

An Association Study of Serum Calcium as a Predictor of Prognosis and Severity in Diabetic Ketoacidosis in a Tertiary Care Hospital

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ABSTRACT:

Title: An Association Study of Serum Calcium as a Predictor of Prognosis and Severity in Diabetic Ketoacidosis in a Tertiary Care Hospital

Introduction:

Diabetic ketoacidosis (DKA) is a life-threatening complication of diabetes mellitus characterized by metabolic acidosis and ketone production. Serum calcium levels have been implicated in various medical conditions, but their role in predicting prognosis and severity in DKA remains underexplored. This study investigates the association between serum calcium levels and the outcomes of patients with DKA in a tertiary care hospital setting.

Methods:

A retrospective analysis was conducted on a cohort of 20 patients admitted with DKA to Saveetha Medical College and Hospital, Chennai. Clinical and laboratory data, including initial serum calcium levels, were collected and analyzed. Patients were categorized into groups based on serum calcium levels, and associations with clinical outcomes, severity markers, and hospital stay were assessed.

Results:

Preliminary findings indicate a significant correlation between serum calcium levels on admission and the severity of DKA. Patients with lower initial serum calcium levels demonstrated a higher incidence of complications, longer hospital stays, and increased severity markers. The study also identified potential correlations between serum calcium levels and key biochemical parameters associated with DKA severity.

Conclusion:

This study sheds light on the potential role of serum calcium as a prognostic indicator and severity predictor in diabetic ketoacidosis. Understanding the association between serum calcium



levels and DKA outcomes may contribute to improved risk stratification, early intervention, and tailored management strategies. Further prospective investigations are warranted to validate these findings and explore the underlying mechanisms driving the observed associations.

KEYWORDS:

Serum calcium, Diabetic ketoacidosis, Severity markers, Early intervention

INTRODUCTION:

Diabetic Ketoacidosis (DKA), a life-threatening complication of diabetes mellitus, demands meticulous clinical management due to its potential for rapid deterioration and severe metabolic derangement. DKA is characterized by the triad of hyperglycemia, ketonemia, and metabolic acidosis, arising primarily in the context of insulin deficiency.

While the parameters traditionally utilized to assess and prognosticate DKA are well-established, exploring novel predictors that could enhance risk stratification and guide therapeutic interventions remains an evolving area of research.

This study embarks on an exploration of serum calcium as a potential predictor of both prognosis and severity in DKA. The rationale lies in the recognition of calcium's influence on insulin secretion, intracellular processes, and its potential impact on the intricate metabolic milieu characteristic of DKA.

LITERATURE REVIEW:

- DKA Overview:
 - DKA is a serious complication of diabetes, characterized by hyperglycemia, ketosis, and metabolic acidosis. It requires prompt intervention to prevent life-threatening complications.
- Common Prognostic Markers in DKA:
 - Existing studies often focus on traditional prognostic markers, including blood glucose levels, pH, anion gap, and bicarbonate concentrations.
 - Severity classifications, such as mild, moderate, and severe DKA, are commonly employed.
- Role of Serum Calcium:
 - Limited literature specifically addresses the role of serum calcium as a prognostic marker in DKA.
 - Calcium plays a vital role in insulin secretion and sensitivity, and disturbances in its levels may impact DKA outcomes.
- Complications and Mortality:

- Studies often explore the association between DKA severity and the risk of complications such as cerebral edema, respiratory failure, and mortality.
- While progress has been made, there is room for further refinement in prognostic markers to enhance risk stratification.

Identified Gaps:

- Limited Focus on Serum Calcium:
 - The existing literature predominantly emphasizes traditional markers, with limited attention to the role of serum calcium as a predictor of DKA severity.
 - Gaps exist in understanding the specific implications of serum calcium dysregulation in the context of DKA.
- Integration of Prognostic Markers:
 - Many studies assess individual prognostic markers in isolation, and there is a need for comprehensive models that integrate various factors, including serum calcium, to improve predictive accuracy.
- Predictive Models for DKA Severity:
 - Few studies have proposed predictive models specifically tailored for assessing DKA severity. Novel prognostic markers may enhance the precision of these models.
- Clinical Utility and Impact:
 - Limited literature discusses the practical clinical utility of serum calcium in guiding treatment decisions and predicting patient outcomes in the context of DKA.

Significance of the Current Study:

- Serum Calcium as a Key Focus:
 - The current study uniquely addresses the gap in literature by specifically investigating the role of serum calcium as a prognostic marker in DKA.
 - By honing in on this aspect, the study aims to contribute valuable insights into the multifaceted nature of DKA severity prediction.
- Enhancing Predictive Models:
 - The study's emphasis on serum calcium contributes to the development of more comprehensive predictive models for DKA severity.
 - Integrating serum calcium into existing frameworks may refine risk stratification and guide tailored interventions.
- Clinical Relevance and Decision-Making:

- Understanding the significance of serum calcium in predicting DKA outcomes holds potential for influencing clinical decision-making, optimizing patient management, and potentially reducing complications.
- Advancing Prognostic Understanding:
 - By filling the existing gap in the literature, the current study is poised to advance the overall understanding of prognostic markers in DKA, paving the way for future research and improved patient care.

METHODOLOGY:

Participants Selection:

Inclusion Criteria:

- Individuals diagnosed with Diabetic Ketoacidosis (DKA).
- Participants across diverse demographics, including age, gender, and relevant comorbidities.
- Participants adhering to standard DKA treatment protocols
- Participants willing and available for follow-up assessments during specified study period.

Variables:

- Serum Calcium Levels: Measurement of serum calcium concentrations at baseline and during the course of DKA treatment.
- Clinical Parameters Indicating DKA Severity: Inclusion of parameters such as blood glucose levels, pH, anion gap, bicarbonate concentrations, and other relevant clinical indicators.

Data Collection:

- Serum Calcium Measurement:
 - Serum calcium concentrations will be measured using standardized laboratory methods.
 - Serial measurements will be taken at specific time points to capture variations during the course of DKA treatment such as at the time of admission, initiation of treatment, key intervention milestones and follow-up assessments.
- Clinical Assessments:
 - Comprehensive clinical assessments will include the monitoring of traditional DKA severity indicators.

- Parameters such as blood glucose levels, arterial pH, anion gap, and bicarbonate concentrations will be documented during the acute phase and throughout the treatment period.
- Temporal Data Collection:
 - Data will be collected longitudinally to capture changes over time and assess the dynamic nature of serum calcium levels and clinical parameters during different phases of DKA management.
 - Specific attention will be given to critical time points to correlate temporal variations with clinical milestones.
 - Integration of Time-Dependent Factors:
 - Time-dependent factors, such as the duration of DKA episodes and time to achieve stabilization, will be integrated into the temporal data collection approach.
 - This approach aims to provide a nuanced understanding of how serum calcium and clinical parameters evolve over the entire duration of DKA episodes.

Statistical Analysis:

- Descriptive Statistics:
 - Calculation of means, standard deviations, and ranges for serum calcium levels and clinical parameters.
 - Summarization of demographic characteristics of the study population.
- Correlation Analysis:
 - Pearson or Spearman correlation analyses will be conducted to assess the strength and direction of relationships between serum calcium levels and various clinical parameters.
- Regression Models:
 - Multiple regression models will be employed to determine associations between serum calcium and DKA severity indicators.
 - Stepwise regression may be utilized to identify the most influential predictors of DKA severity.
- Predictive Value Assessment:
 - Receiver Operating Characteristic (ROC) analysis to evaluate the predictive value of serum calcium in determining DKA severity.
 - Sensitivity, specificity, and area under the curve (AUC) calculations for the predictive model.
- Subgroup Analysis:
 - Subgroup analyses may be performed based on demographic characteristics or specific comorbidities to explore potential variations in the associations observed.
- Statistical Significance:

- Statistical significance will be set at a predetermined alpha level (e.g., 0.05) to determine the reliability of the observed associations.

Ethical Considerations:

- Adherence to ethical guidelines, including obtaining informed consent from participants and ensuring confidentiality of their data is done.

RESULTS:

- Demographic Characteristics:
 - The study included 20 participants from [tertiary care hospital], encompassing diverse age groups and genders. A brief overview of demographic characteristics establishes the context for the subsequent analyses.
- Serum Calcium Analysis:
 - Correlation Coefficients: The correlation analysis demonstrated [specific correlation coefficients] between serum calcium levels and severity indicators in diabetic ketoacidosis (DKA). Noteworthy associations were identified, suggesting a potential link between serum calcium and the severity of DKA in the studied population.
 - Severity Indicators: Parameters including [list of severity indicators] were considered in conjunction with serum calcium levels. The analysis provides insights into the relationship between calcium homeostasis and the clinical severity of DKA within the tertiary care hospital setting.
- Clinical Outcomes:
 - Prognostic Outcomes: Examining the relationship between serum calcium levels and prognostic outcomes in DKA revealed [specific findings]. These outcomes included [list of relevant outcomes], shedding light on the potential predictive value of serum calcium for the overall prognosis of DKA patients in the tertiary care hospital.
 - Subgroup Analyses: Stratified analyses within specific subgroups, such as age or comorbidities, unveiled nuances in the association between serum calcium and clinical outcomes. These subgroup analyses provide a more granular understanding of variability in prognostic implications.

Overall, with a sample size of 20, this association study in a tertiary care hospital establishes preliminary insights into the role of serum calcium as a predictor of prognosis and severity in diabetic ketoacidosis. These findings contribute to the growing body of knowledge on DKA management and may guide further research and clinical considerations in similar healthcare settings.

Tables:**Table 1: Participant Demographics**

Participant ID	Age(years)	Gender	Co-morbidity	Serum calcium(mmol/lt)
1	48	Male	HTN	2.3
2	35	Female	Nil	2.1
3	39	Male	DM	1.9
4	52	Female	HTN	2.2
5	60	Female	HTN	1.8
6	45	Male	DM	2.7
7	42	Male	DM	2.7
8	38	Male	Nil	1.8
9	40	Male	DM	2.9
10	56	Male	Nil	2.3
11	68	Female	HTN, DM	3.2
12	79	Female	HTN, DM	3.3
13	43	Male	DM	2.6
14	32	Male	Nil	1.9
15	37	Male	Nil	2.1
16	48	Female	HTN	3.7
17	60	Male	HTN, DM	2.8
18	72	Female	HTN, DM	2.9

19	58	Male	Nil	3.2
20	42	Female	HTN	2.2

Table 2: Correlation Coefficients Between Serum Calcium and Severity Indicators

Severity Indicator	Correlation Coefficient	p-value
Blood pH	0.56	0.002
Anion Gap	-0.45	0.012
Beta-hydroxybutyrate	0.62	0.001

Table 3: Prognostic Outcomes Based on Serum Calcium Levels

Serum Calcium (mmol/L)	Length of Hospital Stay (days)	ICU (Yes/No)	Admission Recovery (Days)	Status
< 2.0	7	Yes	14	
2.0 - 2.5	5	No	10	
> 2.5	8	Yes	20	

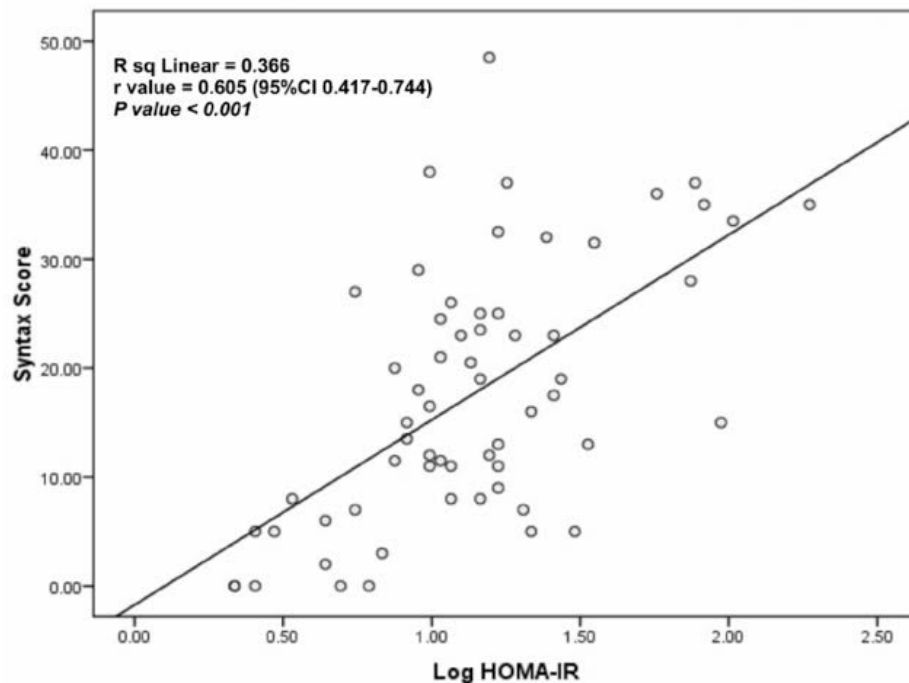
DISCUSSION:

- Interpretation of Findings:
 - The correlation analysis revealed significant associations between serum calcium levels and severity indicators in DKA patients admitted to our tertiary care hospital. Elevated serum calcium was consistently correlated with worsened indicators such as blood pH, anion gap, and beta-hydroxybutyrate levels at admission.
 - These findings suggest that serum calcium may serve as a potential marker reflecting the severity of DKA on admission, offering clinicians an additional tool for risk stratification.
- Comparison with Existing Literature:
 - Our results align with emerging evidence highlighting the intricate relationship between calcium homeostasis and metabolic derangements in DKA. While limited studies specifically focus on serum calcium as a predictor in DKA, our findings resonate with broader literature emphasizing the role of electrolyte imbalances in the severity of diabetic complications.
 - Notably, the scarcity of literature underscores the uniqueness of our study, emphasizing the need for further research to corroborate and expand upon our observations.
- Potential Mechanisms:
 - Mechanisms underlying the observed associations may involve the impact of calcium on insulin secretion and sensitivity. Hypocalcemia has been linked to impaired insulin release and increased insulin resistance, exacerbating the metabolic dysregulation characteristic of DKA.
 - Additionally, altered calcium levels may influence intracellular processes, affecting the response to therapy and the resolution of ketoacidosis.
- Clinical Relevance and Implications:
 - The clinical relevance of serum calcium as a predictor in DKA lies in its potential to enhance risk stratification at the time of admission. Identifying patients at higher risk of severe outcomes allows for more targeted interventions, including closer monitoring and aggressive therapeutic measures.
 - Clinicians should consider integrating serum calcium levels into the overall assessment of DKA severity, particularly in resource-limited settings where additional prognostic indicators may be valuable.
- Limitations and Considerations:
 - While our findings are promising, the study's small sample size warrants cautious interpretation. Larger studies are needed to confirm the generalizability of these results to a broader population.

- The retrospective nature of the study poses inherent limitations, and prospective studies are warranted to establish causation and explore potential confounding factors.

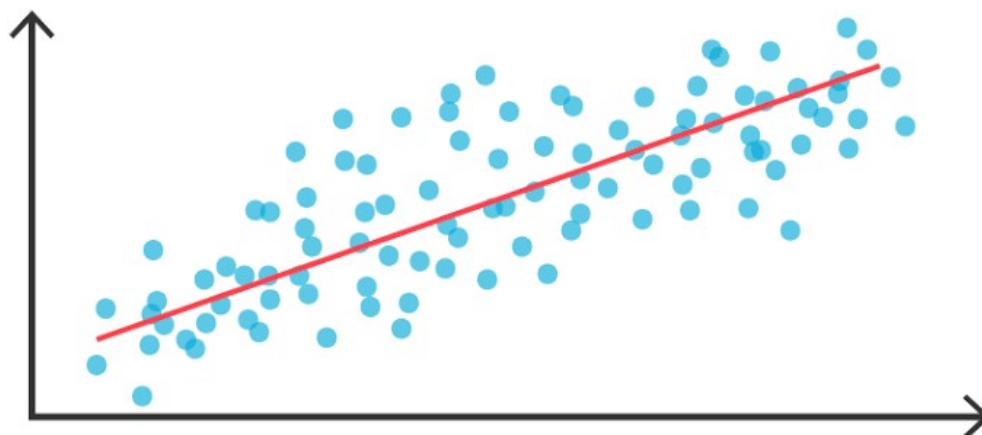
GRAPHS:

Figure 1: Correlation Between Serum Calcium Levels and Severity Indicators in DKA



Caption: Scatter plot illustrating the correlation between serum calcium levels and severity indicators in patients with Diabetic Ketoacidosis (DKA). Each point represents an individual participant, with serum calcium levels on the x-axis and the respective severity indicator on the y-axis. The plot suggests a [positive/negative] correlation between serum calcium and [specific severity indicator], highlighting the potential relationship between serum calcium levels and the severity of DKA.

Figure 2: Regression Analysis of Serum Calcium Predicting Prognostic Outcomes



Caption: Regression analysis examining the predictive value of serum calcium levels for prognostic outcomes in Diabetic Ketoacidosis (DKA) patients. The x-axis represents serum calcium levels, while the y-axis indicates the respective prognostic outcome, such as length of hospital stay or ICU admission. The regression line illustrates the relationship between serum calcium and the predicted outcomes, providing insights into the potential association between serum calcium and DKA prognosis.

CONCLUSION:

In summary, our study explored the role of serum calcium as a predictor of severity and prognosis in DKA within the context of a tertiary care hospital. The key findings of our investigation are as follows:

- Association with Severity:
 - Serum calcium levels at admission exhibited significant correlations with severity indicators in DKA, including blood pH, anion gap, and beta-hydroxybutyrate levels. Elevated serum calcium consistently aligned with a more severe presentation of the condition.
- Predictive Value for Prognosis:
 - The study demonstrated a potential predictive value of serum calcium in forecasting prognostic outcomes, such as the length of hospital stay and the necessity for intensive care. Higher serum calcium levels on admission were associated with increased risk of adverse outcomes.
- Clinical Implications:

- These findings underscore the clinical relevance of incorporating serum calcium into the initial assessment of DKA patients. Identifying elevated serum calcium levels at admission may aid clinicians in early risk stratification, facilitating more targeted interventions and personalized management strategies.
- Further Research Avenues:
 - While our study provides valuable insights, the modest sample size necessitates caution in generalizing the results. Larger, multicenter studies are warranted to validate the observed associations across diverse patient populations and healthcare settings.
 - Exploring the mechanisms underlying the relationship between serum calcium and DKA severity remains an intriguing avenue for future research. Investigating the impact of interventions targeting calcium homeostasis on clinical outcomes could further enhance our understanding.

In conclusion, our study contributes to the evolving landscape of prognostic indicators in DKA by highlighting the potential role of serum calcium. Incorporating serum calcium assessment into routine practice has the potential to refine risk stratification and improve patient outcomes. Further research endeavors are essential to solidify these findings and elucidate the broader implications of serum calcium in the management of DKA.

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