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# CORRELATION BETWEEN THE OUTCOMES AND SEVERITY OF DIABETIC KETOACIDOSIS: A RETROSPECTIVE PILOT STUDY

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**Abstract:**

*(DKA) Diabetic Ketoacidosis is a critical acute metabolic snag of DM (diabetes mellitus). Further, it is categorized into minor, moderate and severe grounded on sternness according to the guidelines of ADA (American Diabetes Association). There are limited literature and data based on the correlation between the outcomes of DKA while using this categorization system and the severity of Diabetic Ketoacidosis. The core objective of this study is to describe the correlation between severity of DKA and outcomes in a tertiary care center of India, and data has been extracted through Medline Database while using Internet resources.*

*According to this retrospective pilot study, the number of patients with Diabetic Ketoacidosis was 1527, which were recognized over a three years' period of which 63 patients have been discharged diagnosis of Diabetic Ketoacidosis and 37 accomplished the criteria of ADA for Diabetic Ketoacidosis. Following descriptions of inclusion were compared on clinical constraints and results of affected persons were minor, moderate and severe degrees of Diabetic Ketoacidosis.*

*Minor, moderate and severe Diabetic Ketoacidosis measured for 8%, 41%, and 51% respectively in the patients. For 6.7% patients, ICU (Intensive Care Unit) was obligatory and 47.4% of those are affected with moderate and acute Diabetic Ketoacidosis respectively. IV (Invasive ventilation) also required for (9) 47% of those who have severe Diabetic Ketoacidosis only. The rate of mortality was 26% and 13.3% among those who have moderate and severe Diabetic Ketoacidosis.*

*The classification of ADA of the severity of Diabetic Ketoacidosis correlates well as the duration of hospital stay, the requirement of Intensive Care Unit, the cost of care, the requirement of IV or non-IV, and mortality. This proposes that this system of categorization may help to be a worthy approach while predicting results.*

**Keywords:** *Diabetic Ketoacidosis, Results, Severity*

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## 1.0 INTRODUCTION:

DKA (Diabetic Ketoacidosis) is a severe, life-threatening acute metabolic issue in DM (diabetes mellitus) patients. Diabetic Ketoacidosis diagnosis comprises of a triad of unmanaged metabolic acidosis (pH <7.3), (blood glucose >250 mg/dL) hyperglycemia and elevated overall body ketone concentration. Relative or an absolute insulin shortage and an elevated in counter-regulatory hormones like catecholamines, cortisol, and glucagon and development hormone lead to DKA (BRANDT and MILES, 2017).

The diabetes prevalence in Southeast Asia is on the very dangerous level of 8.4% and specifically, India is the capital of diabetic patients throughout the globe with 8.7% (69.2 million) people living with this acute diabetes disease, as per Medline Database and according to the Indian National Surveillance Data in 2015. Most of the patients with Diabetic Ketoacidosis have diabetes of type 1; therefore, type 2 diabetes patients are also living at high risk in the time period of an acute illness like surgery, trauma, myocardial infarction, and other infections (Coelho et al., 2016).

Clinical presentation and results are different among these patients. Diabetic Ketoacidosis is categorized minor, moderate and severe on the basis of severity as per the descriptions of ADA (American Diabetes Association) recommendations. Though there is a severity-based categorization of Diabetic Ketoacidosis there are very limited data on Diabetic Ketoacidosis severity correlation and its results while utilizing this system of categorization. Multiple types of research have done in past, demonstrated that the ICU duration and patient's stay in hospital were related to the occasioning Diabetic Ketoacidosis cause and not to the severity scores of disease like (APACHE) Chronic Health Evaluation II and Acute Physiology and the Therapeutic Intervention Scoring System (BRANDT and MILES, 2017).

The rate of mortality in Diabetic Ketoacidosis patients is stated as being <1% as per different studies with an elevated rate of 5% has been stated specifically in old age patients and those who have associated with life-threatening conditions. A potential study in a tertiary care center in India stated that patients' rate of mortality in the hospital was 10% with Diabetic Ketoacidosis in 2015. In this research, we intended to explore the correlation between severity and outcomes of Diabetic Ketoacidosis in the account for stay requirements of ICU, morbidity, cost of care for patients and (NIV) (IV) non-invasive ventilation in those patients which have Diabetic Ketoacidosis (Frank, 2016).

## 2.0 METHODS:

This reflective and observational research was managed among in those patients which seen in a single general medicine department in a specific tertiary care center in India. With the help of Medline Database, all patients' record, with a discharge diagnosis of Diabetic Ketoacidosis from 2014 April till 2017 November, were examined by an independent doctor. Those justifying the Diabetic Ketoacidosis diagnosis according to the ADA recommendations were included in this study. These were further categorized into minor, moderate and severe Diabetic Ketoacidosis on the basis of laboratory values and other examination discoveries (BRANDT and MILES, 2017).

Laboratory parameters, demographic parameters, precipitators of Diabetic Ketoacidosis, clinical presentation and other managerial details were established. Pre-specified results of the disease severity in the account of stay of patients' duration, invasive requirement or NIV, stay of ICU and mortality were assessed. Completely independent physician accomplished the statistical analysis with SPSS (Statistical Package for the Social Sciences). There was also performed a chi-square test for categorical variable's comparison and Student's *t*-test has been used for continuous variable comparison. It is also considered that two-sided *P<0.05* as statistically significant.

Figure 1: American Diabetes Association classification of diabetic ketoacidosis

| | DKA | | |
|---|---|---|---|
| | Mild (plasma glucose >250 mg/dl) | Moderate (plasma glucose >250 mg/dl) | Severe (plasma glucose >250 mg/dl) |
| Arterial pH | 7.25–7.30 | 7.00 to <7.24 | <7.00 |
| Serum bicarbonate (mEq/l) | 15–18 | 10 to <15 | <10 |
| Urine ketone* | Positive | Positive | Positive |
| Serum ketone* | Positive | Positive | Positive |
| Effective serum osmolality† | Variable | Variable | Variable |
| Anion gap‡ | >10 | >12 | >12 |
| Mental status | Alert | Alert/drowsy | Stupor/coma |

(Source: BRANDT and MILES, 2017)

### 3.0 RESULTS:

There were total 5023 patients admitted in three years period of time from 2014 to 2017, of these 1527 numbers of patients had diagnosed diabetes mellitus. Among these 63 numbers of patients found a discharge of diagnosis of Diabetic Ketoacidosis. Therefore 37 patients accomplished the ADA norms of Diabetic Ketoacidosis.

Diabetic Ketoacidosis accounted for 0.74% regarding all registrations over three year's period. Diabetic Ketoacidosis was observed in 2.4% of diabetes patients. Mild, moderate and severe Diabetic Ketoacidosis observed for 8% (3 patients), 41% (15 patients) and 51% (in 19 patients) respectively. Mean age observed 50.2 ± 17.4 years, as shown as Table 1:

| Variables | Mild DKA | Moderate DKA | Severe DKA |
|---|---|---|---|
| Number of patients | 3 (8%) | 15 (41%) | 19 (51%) |
| Mean Age (years) | 49 | 52 | 49 |
| Sex | | | |
| Male | 1 (33%) | 7 (47%) | 12 (63%) |
| Female | 2 (67%) | 8 (53%) | 7 (37%) |
| Mean Duration of stay (days) | 6.3 | 6.1 | 8.7 |
| Mean Plasma Glucose Levels (mg/dl) | 455 | 446 | 533 |
| Mean Arterial pH | 7.27 | 7.19 | 7.04 |
| Mean Serum Bicarbonate (meq/L) | 16 | 10.3 | 7.4 |
| Mental status | Alert - 100% (3) Drowsy - 0 Stupor - 0 | Alert - 53.3% (8) Drowsy - 46.7% (7) Stupor - 0 | Alert - 15.8% (3) Drowsy - 26.3% (5) Stupor - 57.9% (11) |
| Mean serum Creatinine (mg/dl) | 1.45 | 1.75 | 1.58 |
| Age at diagnosis of DM | | | |
| < 40 years | 66.7% (2) | 46.7% (7) | 42.1% (8) |
| > 40 years | 33.3% (1) | 53.3% (8) | 57.9% (11) |
| Type of DM | | | |
| Type I | 0 | 20% (3) | 15.8% (3) |
| Type 2 | 66.7% (2) | 73.3% (11) | 68.4% (13) |
| Others* | 33.3% (1) | 6.7% (1) | 15.8% (3) |
| Duration of DM (Mean, in years) | 7.8 | 6.3 | 3.1 |
| Mean Sodium (Meq/dL) | 115.3 | 121.2 | 130.5 |
| Mean haemoglobin (g/L) | 12.5 | 12.9 | 14.1 |
| Mean potassium (Meq/dL) | 4.5 | 4.7 | 4.7 |
| Mean Calcium ' (Meq/dL) | 8.45 | 7.9 | 8.2 |
| Mean phosphate⁺ (Meq/dL) | 2.6 | 2.4 | 2.6 |
| Mean Serum Albumin $ (g/L) | 3.1 | 3.5 | 3.6 |
| Mean Hba1c (%)‖ | 10.8 | 11.6 | 12.8 |
| Systemic Hypertension | 33.3% (1) | 33.3% (5) | 15.8% (3) |
| Microvascular complications | | | |
| Retinopathy | 33.3% (1) | 33.3% (5) | 21% (4) |
| Neuropathy | 33.3% (1) | 40% (6) | 36.8% (7) |
| Nephropathy | 33.3% (1) | 40% (6) | 42.1% (8) |
| Macro vascular complications | | | |
| Ischaemic heart disease | 0 | 20% (3) | 10.5% (2) |
| Cerebrovascular disease | 0 | 0 | 15.8% (3) |
| Peripheral vascular disease | 0 | 0 | 0 |

* Pancreatic diabetes, Latent autoimmune diabetes of adulthood, Maturity onset Diabetes of the young; ' Calcium levels available only for 23 out of 37 patients; ⁺ Phosphate levels available only for 28 out of 37 patients; $ Serum albumin levels available only for 34 out of 37 patients; ‖ Hba1c levels available only for 29 out of 37 patients

(Source: BRANDT and MILES, 2017)

According to records, male patients were 54.1% (20 patients) in overall groups collectively. Type 2 diabetes patients were 67.6% (25 in numbers) of all patients and Type 1 patients were 16.2% (6 numbers of patients), accordingly, 16.2% patients had other diabetes' types. In 45.9% (17 patients) young-onset diabetes described and the age of patients was a ≤40 year. Diabetes mean duration was 4.7 ± 5.4 (mean ± SD) years in all categories. HbA1c mean was (mean ± SD) 12.1 ± 2.7 in all categories. Infections were observed the most general hastening factor in 25 (59.1%) patients with DKA, according to Table 2 below (George, Mishra and Iyadurai, 2018).

**Table 2: Precipitating factors of DKA**

| Precipitating Factor | Number of patients |
|---|---|
| Infection | 25 (58.1%) |
| Non Compliance | 9 (20.9%) |
| Intoxication | 5 (11.6%) |
| Infarction | 4 (9.3%) |

(Source: George, Mishra and Iyadurai, 2018)

In 6.7% patients, Intensive Care Unit was obligatory and 47.4% (9 patients) of those ICU referred patients having moderate and severe Diabetic Ketoacidosis respectively *(P=0.007)*. IV (Invasive ventilation) referred in 47% (9 patients) between those who have severe stage Diabetic Ketoacidosis only *(P=0.002)*. NIV was required in 4 patients (27%) and 4 patients (21%) of those with minor, moderate and severe Diabetic Ketoacidosis respectively (George, Mishra and Iyadurai, 2018).

The overall rate of mortality was observed by 7 patients (18.9%), with 15% rates (2 patients) and 26% (5 patients) among those have moderate and severe Diabetic Ketoacidosis, as mentioned in Table 3 below.

**Table 3: Outcomes in patients with DKA**

| Variables | Mild DKA | Moderate DKA | Severe DKA |
|---|---|---|---|
| Number of patients | 3 (8.1%) | 15 (40.5%) | 19 (51%) |
| ICU stay | 0 | 1 (6.7%) | 9 (47.4%) [p - 0.007] |
| Invasive Ventilation | 0 | 0 | 9 (47.4%) [p - 0.002] |
| Non Invasive ventilation | 0 | 4 (26.7%) | 4 (21%) |
| Shock | 0 | 0 | 4 (21%) |
| Acute Kidney Injury (Serum Creatinine $\geq$1.4 mg/dl) | 2 (66%) | 5 (33%) | 11 (58%) |
| $\leq$ 7 days hospital stay | 3 (100%) | 9 (60%) | 9 (47.4%) |
| Mortality | 0 | 2 (13.3%) | 5 (26.3%) |
| Mean Expenditure (Rs.) | 29,000 | 30,000 | 64,000 |

(Source: George, Mishra and Iyadurai, 2018)

**4.0DISCUSSION:**
Diabetic Ketoacidosis is considered as a life threating severe metabolic issue in DM holding patients and also observed with the uncontrolled hyperglycemia triad presence, increased overall body ketone concentration with metabolic acidosis. Though it developed countries like the United States of America the rate of hospitalization for Diabetic Ketoacidosis was 7.7 in 1000 patients but the condition in the country like India is very different and miserable. The Diabetic Ketoacidosis incidence per 1000 admissions as our research analyzed was 7.3 if we go to a comparison with the rate of 4.59 per 1000 admission in a Canadian based research for the same topic (George, Mishra and Iyadurai, 2018).

Invasive Ventilation requirement was 47% as per this research and our study also described the patients'

numbers with severe Diabetic Ketoacidosis need ICU care at the rate of 48% which is bluntly high as compared to moderate category Diabetic Ketoacidosis patients. As compared with minor and moderate in severe Diabetic Ketoacidosis patients the requirement of mechanical ventilation was particularly high, this demonstration was in concordance with other studies also. HbA1c baseline was increased (>10) in every category and it is same as other studies. Hospital stay duration, according to this study, was identical with other studies. All those patients who have moderate and severe Diabetic Ketoacidosis need a longer period of time to stay if we make a comparison with other patients. According to a past study, it was stated that severity scores of disease did not forecast protracted stay at the hospital, therefore, according to this study, the score of APACHE II correlation and Logistic Organ Dysfunction System was also used (Nfonoyim, Ng and Petrenko, 2017).

The general precipitating factor according to our research was infections. As infections and health's poor access were the most general precipitating Diabetic Ketoacidosis factors in researches accounted by developing countries, as compared with regimen change, noncompliance and freshly detected DM in the US and other developed countries. Non-compliance considered as the second most general precipitating Diabetic Ketoacidosis factor with the rate of 20.9% in this research. In this study 25 patients were found with Type 2 diabetes while if we compare it with another similar study in Israel, most of Diabetic Ketoacidosis patients had Type 1 diabetes, therefore, different other researches are in concordance with our conclusions (Verma, 2017).

In many past studies, observing at results in moderate and severe Diabetic Ketoacidosis, the rate of mortality were 3.4% and 11.4% respectively, therefore, according to this study, the rate of mortality was elevated with 13% and 26% in Diabetic Ketoacidosis moderate and severe respectively. The elevated rate of mortality may be the limited size of the sample and a referral bias. Therefore, this situation is not statistically important. In severe Diabetic Ketoacidosis, the care cost was more than double the costs bear in minor and moderate Diabetic Ketoacidosis groups. This is particular in developing county, such as India, where people mostly lived in very poor socioeconomic culture. Therefore, the patient educational role to cure the Diabetic Ketoacidosis complications may not be overlooked. In this study, the author observes the high role of ADA severity category of Diabetic Ketoacidosis while establishing clinical

classification, predicting prognosis, facilitating treatment and resource requirement between patients of Diabetic Ketoacidosis (Verma, 2017).

This study also has multiple limitations, basically, it is a pilot study based on Medline Database and Internet resources only with a small size of the population and only from a single treatment unit. This study does not claim to have long-term outcomes as it is only a retrospective nature of the research.

## 5.0 CONCLUSION:

The ADA severity categorization of Diabetic Ketoacidosis correlates accordingly with the invasive ventilation requirement and the care of ICU. An elevated trend in expenditure and mortality is also stated with the Diabetic Ketoacidosis severity. This benchmark although simple but can use as an effective approach in forecasting results.

## REFERENCES:

1. BRANDT, K. and MILES, J. (2017). Relationship Between Severity of Hyperglycemia and Metabolic Acidosis in Diabetic Ketoacidosis. *Mayo Clinic Proceedings*, 63(11), pp.1071-1074.
2. Coelho, C., Nunes, C., Fernandes, V., Pinto, M., Souto, S. and Marques, O. (2016). Hyperosmolar hyperglycaemic state and diabetic ketoacidosis: a 5-year retrospective study in a university hospital. *Endocrine Abstracts*, 2(3).
3. Frank, M. (2016). Markers of Disease Severity and Prolonged Length of Stay for Paediatric Diabetic Ketoacidosis. *International Journal of Life-Sciences Scientific Research*, 2(3).
4. Galm, B., Bagshaw, S. and Senior, P. (2018). Acute Management of Diabetic Ketoacidosis at 3 Teaching Hospitals in Canada: A Multi-Centre, Retrospective Cohort Study. *Canadian Journal of Diabetes*, 42(5), p.S4.
5. George, J., Mishra, A. and Iyadurai, R. (2018). Correlation between the outcomes and severity of diabetic ketoacidosis: A retrospective pilot study. *Journal of Family Medicine and Primary Care*, 7(4), p.787.
6. Nfonoyim, J., Ng, J. and Petrenko, I. (2017). USING A DIABETIC KETOACIDOSIS SEVERITY OF ILLNESS SCORE FOR ICU ADMISSIONS. *Chest*, 130(4), p.148S.
7. Su, Y., Ren, D., Zou, Y., Lu, J. and Wang, P. (2016). A retrospective study evaluating the correlation between the severity of intervertebral disc injury and the anteroposterior type of thoracolumbar vertebral fractures. *Clinics*, 71(6), pp.297-301.
8. Tisal, E. (2016). Guidelines fail to improve

outcomes in diabetic ketoacidosis. *PharmacoEconomics & Outcomes News*, 98(1), pp.10-10.

9. Verma, A. (2017). Correlation of Severity of Dengue Fever with Serum Transaminase Levels: A Retrospective Study. *Journal of Medical Science And clinical Research*, 5(11).