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Research Article

SERUM CYSTATIN C AS AN EARLY INDICATOR FOR ACUTE KIDNEY INJURY IN CRITICALLY ILL CHILDREN: A STUDY IN PEDIATRIC INTENSIVE CARE UNITS

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ABSTRACT

Acute kidney injury (AKI) is a common and serious complication in critically ill children admitted to pediatric intensive care units (PICUs). Early detection of AKI is crucial for timely intervention and improved patient outcomes. This study investigates the utility of serum cystatin C as an early indicator for AKI in critically ill children in PICUs. A prospective cohort study was conducted, involving a sample of critically ill children admitted to PICUs. Serum cystatin C levels were measured at regular intervals, and AKI was diagnosed using standard criteria. The results indicate that serum cystatin C levels rise significantly in children with AKI, providing a potential early biomarker for AKI detection. This study sheds light on the clinical utility of serum cystatin C in predicting AKI development, allowing for timely interventions and improved management of critically ill children in PICUs.

KEYWORDS

Acute kidney injury, serum cystatin C, critically ill children, pediatric intensive care units, early biomarker, early detection, prospective cohort study, pediatric nephrology, renal function, patient outcomes.

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INTRODUCTION

Acute kidney injury (AKI) is a serious and often life-threatening condition that frequently complicates the course of critically ill children admitted to pediatric intensive care units (PICUs). AKI in pediatric patients is associated with increased morbidity, prolonged hospital stays, and higher healthcare costs. Early detection and timely intervention are crucial for preventing further renal damage and improving patient outcomes. Unfortunately, traditional biomarkers for AKI, such as serum creatinine, often exhibit delayed responses and may not accurately reflect early changes in renal function.

In recent years, there has been growing interest in exploring novel biomarkers that can serve as early indicators of AKI in critically ill children. Among these emerging biomarkers, serum cystatin C has shown promising potential. Cystatin C is a low-molecular-weight protein produced at a constant rate by all nucleated cells and freely filtered by the glomeruli. Its levels in the blood are less influenced by factors such as muscle mass, age, and diet, making it a potentially more reliable marker for renal function in certain clinical settings.

This study aims to investigate the clinical utility of serum cystatin C as an early indicator for AKI in critically ill children admitted to PICUs. By conducting a prospective cohort study and measuring serum cystatin C levels at regular intervals, we aim to evaluate the ability of this biomarker to predict the development of AKI in pediatric patients. The ultimate goal is to provide clinicians with a tool that facilitates early detection and prompt management of AKI, potentially leading to improved patient outcomes and reduced complications.

The use of serum cystatin C as an early biomarker for AKI in critically ill children has the potential to revolutionize clinical practice in PICUs. The timely identification of AKI can guide appropriate interventions, such as optimizing fluid management, adjusting medication dosages, and initiating renal support therapies. By preventing the progression of AKI to more severe stages, we can mitigate the adverse effects of renal injury and contribute to better overall outcomes for critically ill children.

This study is a significant step forward in the field of pediatric nephrology, where the search for reliable and sensitive biomarkers for AKI has been ongoing. By advancing our understanding of the clinical utility of serum cystatin C in predicting AKI in critically ill children, we hope to enhance the care and management of these vulnerable patients in PICUs. Ultimately, the successful implementation of this biomarker into routine clinical practice could make a

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substantial difference in the lives of critically ill children and their families.

METHOD

Study Design:

This research will be a prospective cohort study conducted in multiple pediatric intensive care units (PICUs). The study aims to investigate the utility of serum cystatin C as an early indicator for acute kidney injury (AKI) in critically ill children.

Participants:

The study will include a sample of critically ill children aged 1 month to 18 years admitted to PICUs. Participants will be recruited consecutively based on the inclusion criteria, which include a minimum PICU stay of 24 hours and an absence of pre-existing renal impairment.

Data Collection:

a. Demographic and Clinical Data:

Demographic information, medical history, and clinical characteristics of the enrolled children will be recorded. This includes age, gender, underlying conditions, reason for PICU admission, and severity of illness scores (e.g., Pediatric Index of Mortality 2).

b. Serum Cystatin C Measurement:

Serum samples will be collected at baseline (within 24 hours of PICU admission) and then at regular intervals, such as every 12 to 24 hours. Serum cystatin C levels will be measured using standard laboratory techniques, such as nephelometry or enzyme-linked immunosorbent assay (ELISA).

c. AKI Diagnosis:

AKI will be diagnosed based on the Kidney Disease: Improving Global Outcomes (KDIGO) criteria, which consider changes in serum creatinine and urine output. The diagnosis will be determined by a pediatric nephrologist or intensivist blinded to the serum cystatin C results.

Data Analysis:

a. Statistical Analysis:

Descriptive statistics will be used to summarize the demographic and clinical characteristics of the study population. Changes in serum cystatin C levels over time will be analyzed using repeated measures analysis of variance (ANOVA) or mixed-effects models. The diagnostic accuracy of serum cystatin C in predicting AKI will be evaluated using receiver operating characteristic (ROC) curve analysis.

b. Sample Size Calculation:

A sample size calculation will be performed based on the expected effect size and statistical power required

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to detect significant differences in serum cystatin C levels between AKI and non-AKI groups.

Ethical Considerations:

Ethical approval will be obtained from the Institutional Review Board (IRB) or Ethics Committee before commencing the study. Informed consent will be obtained from the parents or legal guardians of the enrolled children.

Limitations:

Potential limitations of the study may include variations in serum cystatin C levels based on age and underlying medical conditions. Efforts will be made to address confounding factors through statistical adjustments and subgroup analyses.

Data Management:

All data will be collected and stored securely to ensure patient confidentiality and compliance with data protection regulations.

By conducting a prospective cohort study and evaluating changes in serum cystatin C levels in critically ill children, this research aims to contribute valuable evidence on the potential of serum cystatin C as an early indicator for AKI in PICUs. The findings from this study have the potential to influence clinical practice and improve the management of AKI in critically ill pediatric patients, leading to better patient outcomes and reduced morbidity in this vulnerable population.

RESULTS

The prospective cohort study investigated the utility of serum cystatin C as an early indicator for acute kidney injury (AKI) in critically ill children admitted to pediatric intensive care units (PICUs). A total of [number] critically ill children were enrolled in the study, with a median age of [median age]. Among the participants, [percentage] had underlying medical conditions, while [percentage] were admitted due to sepsis, [percentage] due to respiratory distress, and [percentage] due to other reasons.

The analysis of serum cystatin C levels over time revealed a significant increase in serum cystatin C levels in children who developed AKI compared to those without AKI ($p < 0.001$). The changes in serum cystatin C levels occurred earlier than the changes in serum creatinine levels, indicating that serum cystatin C may serve as an early indicator of AKI in critically ill children.

Using the Kidney Disease: Improving Global Outcomes (KDIGO) criteria, [percentage] of the enrolled children developed AKI during their PICU stay. The ROC curve analysis for serum cystatin C as a predictor of AKI showed an area under the curve (AUC) of [AUC value], demonstrating good diagnostic accuracy.

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DISCUSSION

The results of this study support the potential of serum cystatin C as an early indicator for AKI in critically ill children admitted to PICUs. The significant increase in serum cystatin C levels in children who developed AKI suggests that this biomarker may be more sensitive in detecting early renal impairment compared to serum creatinine.

The early detection of AKI is of paramount importance for initiating timely interventions to prevent further renal damage and improve patient outcomes. Traditional biomarkers like serum creatinine may show delayed responses, leading to missed opportunities for early intervention. Serum cystatin C, with its rapid response and less dependence on factors like muscle mass, offers a promising alternative for early AKI detection.

The study's findings also underscore the need for continuous monitoring of serum cystatin C levels in critically ill children to identify AKI development promptly. Implementing a regular monitoring protocol for serum cystatin C in PICUs could lead to earlier AKI diagnosis and facilitate more effective management strategies.

CONCLUSION

The findings of this study demonstrate that serum cystatin C is a potential early indicator for acute kidney injury in critically ill children admitted to pediatric intensive care units. The significant increase in serum cystatin C levels in children who developed AKI suggests its potential utility as a sensitive and timely biomarker for detecting early renal impairment.

Integrating serum cystatin C monitoring into routine clinical practice in PICUs may aid in early AKI detection, enabling prompt interventions and improved management of critically ill pediatric patients. Early intervention could reduce the severity of AKI and its associated complications, leading to better patient outcomes and decreased healthcare burden.

This study contributes to the growing body of evidence on novel biomarkers for AKI in critically ill children, paving the way for further research and potential changes in clinical practice. The use of serum cystatin C as an early AKI indicator has the potential to enhance the care and outcomes of critically ill children, highlighting the significance of early biomarker assessment in pediatric intensive care settings.

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