Limited data are available for the effects of ketogenic diet on QT dispersion and P-wave dispersion measures. Therefore we aimed to search for the changes in the corrected QT interval, QT dispersion and P-wave dispersion with serial electrocardiograms (ECGs) in patients treated with ketogenic diet.

Materials and Methods

A total of 23 drug-resistant epileptic patients who were treated with ketogenic diet at the Pediatric Neurology clinic from September 2012 to September 2013 were enrolled in this prospective study. Electrocardiography was performed in all patients before the beginning of ketogenic diet and after the sixth month of treatment. Patients older than 1 year of age with intractable epilepsy who received ketogenic diet for at least six months were included into the study.

All children were started on a standardized 3:1 ketogenic diet with a non-fasting gradual initiation protocol. During the diet’s initiation, patients were closely monitored for any acute adverse effects for the first week, and blood glucose and ketones were measured twice daily. The recipes were planned in-house and calculated considering the families and the child’s preferences and cultural differences. Patients who had medically refractory epilepsy, who had more than 4 seizures per week despite the appropriate use of at least two AEDs, and who continued treatment for at least six months were identified.

Heart rate, maximum and minimum P-wave durations, P-wave dispersion, maximum and minimum corrected QT durations and QT dispersion were manually measured from the 12-lead surface ECGs.

Results

A total of 23 patients (13 male and 10 female) with median age of 51 months ranging from 13 to 158 months were included in the study. Electrocardiographic measurements before the beginning of ketogenic diet and after six month of treatment are presented in Table 1. Minimum and maximum corrected QT and QT dispersion measurements showed non-significant increases at 6th month when compared to baseline values. Other previously mentioned ECG parameters showed no significant changes (Table 1).

Table 1. Electrocardiographic measurements of the patients

<table>
<thead>
<tr>
<th>Variables</th>
<th>Baseline</th>
<th>6th month</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean HR, bpm</td>
<td>112 ± 25</td>
<td>115 ± 28</td>
<td>0.521</td>
</tr>
<tr>
<td>P max, ms</td>
<td>96 ± 14</td>
<td>95 ± 20</td>
<td>0.768</td>
</tr>
<tr>
<td>P min, ms</td>
<td>47 ± 11</td>
<td>46 ± 9</td>
<td>0.716</td>
</tr>
<tr>
<td>P-wave dispersion, ms</td>
<td>48 ± 9</td>
<td>51 ± 12</td>
<td>0.242</td>
</tr>
<tr>
<td>QTc max, ms</td>
<td>438 ± 26</td>
<td>455 ± 41</td>
<td>0.053</td>
</tr>
<tr>
<td>QTc min, ms</td>
<td>381 ± 20</td>
<td>389 ± 28</td>
<td>0.209</td>
</tr>
<tr>
<td>QT dispersion, ms</td>
<td>43 ± 16</td>
<td>47 ± 18</td>
<td>0.382</td>
</tr>
</tbody>
</table>

Discussion

The present study has shown that a 6-month duration ketogenic diet had no significant effect on ECG parameters in children. Similarly, Sharma and Gulati (1) did not find any changes in the mean corrected QT interval after 1 year in patients treated with ketogenic diet. However, Best et al. (2) studied the QT interval in the ECGs of 21 children on the ketogenic diet and found prolonged QT interval in 3 patients. They reported a significant correlation between prolonged corrected QT interval and both low serum bicarbonate and high beta-hydroxybutyrate levels. In addition, three patients had evidence of cardiac chamber enlargement (3).

In the present study, non-significantly increased corrected QT interval and QT dispersion measurements that may be associated with increasing age were detected in patients without biochemical abnormality, cardiomyopathy or selenium deficiency.

Previous studies demonstrated an association between the ketogenic diet and corrected QT interval. However, the effect of the ketogenic diet on P-wave dispersion and QT dispersion in children has not been studied before.

The QT interval is an indirect measure of the duration of ventricular depolarization and repolarization (4). Prolonged corrected QT interval is associated with serious ventricular arrhythmias and is an independent risk factor for sudden cardiac death (5). On the other hand, QT dispersion has been suggested as a measure for the heterogeneity of ventricular recovery time, which is a powerful determinant of the susceptibility to ventricular tachycardia and/or fibrillation in clinical studies (6). Both prolonged corrected QT interval and corrected QT dispersion have been shown as risk factors for sudden cardiac death (7).

Increased corrected QT dispersion and corrected QT maximum in epileptic children compared to healthy subjects have been reported previously (8). Moreover, significantly shorter corrected QT interval has been reported in epileptic patients when compared to controls (9).

Since calculation of corrected QT dispersion is influenced by sinus arrhythmia, which is common in childhood, correction QT dispersion is not recommended for heart rate in children (25). Therefore we used only QT dispersion instead of corrected QT dispersion. We used Bazett’s formula for correction of QT interval, although several different formulas have been developed since it was first introduced (10-12). Indeed, Bazett’s formula is the most widely used formula and no formula has been shown to have a clear advantage over Bazett’s formula. The use of other four-correction formulas has been recommended when corrected QT interval is in pathologic range (13). Since corrected QT interval was in normal range in all of our patients we didn’t use other formulas.

The small sample size of patients treated with ketogenic diet likely obscured our ability to show corrected QT and QT dispersion prolongation in this study. However, sudden cardiac deaths in the ketogenic metabolic situations and ketogenic diet programs have been reported even in the patients with normal serum selenium levels. Therefore, we cannot suggest that ECG is unnecessary in follow-up of patients treated with ketogenic diet.

References