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Utility of Point-of-Care Beta-hydroxybutyrate Testing for Predicting Diabetic Ketoacidosis in the Pediatric Emergency Department

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*No conflict of interests exist

Background

Diabetic ketoacidosis (DKA) is a potentially life-threatening complication of insulin-dependent diabetes. Delayed results of serum and/or urine studies may hinder timely diagnosis and intervention, contributing to negative outcomes. With the recent availability of capillary beta-hydroxybutyrate (BOHB) testing, immediate results are available and several studies have suggested the potential for the early diagnosis of DKA.

Guidelines from the International Society of Pediatric and Adolescent Diabetes (ISPAD) in 2018 define a serum BOHB level of ≥ 3.0 mmol/L as indicative of DKA. The objective of our investigation was to describe the diagnostic characteristics of point-of-care (POC) BOHB testing to predict DKA among pediatric patients presenting with hyperglycemia in the Pediatric Emergency Department (ED).

Methods

Diabetes-related encounters in our Pediatric ED between January 2015 and June 2018 were reviewed. Those with an initial POC glucose ≥ 200 mg/dL, as well as POC BOHB and serum bicarbonate data were included. Sensitivity, Specificity, Positive Predictive Value (PPV), and Negative Predictive Value (NPV) for BOHB values ≥ 3.0 mmol/L for the diagnosis of DKA, defined as serum bicarbonate < 15 mmol/L, were calculated.

Results

A total of 463 encounters were reviewed; 34% had newly diagnosed diabetes, and 77% were in DKA based on serum bicarbonate levels. Only 13 patients (3%) had a POC BOHB <3.0 mmol/L.

Test Characteristics of BOHB ≥ 3.0 to predict DKA (CO₂ < 15)

<table>
<thead>
<tr>
<th></th>
<th>All patients</th>
<th>Known Diabetes</th>
<th>New Onset Diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>97%</td>
<td>98%</td>
<td>97%</td>
</tr>
<tr>
<td>Specificity</td>
<td>4%</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>PPV</td>
<td>77%</td>
<td>84%</td>
<td>65%</td>
</tr>
<tr>
<td>NPV</td>
<td>31%</td>
<td>25%</td>
<td>40%</td>
</tr>
<tr>
<td>ROC AUC (95% CI)</td>
<td>0.72 (0.67-0.77)</td>
<td>0.74 (0.68-0.81)</td>
<td>0.72 (0.64-0.81)</td>
</tr>
</tbody>
</table>

Conclusions

Based on ROC Curve data, POC BOHB testing is a poor-to-fair predictor of DKA in the ED setting, though its accuracy may be increased among patients with an established diagnosis of diabetes compared to newly diagnosed patients. While a POC BOHB ≥ 3.0 is an excellent screening test to rule out DKA in the ED (sensitivity of 97%), it should not be used to initiate therapy, particularly in new-onset diabetes where 35% of positive tests are false. Increasing the BOHB threshold to ≥ 4.75 increases the overall accuracy for predicting DKA.