RESEARCH ARTICLE

Association of serum lactate levels among patients with Type 2 diabetes mellitus of a tertiary care hospital, Uttar Pradesh

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ABSTRACT

Background: Serum lactate levels are a direct quantification of gap in between energy-expenditure and oxidative capacity. Variation in the lactate levels among the resting individuals could be exigent, requiring attention often and raised lactate levels can be observed among the individuals with mitochondrial impairments in the oxidative phosphorylation pathways.

Aim and Objectives: Aim and objectives of the study was to evaluate the association of serum lactate levels among Type 2 diabetes mellitus patients.

Materials and Methods: This present observational cross-sectional study involved 300 diabetic patients who presented to the tertiary care hospital of Uttar Pradesh. The patients were stratified according to their random blood sugar, Glycated hemoglobin and lactate levels. Student t-test was used for assessing the significance, a probability of <0.05 is considered significant.

Results: A total of 300 patients have been included in this study, of which 150 are males and 150 are females, the median age was 48 years. The highest age of patient included was 84 years, and the lowest of patient included in the study was 34 years. The patients with high lactate levels are found to have poor glycaemic control, which may further proceed to worst outcome of the disease. Conclusion: Serum lactate levels could be the potential predictor and reliable indicator of poor glycemic control/status of diabetic patients.

KEY WORDS: Blood Sugar; Diabetes Mellitus; Hyperglycaemia; Lactate; Oxidative Phosphorylation

INTRODUCTION

Diabetes mellitus (DM) is a chronic disease-causing dysregulation of blood sugar levels and is considered to be a global burden causing millions of deaths worldwide. Type 2 “Diabetes Mellitus (DM),” a more usual form of DM resulting from the ineffective use of insulin by the body.[1] There is an increasing trend of higher incidence of DM being reported from low-and middle-income countries, of which Asia being the epicentre with over 60% contribution to the rising prevalence.[2,3] Lactate is a by-product of the “anaerobic glycolysis” in adipose tissue, muscle, and other tissues of human body. Anaerobic glycolysis will be more when the body’s energy demand exceeds the oxidative capacity of mitochondria.[4] Serum lactate levels are a direct quantification of gap in between “energy-expenditure and oxidative capacity.” Conventionally, the blood lactate levels are used as a biomarker of ischemia clinically and as fitness measure among the individuals exercising.[5] Disparity in the lactate levels among the resting individuals could be exigent, requiring attention often and raised lactate levels can be observed among the individuals with mitochondrial damage in the “oxidative phosphorylation” pathways.[6] The growing evidence indicates that lower oxidative capacity resultant
of “impaired mitochondrial oxidative phosphorylation” is strongly connected to the “insulin resistance,” which further leading to the condition of Type 2 DM (T2DM). It is still indistinct that low oxidative capacity is a consequence or cause of DM.[7] Hence, studies like ours addressing this association using the markers of oxidative capacity like lactate levels among the incident diabetic individuals could validate the associations, thereby could help in better management of the disease. According to our literature review, there are no significant studies from Asia to validate this association between serum lactate levels and uncontrolled T2DM. Therefore, we aim to evaluate the association of serum lactate levels in uncontrolled T2DM in a tertiary care hospital of India.

MATERIALS AND METHODS

Study Design and Setting

This is an “observational cross-sectional study” conducted at a tertiary care hospital of Uttar Pradesh, India.

Study Participants and Sampling

Through convenient sampling method, the present study involved 300 diabetic patients (Males - 150) (Females - 150) who presented to the tertiary care hospital of Uttar Pradesh, between March 2019 and December 2019. “Informed consent” was attained from all the patients before the study. Those patients who are greater than 18 years of age and are known case of DM or patients having random blood sugar levels >200 mg/dl at the time of consultation were included in the study. The patients with severe complications were excluded from the study.

Data Collection Tool and Techniques

The study participants were checked for Random blood sugars, Glycated hemoglobin (HbA1c) and serum lactate levels by drawing their blood sample after getting the informed consent. The patients were stratified according to their random blood sugar, HbA1c and lactate levels. The stratification based on lactate levels include: Normal-“lactate levels of <2 mmol/L;” Hyperlactemia-“lactate levels of 2.0–4.0 mmol/L;” and Lactic acidosis-“lactate levels >4.0 mmol/L.”[8] The patients were classified according to their HbA1c as good control-HbA1c <6.5%, fairly good control-HbA1c between 6.5 and 7.9% and poor control-HbA1c >8.0%.[9] The patients were then assorted based on their glucose and lactate levels for further analysis.

Ethical Consideration

The study protocol has been accepted by the Institutional Ethical Committee, and the informed consent was obtained from all the study participants. Confidentiality of data was maintained.

Statistical Analysis

Data were analyzed using Statistical Package for the Social Sciences 24.0 version. Student $t$-test has been used to assess the significance between the groups. A probability value of $<0.05$ is considered significant.

RESULTS

A total of 300 patients were counted into this study, of which 150 were males and 150 were females, the median age was 48 years. The highest age of patient included was 84 years, and the lowest of patient included in the study was 34 years. The distribution of patients based on their blood glucose levels by random glucose check is shown in Table 1. The distribution of patients based on their HbA1c levels is shown in Table 2. The stratification of patients based on their lactate levels and glycemic control is shown in Table 3. When the patients were classified based on their HbA1c and the lactate levels, the good glycemic control have been observed in the patients with normal lactate levels; the poor glycemic control have been observed in the patients with high lactate levels shown in Table 4.

Table 1: Distribution of patients based on their blood glucose

<table>
<thead>
<tr>
<th>Random blood sugars (mg/dl)</th>
<th>Number of patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;200</td>
<td>184 (61.3)</td>
</tr>
<tr>
<td>200–300</td>
<td>88 (29.3)</td>
</tr>
<tr>
<td>300–400</td>
<td>26 (8.7)</td>
</tr>
<tr>
<td>&gt;400</td>
<td>2 (0.7)</td>
</tr>
</tbody>
</table>

Table 2: Distribution of patients based on their HbA1c levels

<table>
<thead>
<tr>
<th>HbA1c levels (%)</th>
<th>Number of patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;6.5</td>
<td>205 (68.3)</td>
</tr>
<tr>
<td>6.5–7.9</td>
<td>58 (19.4)</td>
</tr>
<tr>
<td>&gt;8</td>
<td>37 (12.3)</td>
</tr>
</tbody>
</table>

HbA1c: Glycated hemoglobin

Table 3: Stratification of patients based on their lactate levels

<table>
<thead>
<tr>
<th>Lactate levels (mmol/L)</th>
<th>Number of patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2</td>
<td>208 (69.3)</td>
</tr>
<tr>
<td>2–4</td>
<td>84 (28)</td>
</tr>
<tr>
<td>&gt;4</td>
<td>08 (2.7)</td>
</tr>
</tbody>
</table>
References


Discussion

By this study, we observed that the association of two familiar markers, HbA1c and lactate levels provide more useful information toward the prior patient identification who may progress toward the bad outcomes. Those patients who are with high lactate levels are found to have poor glycemic control, which may further proceed to worst outcome of the pathological condition.[10]

A similar study by Green et al. observed that the mortality risk in the diabetic patients has not been increased unless the hyperglycemia was linked to hyperlactatemia, which strengthens the results of our study, which strengthens the results of our study.[11] The association between raised levels of glucose, poor glycemic control and the outcomes of patients have been evaluated and an existing evidence seconcing the association of raised glucose values with escalated morbidity, having higher lactate levels leading to a condition of metabolic acidosis.[12] These associations can also be connected to the metabolic alterations happening from dysregulated glucose and lactate metabolism, contributing toward elevated glucose levels.[13-15]

The strength of the study include as this is the foremost study to evaluate the serum lactate levels among T2DM patients from Indian tertiary care setting. The limitation of present study is that the sample of the study is not very large, future studies with large data are required to further validate this association of serum lactate levels among T2DM patients.

Conclusion

The results of our study denote that the serum lactate level is a predictor of incident diabetes, especially of uncontrolled diabetes, suggestive of a potential role toward oxidative insufficiency in the pathogenic course of diabetes. This indicates a strong association of elevated lactate levels with impaired fasting glucose and insulin resistance. Therefore, serum lactate levels could be the potential predictor and reliable indicator of poor glycaemic control/status of diabetic patients.

Table 4: Stratification of patients based on their lactate levels and glycaemic control with significance

<table>
<thead>
<tr>
<th>Lactate levels (mmol/L)</th>
<th>Glycaemic control</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Good control (HbA1c&lt;6.5%)</td>
<td>Fairly good control (HbA1c 6.5–7.9%)</td>
</tr>
<tr>
<td>&lt;2</td>
<td>190</td>
<td>42</td>
</tr>
<tr>
<td>2–4</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>&gt;4</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

*Significant, HbA1c: Glycated hemoglobin


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