

Triaging children with Diabetic Ketoacidosis (DKA) by PRISM III score and assessment of the outcomes - A tertiary care experience.

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Abstract:

Background: DKA is an acute life threatening condition with mortality of 3.4% to 13.4% in developing countries like India.

Objective: Utilise PRISM III score for triage and prognostication in DKA.

Methodology: It is a cross sectional hospital based study conducted on 50 DKA patients of age 1 month to 12 years, fulfilling the criteria (ISPAD guidelines) for 2 years duration at Department of Pediatrics, Niloufer Hospital, Osmania Medical College. PRISM III score was used to triage these children with DKA which comprised of 17 physiologic variables.

Results: Of the 50 patients studied, 52% were females. 60% children had moderate DKA and 38% had severe DKA. 66% were discharged and the rest 34% have expired. There was statistically significant association noted between PRISM III scores and duration of ICU stay and between severity of DKA and the outcome in terms of Discharge or Death. The death rate was directly proportional to severity of DKA. Mean score in death is statistically greater than the mean score in discharge.

Conclusion: PRISM III score is a suitable and accurate triage system for DKA which uses readily available clinical data and is easy to compute.

Keywords: Diabetic Ketoacidosis, Pediatric Risk of Mortality, Triaging.

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I. Introduction

India is home to the second largest number of children with type 1 diabetes in the world (70,200), after the USA, and accounts for the majority of the children with type 1 diabetes in the region^[1]. Death in DM is predominantly due to DKA. Diabetic Ketoacidosis (DKA) is a life-threatening pediatric metabolic emergency that is characterized by hyperglycemia (>200 mg/dl or 11.1 mmol/l), metabolic acidosis (venous pH <7.3 and/or serum bicarbonate <15mEq/l) with associated glycosuria, ketonuria, and ketonaemia.^[2] Overall mortality in children with DKA varies from 0.15% to 0.35% in developed countries like Canada, United States and United Kingdom^[3-6] and from 3.4% to 13.4% in developing countries like India, Pakistan and Bangladesh.^[7-13] Cerebral edema is the major cause for mortality in DKA.^[14,15] Occurrence of cerebral edema varies from 0% to 5.5% in developed countries.^[16-18] and is reported to vary from 24% - 26% in developing countries.^[9] Recent data from developing countries has shown sepsis, shock and renal failure as other factors causing death in DKA. The practice of pediatric critical care is dynamic and evolving. Paediatric population is a vulnerable group necessitating standard care for medically and surgically ill children. However, standard care is not well defined for pediatric critical care, as most of the protocols and practices in pediatric intensive care unit (PICU) are actually extrapolation of adult critical care.^[19]

Whether adult or pediatric, severity of illness, assessments are critical for wide range of ICU management and administration.^[20-22] In context of intensive care, a rational and objective way to define and quantify severity of illness is through the development of probability models predicting mortality risks. Scoring systems are arrived at evaluation of the patient's mortality risk in the ICU by assigning a score to patient and predicting the outcome. However, patient's mortality is not only affected by ICU performance but also depends on many other factors such as demographic and clinical characteristic of population, infrastructure and non medical factors (management and organization), case mix and admission practice.^[23] Therefore there is need for field testing of these scoring system in setting different from the one in which they were originally developed. The ideal probability scoring system would be institution independent and population independent.^[24]

1.1. Objective:

The principal aim of the study is to utilise PRISM III score at admission, for children with Diabetic Ketoacidosis (DKA) for

(1.1.1) Prognostication

(1.1.2) Determining the level of Intensive Care required for optimal management outcomes.

II. Methodology

2.1. Study design: This is a cross sectional hospital based study done at Department of Pediatrics, Niloufer Hospital and Institute of child Health, Osmania Medical College, Hyderabad. The study was conducted with 50 Diabetic Ketoacidosis patients in the age group of 1 month to 12 years, admitted in Niloufer hospital who have fulfilled the criteria according to the ISPAD guidelines given under the inclusion criteria, for a period of 2 years.

2.2. Inclusion criteria: Children with confirmed DKA by lab investigations which included; Hyperglycemia (RBS > 200 mg/dl or 11.1 mmol/l), Metabolic acidosis (ph <7.3 and/or serum bicarbonate < 15mEq/l), Ketonuria (urine ketones positive) according to the ISPAD guidelines.

2.2.1. The Severity of DKA was defined as: mild (pH<7.30 or bicarbonate10-15mEq/l), moderate (pH<7.2 or bicarbonate 5-10 mEq/l) and severe (pH <7 or bicarbonate < 5 mEq/l)

2.2.2. Age was classified according to WHO classification Infants 1month - 12months, Children >12 months to <120 months, Adolescents >120 months.

2.3. Exclusion criteria: Other causes of metabolic acidosis, hyperglycemia

2.4. Data Collection and Analysis: The children who were diagnosed with DKA were then managed as inpatients at Niloufer hospital in the Emergency Service Room (ESR) after admission. PRISM III score was used to triage these children with DKA after the initial stabilization which comprised of 17 physiologic variables subdivided into 26 ranges and is population independent. The components broadly include:

2.4.1 Cardiovascular Score: temperature, heart rate, systolic blood pressure

2.4.2 Neurologic Score: mental status, papillary response

2.4.3 Acid-Base And Blood Gas: bicarbonate, pH, PCO₂

2.4.4 Chemistry Tests: blood glucose, BUN, serum creatinine, potassium

2.4.5 Hematology Tests: WBC, Platelets, PT, aPTT

2.4.6 Co morbidities: Non operative cardiovascular disease, Chromosomal anomaly/other endocrine disease, Cancer, Previous ICU admission during current admission, Pre-ICU CPR during current admission, Post-operative (not including catheterizations) during past 24 hours, Acute diabetes with ketoacidosis or other severe complication.

2.4.7 Minimum Subscore and Total Score: 0

2.4.8 Maximum Cardiovascular and Neurologic Subscore: 30

2.4.9 Maximum Acid-Base and Blood Gas Subscore: 22

2.4.10 Maximum Chemistry Subscore: 10

2.4.11 Maximum Hematology Subscore: 12

2.4.12 Maximum Total PRISM III Score: 74

In addition to the above data name, gender was noted. These children were followed up till the time of discharge or demise. The duration of hospital stay was also documented. Data was entered and analyzed using Microsoft X CEL, EPI software. In the analysis, the mean, standard deviations and percentages were computed. Associations were evaluated using chi-square test, T-test and ANNOVA where applicable. A p-value of < 0.05 was considered statistically significant, unless otherwise specified. All ethical considerations were ensured throughout the study.

III. Results

Among 50 patients of age group 1 month -12 years, 64% were children 8% were infants and the remaining were adolescent, 52% of the study population were females. The male to female ratio was 1: 1.08.

Table 1 Population distribution according to severity of DKA

Severity of DKA	Mild DKA	Moderate DKA	Severe DKA	Total
No. of patients	1	30	19	50
Percentage	2%	60%	38%	

31% patients had a score ranging from 21-30 and 6% with a higher score of 41 – 50. 28% children had a least score of 0-10. **T-test** was utilized to correlate between total scores and admission to ICU, with **p=0.04**, this was found to be statistically significant. There was statistically significant association noted between total scores and duration of ICU stay (**p=0.03**) with ANNOVA test. Out of the 32 DKA patients who received ICU

care 65% were children, 6% were infants and the rest 28% were adolescents. Statistically significant correlation was not observed between age and ICU admissions.

Table 2 Total score versus duration of ICU stay in 32 DKA cases

Total score	<3 days	3-7 days	>7 days	Percentage
0-10	6	3	0	28%
11-20	2	4	1	21%
21-30	5	5	0	31%
31-40	2	1	1	12%
41-50	0	2	0	6%
Total	15	15	2	32

Table 3 Outcome of patients with DKA

OUTCOME	No of Patients	Percentage
Death	17	34%
Discharge	33	66%
Total	50	100%

Table 4 Severity of DKA versus Outcome

Severity of DKA	Death	Discharge	Total
Mild (2%)	0	1 (100%)	1
Moderate (60%)	5 (13%)	25 (83%)	30
Severe (38%)	12 (63%)	7(36%)	19

Chi Square test was applied to analyze the correlation between severity of DKA and the outcome in terms of Discharge or Death with a p value of 0.002, which was statistically significant. The death rate increased as the severity of DKA increased and similarly for mild DKA cases discharge rates were high.

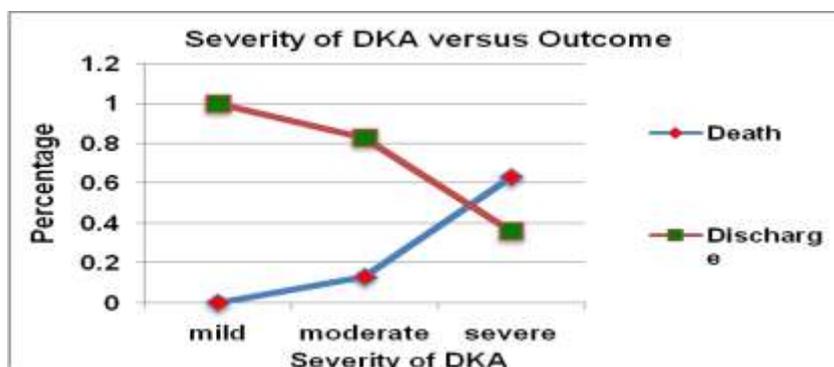


Fig 1 Severity of DKA versus Outcome

T-test was applied to analyze the correlation between total scores and the outcome in terms of Discharge and Death. Mean score in death is 30.65 ± 7.50 which is statistically greater than the mean score in discharge is 12.58 ± 7.95 ($p < 0.001$)

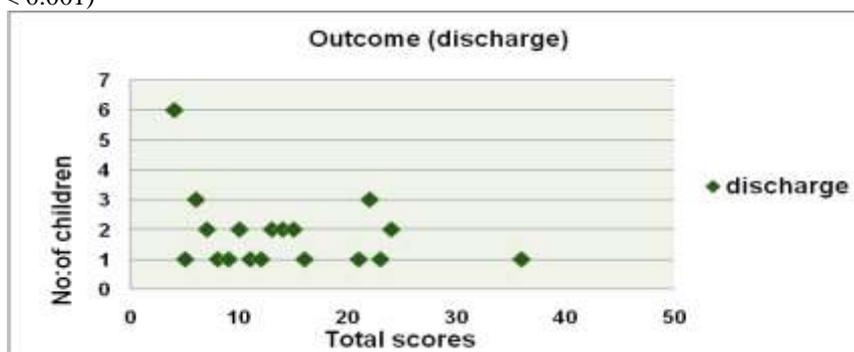


Fig 2 Distribution of discharges in relation to total PRISM III score

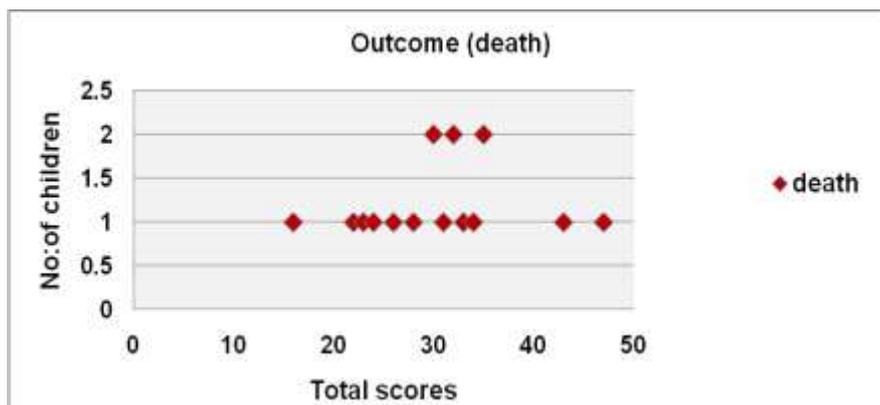


Fig 3: Distribution of Deaths in relation to total PRISM III score

In the study population which comprised of 50 DKA children, 52% had co morbidities, of which 28% was constituted by acute severe DKA along with acute kidney injury or cerebral edema.

IV. Discussion

Despite the increasing incidence of diabetes mellitus in India, the complications from this condition, including DKA, remain a neglected health issue.^[25] Limited literature is available regarding DKA in the south east Asian population.^[25-32] In particular, there are few studies available that have looked at the clinical profile and outcomes of DKA in the pediatric age group in our country. Studies taken as references in the present study were retrospective, hospital record based studies. Few studies dealt with using prognostic scoring systems in cases of hyperglycemia to predict the risk of Diabetic Ketoacidosis in adult population.

Despite the higher incidence of DKA in pediatric population, limited research has been done to prognosticate these children with DKA and triage them for effective allocation of available resources. There is a lot of scope for research in this area and was the main purpose behind this study. In the present study, 50 children with biochemically confirmed DKA were studied. The mean age of the study population was 7.77+ 2.5 years which was similar to the Madiha Syed et al^[33] study done in Pakistan. The sex ratio in our study was, Male: female =1: 1.08 and 1.9:1 in the study quoted above. The study population in Madiha Syed et al (n=88), comprised of 50% moderate DKA cases whereas it was 60% in our study. Mild DKA cases were 30% in the previous study, when compared to 2% in our study.

Similar observation was made in the proportion of severe DKA cases which was higher, i.e., 38% when compared 20% in the previous study. Our centre being a referral unit could be a possible reason for this discrepancy. The total duration of Hospital stay was directly proportional to the severity of DKA at presentation which was classified as mild, moderate, severe i.e., children with severe DKA at presentation had a longer duration of hospital stay. This observation was found to be statistically significant (**p=0.002**) which was in tune with the Madiha Syed et al study.^[33]

Table 5 Comparison of Severity of DKA and outcome in terms of discharge

Severity of DKA	Mild DKA	Moderate DKA	Severe DKA	Total
Madiha Syed et al ^[33] (n=88)	26	44	15	85
Present study (n=50)	1	25	7	33

Madiha et al study 85 DKA children were discharged successfully out of 88 study population, of which 44% were moderate DKA cases in the present study, out of 50 DKA children, 33 were discharged, of which 75% were Moderate DKA cases. This variation could be due to less proportion of mild DKA children (2%) in our study when compared to the study quoted above and relatively higher proportion of Moderate DKA cases.

Table 6 Comparison of severity of DKA and outcome in terms of Death:

Severity of DKA	Mild DKA	Moderate DKA	Severe DKA	Total
Madiha Syed et al ^[33] (n=88)	0	0	3	3
Present study (n=50)	0	5	12	17

In Madiha Syed et al study 3 DKA children have expired out of 88 study population, of which all were severe DKA cases. The outcome in terms of discharge and death correlated with the severity of DKA at presentation, discharge rates were higher with children who presented with mild and moderate DKA whereas death rates were higher in Severe DKA group. This observation was statistically significant with a **p value = 0.002** in the present study which was in tune with the Madiha Syed et al study.

Use of PRISM Scores in triage of pediatric patients with Diabetic Ketoacidosis ^[34] - Kathy W. Monroe et al study.

This study assesses the usefulness of the traditional PRISM score which uses the worst recorded values over the first 24 hours and an adaptation of that score PRISM-ED, which uses presentation data only in predicting hospital stay in pediatric patients with DKA. PRISM and PRISM-ED were tested for correlation with the length of stay and the length of ICU stay. A medical record review was conducted for patients admitted to the hospital with DKA during an 18 months period (n=79). The difference in the mean scores of ICU admissions and Non-ICU admissions were found to be statistically significant. Also correlations were significant for both scores versus ICU stay with p value <0.001.

Table 7 Comparison with scoring systems in Kathy W. Monroe et al study ^[34]

Scores	ICU (mean)	Non- ICU (mean)	P value
PRISM	8.6	10.3	0.04
PRISM-ED	8.5	13.4	<0.001
PRISM III (Present study)	19.34	17.61	0.01

The difference between mean of PRISM and PRISM-ED scores of ICU admitted and Non-ICU cases of DKA in the Kathy W. Monroe et al^[34] study (n=79) was found to be statistically significant. In the present study which includes 50 DKA children, 32 children received ICU care. The mean of the total PRISM III scores of children in ICU was higher than the mean of PRISM III scores of the remaining 18 children who were managed in Emergency Service Room. This observation was found to be statistically significant with a p value of 0.01 which was in tune with the Kathy W. Monroe et al study ^[34]

V. Conclusions

5.1 Risk stratification of children with DKA is possible by simple clinical and laboratory variables available during first day of hospital admission.

5.2 Triaging DKA patients is essential for targeted allocation of intensive care resources to ensure better outcome.

5.3 The prognosis was guarded in children with higher PRISM III scores.

5.4 Children with higher scores should receive level 3 care.

5.5 The PRISM III score correlated well with the length of ICU stay.

5.6 Limitations PRISM III scores were calculated based on at admission general condition, vitals and other investigations. Revision of score was not done at regular intervals i.e., at 6,12,18,24 hours of hospital stay to know the progress of the illness. Clinical profile, treatment modality and precipitating factor for DKA was not taken into the scoring system.

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