illness (40.9%) followed by head trauma, and septic shock (7.6%). Average length of PICU stay was 28.5 ± 84.2 days (median 7 d). Sixty-one percent were intubated. [12]

Recently reviewed the follow-up functional outcome literature for general intensive care cohorts. Rates of acquired functional impairment ranged from 10% to 36% at hospital discharge and 10% to 13% after more than 2 years. [13]

On the other hand, several relatively recent general cohort studies with follow-up periods of at least 6 months have had notably pessimistic results. Utilizing a Health Utilities Index in the United Kingdom found that only 27.3% were in full health, 5.5% had impairment in all outcome domains and the mortality rate was 11.1[14].

According to total of 29% of all patients died or developed worsening functional status at long-term follow-up. For those who developed a new morbidity at long-term follow-up, 82% were severely or very severely dysfunctional. Those who died had the highest incidence of cancer and many of their deaths were likely associated with this underlying condition. [11]

Surprisingly found that few children improved over the 3 years. The overall prevalence of poor long-term outcomes may also be dependent on access to rehabilitative and support services, compliance with medical regimens, social support, coordination of care, new or repeat illness, and/or other comorbidities. The data in the study of consistent with the increasing trend toward compromised outcomes from critical care, perhaps associated with increased survival. [15]

Our study reflects similar results for a broader PICU population. However, comparison of previous studies is limited using different outcomes measures across these studies. The definition of morbidity of the FSS of 3 or more indicated very significant functional morbidities [16].

Furthermore report more concerning results with only 27.3% of children admitted in 2001–2002 having full health at 6 months after admission as assessed by the Health Utilities Index 2[14].

Similarly, 69% of children admitted between 2002 and 2005 had physical sequelae 3 months after discharge as measured by the Pediatric Cerebral Performance Category (PCPC) and POPC [17].

Using the Modified Glasgow Outcome Scale (MGOS) found that 17.9% of children admitted in 2005–2006 had

moderate or severe disability at approximately 1 year after discharge and for those with long-stays, 67% had unfavourable outcomes with 50% having died, and 17% having moderate or severe disability. [18]

Our study reflects similar results for a broader PICU population. However, comparison of previous studies is limited using different outcomes measures across these studies. The definition of morbidity of the FSS of 3 or more indicated very significant functional morbidities [16].In addition acknowledge that numerous factors may influence the reliable acquisition of long-term results. [18]

Some limitations to our study are common to PICU follow-up studies and may account for many of the differences between this study and others. A significant limitation is the failure to distinguish between long-term outcome secondary to underlying disease, a complication of the acute illness, or a complication of intensive care.

cleared that a detailed review of PICU children discharged with morbidity including these cases indicates that aspects of the chronic disease, acute disease, and acute care and PICU care therapies account for hospital discharge morbidity. [19]

A second substantial limitation to this and similar studies is the inability to directly compare long term outcome studies because the follow-up assessment methods are sufficiently different. Demonstrated that pediatric methods suitable for follow-up of relatively large samples have been based on diverse conceptual frameworks including the Glasgow Outcome Scale, adaptive behaviour, activities of daily living and health related quality of life. [20]

Some limitations to our study are common to PICU follow-up studies and may account for many of the differences between this study and others. A significant limitation is the failure to distinguish between long-term outcome secondary to underlying disease, a complication of the acute illness, or a complication of intensive care.

Conclusions

Morbidity following pediatric intensive care occurs frequently and appears to be increasing as mortality decreases. Majority of patients at PICU at Benha University Hospitals had recovered and only 10.45% of them died. There was a strong negative relationship between age and duration of stay while there was a significant logistic regression relationship between either the recovery rate or the mortality rate and duration of stay. We recommended that further studies with larger sample sizes must be done to analyse all aspects of this issue.

List of abbreviations:

PICU	Pediatric Intensive Care Unit
ICU	Intensive care unit
ARDS	Acute respiratory distress syndrome
AAP	American academy of Pediatrics
ICP	Intracranial pressure
CVVH	Continuous Veno-Venous Hemofiltration
GIT	Gastrointestinal Tract
CNS	Central Nervous System
CBC	Complete blood count
CRP	C-reactive protein
PT	Prothrombin time
PPT	Partial thromboplastin time
INR	International normalized ratio
ALT	Alanine aminotransferase
AST	Aspartate aminotransferase
ABG	Arterial blood gases
LOS	PICU length of stay
MGOS	Modified Glasgow Outcome Scale

PICS-peds	Pediatric post intensive care syndrome

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