Study of ambulatory blood pressure in diabetic children: prediction of early renal insult

Background: Hypertension is a highly prevalent risk factor for cardiovascular disease in patients with type 1 diabetes mellitus. Elevated blood pressure (BP) promotes the development and progression of microvascular complications, e.g., nephropathy and retinopathy. The purpose of this study was to identify and detect early BP changes in diabetic children and adolescents, aiming for the early prediction of future renal and cardiovascular disease risk during childhood.

Methods and materials: Ambulatory BP monitoring was undertaken for 40 normotensive type 1 diabetic children with mean age of 11.56±2.82 years, and 24 healthy children as control group with matched age and sex. Albumin/creatinine ratio and glycated hemoglobin were tested. BP indices and standard deviation scores were calculated using reference standards. The data were analyzed by SPSS software version 20 using mean and standard deviations for descriptive data. Correlation and regression analysis tests were used to study relations between BP indices and diabetic parameters.

Results: All parameters of BP z-scores were highly significantly increased in diabetic patients compared with controlled group (P<0.0001). The frequency of non-dipping was greater and highly significant in microalbuminuric diabetic patients (P<0.0001). Regression analysis revealed that BP parameters were significantly related to albumin/creatinine ratio, glycated hemoglobin, insulin dose, and body mass index.

Conclusion: Our observation revealed a clear link between the nocturnal BP and microalbuminuria which mandates BP follow-up via ambulatory BP monitoring with therapeutic intervention to prevent renal and cardiovascular diabetic complications in adulthood.

Keywords: ambulatory, blood pressure, diabetic, children, renal
in predicting future cardiovascular events and target organ
damage.6,7 To assess risk, whole daytime and nighttime
ambulatory BP and BP load are used. The calculation of
both systolic and diastolic load threshold is manually and
automatically done. It is considered abnormal if BP loads
are in excess of 25%–30%.8

BP will fall at night in normotensive individuals. People
who undergo this normal physiological change are described
as “dippers”. So if more than 10% of the diurnal BP values
dropped nocturnally, it is considered a normal phenomenon.
The non-dipping pattern is defined as a blunted decline in the
person’s physiological nocturnal BP drop in whom the BP
remains high, ie, less than 10% lower than daytime average.10

Heart complications such as ventricular hypertrophy as
well as renal insults with its events of microalbuminuria and
decreased arterial acquiescence are developed in type 1 dia-
betic patients who display normal BP with non-dipping pattern;
moreover, these patients represent a worse outcome.11,12

Surprisingly, there are relatively few data to recognize
whether the changes of BP through the day are repre-
sented in patients with diabetes mellitus as in the normal
population.13

It is known that approximately one third of diabetic
patients will suffer from renal insult an extended time after
onset of diabetes. Clinically detectable diabetic nephropathy
begins with the development of microalbuminuria.14 Hyp-
tension and microalbuminuria are considered the major
cardiovascular risk factors in young patients with T1DM.
Many studies have demonstrated that strict control of blood
glucose level and BP significantly reduces the incidence and
progression of diabetic kidney disease.15

Aim of study
The present study was undertaken to characterize type 1
diabetic children and adolescents for detection of subtle BP
abnormalities using ambulatory blood pressure monitoring
(ABPM) and determining its relation to microalbuminuria
and other diabetic parameters.

Methods and materials
The studied groups included 40 patients with T1DM. Their
ages were from 8 to 17 years. All were diagnosed by decreased
level of C-peptide (connecting peptide) with symptoms of
diabetes; they were followed-up in pediatric clinic of Al Ansari
Specialist Hospital. The studied group included 15 males
and 25 females. Exclusion criteria were as follows: hypertensive
patients, age above 18 years, receiving medication that
affects BP or kidney such as angiotensin-converting-enzyme
(ACE) inhibitors and other antihypertensive drugs, and other
chronic illness such as antihypertensives or ACE inhibitors. Inclusion criteria of diabetic group were children and adoles-
cents aged below 18 years, diabetic patients diagnosed by glucose level, glycated
hemoglobin (HbA1c), and C-peptide levels, normotensive by
traditional simple sphygmomanometer method, and no history
of medication such as antihypertensives or ACE inhibitors.
Inclusion criteria of control group were children and adoles-
cents aged below 18 years, normotensive by traditional simple
sphygmomanometer method, no history of medication such
as antihypertensives or ACE inhibitors, and no history of
chronic illness such as diabetes, heart, or kidney diseases. The control group included 24 children (nine males, 15 females)
of matched age and sex. They were randomly chosen from
children attending outpatient clinics for general checkups and
agreed to participate in this research. The study was approved
by the local ethics committee, and informed consent was
obtained from the parents or legal guardians of participating
children and from children aged above 13 years.

All the studied groups were thoroughly evaluated. Full
history-taking included duration of diabetes in years, dosage
of insulin (units/kg of body weight) weight, height, and body
mass index (BMI). Venous blood for testing HbA1c levels
was drawn from all study groups three times within at least
3 months interval, and the normal range was considered
from 4.05% to 6.05% according to the Diabetes Control and
Complication Trial. The test was done using COBAS INTE-
GRA 400 (Hoffman-La Roche Ltd., Basel, Switzerland) for
the quantitative determination of percent HbA1c following
manufacturer guidelines.

The International Society for Pediatric and Adolescent
Diabetology defined persistent microalbuminuria as albumin
excretion rate of 20–200 mg/min in timed overnight urine
collection in two consecutive urine specimens 4 weeks
apart. They also considered albumin/creatinine ratio of
30–300 mg/g in the morning spot urine sample as positive for
microalbuminuria. In 24 hours urine collection; it is defined
positive if albumin excretion rate is 30–300 mg/24 hours.
In our study, we used albumin/creatinine ratio in the morning
spot urine to study microalbuminuria in our studied groups.
Microalbuminuria was determined from the collected three
separate urine samples with at least 1 month interval. The
patients were asked to avoid physical activity and had to be
afebrile on the day of urine testing. Urinary albumin excre-
tion was measured by the nephelometric method. BP profiles
were compared with albumin/creatinine ratio.

Twenty-four hour ABPM
ABPM was measured by an oscillometric monitor (Win
Pro Model PG MAP; SunTech Medical Inc., Morrisville,
Ambulatory blood pressure in diabetic children

Multiple linear regression analysis was used to identify diabetes-associated risk factors for arterial hypertension. The independent variables which were used to compare with BP profiles were: age in years, total diabetes duration in years, sex, $\text{HBA}_1c$ level, BMI, and the dosage of insulin in units/kg of weight. Statistical results were presented as mean ± standard deviation. In comparison tests, significance was defined by a $P$-value less than 0.05 and highly significant if less than 0.01.

Results
Demographic, descriptive data including that of diabetes and BP profiles and their comparisons between patients and control groups were shown in Table 1. On comparing the data between the two sexes, we found that most of our study parameters with descriptive BP profiles did not differ between the two sexes (Table 2).

$\text{HBA}_1c$, albumin/creatinine ratio, diabetes duration, and insulin dose were positively correlated with all BP parameters including systolic, diastolic, and mean (both nocturnal and diurnal); on the other hand, they were negatively correlated with nocturnal dipping of BP (Table 3).

Multiple regression analysis using age, sex, BMI, albumin/creatinine ratio, $\text{HBA}_1c$, insulin dose, and diabetes duration as independent factors was performed (Table 4). It was found that systolic, diastolic, and mean arterial BP were significantly related to albumin/creatinine ratio, $\text{HBA}_1c$, insulin dose, and BMI. Diabetes duration was significantly associated with increased night systolic BP.

Nocturnal dipping of BP was only associated with albumin/creatinine ratio (Table 5).

Discussion
In this study, diabetic children showed abnormal BP profiles both systolic and diastolic with significant failure of nocturnal dipping.

Age-related changes in BP regulation were observed in diabetic patients suggesting accelerated vascular ageing.²⁰ Being a diabetic patient, one is susceptible to cardiovascular complications and this risk increases significantly if one is pre-hypertensive with changes in ambulatory BP readings; this is evidenced in the Strong Heart Study.²⁰ Our study showed a similar conclusion as these “risky events” already began in children and adolescents who suffered from T1DM.

The increased night BP and occurrence of non-dipping is usually accompanied by cardiovascular insults in most patients.

This insult is an outcome of structural changes in arteries and their higher tone.²¹ Major complications such as stroke...
and infarction of the heart easily occur in non-dippers if compared with normal dippers.22

The studied diabetic children and adolescents had abnormal BP regulation, especially during nighttime which means they may be facing many vascular complications even if they were only recently diagnosed as diabetics. The results regarding diabetic non-dipping during the night corresponds with results of Hermada et al.23 Markuszeuski et al studied the BP changes during 24 hours in T1DM patients. They demonstrated that both nocturnal systolic and diastolic BP were higher in diabetic patients than controls, and the absence of BP drop (non-dippers) was more prevalent in the diabetic group.24 Their result corresponds with this study but disagree with regard to daytime BP, both systolic and diastolic. They found that daytime BP was not significantly different from the control group while this study’s results demonstrated highly significant differences between both groups with regard to daytime systolic and diastolic BPs.

In this study, it was found that BMI was positively correlated with systolic BP both diurnal and nocturnal but had no effect on BP dipping. This result corresponded with that of Axel et al’s findings.25 Also, some researchers demonstrated a significant association between systolic BP and BMI.18

The insulin need is usually increased due to insulin resistance which occurs in obese subjects with a high BMI.26 Uncontrolled diabetic condition for an extended period of time eventually causes vascular disturbances and endothelial damage that can easily lead to changes in BP values and difficulty in its regulation.27

Table 1: Descriptive data and comparison study between studied groups using Mann–Whitney test

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Patients (n=40)</th>
<th>Controls (n=24)</th>
<th>P (significance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years</td>
<td>11.56</td>
<td>13.5</td>
<td>0.067</td>
</tr>
<tr>
<td>Height z-score</td>
<td>1.41</td>
<td>1.54</td>
<td>0.014</td>
</tr>
<tr>
<td>BMi</td>
<td>19.40</td>
<td>19.36</td>
<td>0.761</td>
</tr>
<tr>
<td>IDDM duration in years</td>
<td>4.64</td>
<td>0.0</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>HbA1c</td>
<td>11.22</td>
<td>5.00</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Insulin dose units/kg BW</td>
<td>0.99</td>
<td>0.0</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Albumin/creatinine ratio</td>
<td>42.34</td>
<td>16.83</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Daytime systolic blood pressure z-score</td>
<td>7.73</td>
<td>0.0</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Nighttime systolic blood pressure z-score</td>
<td>8.73</td>
<td>0.0</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Daytime diastolic blood pressure z-score</td>
<td>5.80</td>
<td>0.0</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Nighttime diastolic blood pressure z-score</td>
<td>9.50</td>
<td>0.0</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Mean daytime blood pressure z-score</td>
<td>5.22</td>
<td>0.0</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Mean nighttime blood pressure z-score</td>
<td>6.98</td>
<td>0.0</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Nocturnal systolic dipping</td>
<td>7.80</td>
<td>16.12</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Nocturnal diastolic dipping</td>
<td>7.68</td>
<td>22.46</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Abbreviations: BMi, body mass index; IDDM, insulin dependent diabetes mellitus; HbA1c, glycated hemoglobin; BW, body weight.

Table 2: Comparison study between males and females in the study group by Mann–Whitney test

<table>
<thead>
<tr>
<th>Parameters</th>
<th>P (significance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.308</td>
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<tr>
<td>Height</td>
<td>0.199</td>
</tr>
<tr>
<td>BMi</td>
<td>0.685</td>
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<tr>
<td>IDDM duration in years</td>
<td>0.845</td>
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<tr>
<td>HbA1c</td>
<td>0.408</td>
</tr>
<tr>
<td>Insulin dose units/kg BW</td>
<td>0.775</td>
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<tr>
<td>Albumin/creatinine ratio</td>
<td>0.685</td>
</tr>
<tr>
<td>Daytime systolic blood pressure z-score</td>
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</tr>
<tr>
<td>Nighttime systolic blood pressure z-score</td>
<td>0.822</td>
</tr>
<tr>
<td>Daytime diastolic blood pressure z-score</td>
<td>0.822</td>
</tr>
<tr>
<td>Nighttime diastolic blood pressure z-score</td>
<td>0.663</td>
</tr>
<tr>
<td>Mean daytime blood pressure z-score</td>
<td>0.641</td>
</tr>
<tr>
<td>Mean nighttime blood pressure z-score</td>
<td>0.641</td>
</tr>
<tr>
<td>Nocturnal systolic dipping</td>
<td>0.916</td>
</tr>
<tr>
<td>Nocturnal diastolic dipping</td>
<td>0.443</td>
</tr>
</tbody>
</table>

Abbreviations: BMi, body mass index; IDDM, insulin dependent diabetes mellitus; HbA1c, glycated hemoglobin; BW, body weight.
Table 3 Correlation study between blood pressure parameters and studied variables using Spearman test

<table>
<thead>
<tr>
<th>Variables</th>
<th>Daytime systolic blood pressure z-score</th>
<th>Nighttime systolic blood pressure z-score</th>
<th>Daytime diastolic blood pressure z-score</th>
<th>Nighttime diastolic blood pressure z-score</th>
<th>Mean daytime z-score</th>
<th>Mean nighttime z-score</th>
<th>Nocturnal systolic dipping</th>
<th>Nocturnal diastolic dipping</th>
</tr>
</thead>
<tbody>
<tr>
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<td>r</td>
<td>P</td>
<td>r</td>
<td>P</td>
<td>r</td>
<td>P</td>
<td>r</td>
<td>P</td>
</tr>
<tr>
<td>Height</td>
<td>0.052</td>
<td>0.762</td>
<td>-0.305</td>
<td>0.067</td>
<td>-0.205</td>
<td>0.225</td>
<td>-0.186</td>
<td>0.271</td>
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<td>BMI</td>
<td>0.126</td>
<td>0.457</td>
<td>0.249</td>
<td>0.137</td>
<td>0.150</td>
<td>0.375</td>
<td>-0.270</td>
<td>0.105</td>
</tr>
<tr>
<td>IDD duration</td>
<td>0.961</td>
<td>&lt;0.0001*</td>
<td>0.652</td>
<td>&lt;0.0001*</td>
<td>0.668</td>
<td>&lt;0.0001*</td>
<td>0.858</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>HbA1c</td>
<td>0.732</td>
<td>&lt;0.0001*</td>
<td>0.694</td>
<td>&lt;0.0001*</td>
<td>0.656</td>
<td>&lt;0.0001*</td>
<td>0.793</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Insulin dose</td>
<td>0.788</td>
<td>&lt;0.0001*</td>
<td>0.748</td>
<td>&lt;0.0001*</td>
<td>0.805</td>
<td>&lt;0.0001*</td>
<td>0.754</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Albumin/creatinine ratio</td>
<td>0.776</td>
<td>&lt;0.0001*</td>
<td>0.594</td>
<td>&lt;0.0001*</td>
<td>0.643</td>
<td>&lt;0.0001*</td>
<td>0.804</td>
<td>&lt;0.0001*</td>
</tr>
</tbody>
</table>

Notes: r, Spearman correlation; *P < 0.05 (statistically significant).
Abbreviations: BMI, body mass index; IDD, insulin dependent diabetes mellitus; HbA1c, glycated hemoglobin.


diabetic children using ABPM, is often a “wake-up call”, and

1. The rapid proper diagnosis of hypertension in diabetic children, who require special monitoring. On the other hand, metabolic state, BMI, and insulin dose are considered non-modifiable risk factors that need to be optimized for effective BP control during the day.

2. Age and diabetes duration were also correlated to changes in BP. They are non-modifiable risk factors and they can be used as a tool to classify patients at a higher risk for arterial hypertension who require special monitoring. On the other hand, metabolic state, BMI, and insulin dose are considered non-modifiable risk factors that need to be optimized for effective BP control during the day.

3. It is speculated that in diabetic patients, the tone of sympathetic nervous system is increased including renal vessels resulting from higher sympathetic tone is connected to diabetogenic nephropathy. It is speculated that in diabetic patients, the tone of sympathetic nervous system is increased including renal vessels resulting from higher sympathetic tone is connected to diabetogenic nephropathy. In contrast, some research failed to find any correlation between HbA1c and augmented systolic BP both diurnal and nocturnal. In contrast, some research failed to find any correlation between HbA1c and augmented systolic BP both diurnal and nocturnal. Our research results could be explained by the fact that elevated systolic and diastolic BP, both diurnal and nocturnal, is significantly associated with microalbuminuria. Moreover, microalbuminuria was more frequently linked to diabetogenic nephropathy, while microalbuminuria was more frequently linked to diabetogenic nephropathy, while microalbuminuria was more frequently linked to diabetogenic nephropathy, while microalbuminuria was more frequently linked to diabetogenic nephropathy.

4. Microalbuminuria was more frequently linked to diabetogenic nephropathy, while microalbuminuria was more frequently linked to diabetogenic nephropathy, while microalbuminuria was more frequently linked to diabetogenic nephropathy, while microalbuminuria was more frequently linked to diabetogenic nephropathy.

5. These findings support the hypothesis that microalbuminuria is a marker of target organ damage and may be due to the small sample size of this study. These findings support the hypothesis that microalbuminuria is a marker of target organ damage and may be due to the small sample size of this study. Some findings by the fact that females tend to be obese during puberty with subsequent increase of insulin resistance, thus causing such alterations.

6. These findings support the hypothesis that microalbuminuria is a marker of target organ damage and may be due to the small sample size of this study. These findings support the hypothesis that microalbuminuria is a marker of target organ damage and may be due to the small sample size of this study. These findings support the hypothesis that microalbuminuria is a marker of target organ damage and may be due to the small sample size of this study. These findings support the hypothesis that microalbuminuria is a marker of target organ damage and may be due to the small sample size of this study. Some findings by the fact that females tend to be obese during puberty with subsequent increase of insulin resistance, thus causing such alterations.

7. With respect to sex and alterations of BP, this study demonstrated that females tend to be obese during puberty with subsequent increase of insulin resistance, thus causing such alterations. With respect to sex and alterations of BP, this study demonstrated that females tend to be obese during puberty with subsequent increase of insulin resistance, thus causing such alterations. With respect to sex and alterations of BP, this study demonstrated that females tend to be obese during puberty with subsequent increase of insulin resistance, thus causing such alterations. With respect to sex and alterations of BP, this study demonstrated that females tend to be obese during puberty with subsequent increase of insulin resistance, thus causing such alterations.
Table 4 Multiple linear regression analysis for blood pressure parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>SBP</th>
<th></th>
<th>DBP</th>
<th></th>
<th>MAP</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T</td>
<td>P</td>
<td>T</td>
<td>P</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>Day</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-2.129</td>
<td>0.042*</td>
<td>-1.557</td>
<td>0.131</td>
<td>-4.118</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Sex</td>
<td>0.067</td>
<td>0.947</td>
<td>1.595</td>
<td>0.122</td>
<td>0.817</td>
<td>0.421</td>
</tr>
<tr>
<td>IDDM duration in years</td>
<td>1.956</td>
<td>0.061</td>
<td>-3.325</td>
<td>0.002*</td>
<td>0.642</td>
<td>0.526</td>
</tr>
<tr>
<td>HBA&lt;sub&gt;1c&lt;/sub&gt;</td>
<td>2.231</td>
<td>0.034*</td>
<td>2.148</td>
<td>0.041*</td>
<td>2.302</td>
<td>0.029*</td>
</tr>
<tr>
<td>Insulin dose</td>
<td>5.444</td>
<td>&lt;0.0001*</td>
<td>5.149</td>
<td>&lt;0.0001*</td>
<td>2.700</td>
<td>0.012*</td>
</tr>
<tr>
<td>BMI</td>
<td>3.193</td>
<td>0.003*</td>
<td>2.977</td>
<td>0.006*</td>
<td>2.271</td>
<td>0.031*</td>
</tr>
<tr>
<td>Albumin/creatinine ratio</td>
<td>3.950</td>
<td>&lt;0.0001*</td>
<td>2.993</td>
<td>0.006*</td>
<td>2.810</td>
<td>0.009*</td>
</tr>
<tr>
<td>Night</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-4.050</td>
<td>&lt;0.0001*</td>
<td>-2.407</td>
<td>0.023*</td>
<td>-1.895</td>
<td>0.069</td>
</tr>
<tr>
<td>Sex</td>
<td>0.897</td>
<td>0.378</td>
<td>0.828</td>
<td>0.414</td>
<td>1.891</td>
<td>0.069</td>
</tr>
<tr>
<td>IDDM duration</td>
<td>-3.399</td>
<td>0.002*</td>
<td>0.920</td>
<td>0.366</td>
<td>-1.544</td>
<td>0.134</td>
</tr>
<tr>
<td>HBA&lt;sub&gt;1c&lt;/sub&gt;</td>
<td>2.886</td>
<td>0.007*</td>
<td>2.225</td>
<td>0.034*</td>
<td>1.609</td>
<td>0.119</td>
</tr>
<tr>
<td>Insulin dose</td>
<td>6.048</td>
<td>&lt;0.0001*</td>
<td>2.473</td>
<td>0.020*</td>
<td>2.734</td>
<td>0.011*</td>
</tr>
<tr>
<td>BMI</td>
<td>5.016</td>
<td>&lt;0.0001*</td>
<td>-0.984</td>
<td>0.333</td>
<td>1.960</td>
<td>0.060</td>
</tr>
<tr>
<td>Albumin/creatinine ratio</td>
<td>2.898</td>
<td>0.007*</td>
<td>2.836</td>
<td>0.008*</td>
<td>2.624</td>
<td>0.014*</td>
</tr>
</tbody>
</table>

Note: *P<0.05 (statistically significant).

Abbreviations: BMI, body mass index; IDDM, insulin dependent diabetes mellitus; HBA<sub>1c</sub>, glycated hemoglobin; SBP, systolic blood pressure; DBP, diastolic blood pressure; MAP, mean arterial pressure.

Table 5 Multiple linear regression analysis for nocturnal dipping

| Parameters                  | Systolic blood pressure |            | Diastolic blood pressure |            | Mean blood pressure |            |
|-----------------------------|                         | T          | P          | T          | P          | T          | P          |
| Age                         | -1.560                  | 0.130      | 0.844      | 0.406      | 0.046      | 0.0963     |
| Sex                         | 0.880                   | 0.372      | -0.356     | 0.725      | 0.031      | 0.975      |
| IDDM duration               | 1.966                   | 0.07       | 1.141      | 0.264      | -1.108     | 0.277      |
| HBA<sub>1c</sub>            | 1.611                   | 0.120      | -0.917     | 0.367      | -1.216     | 0.234      |
| Insulin dose                | 0.830                   | 0.416      | 0.891      | 0.380      | 0.606      | 0.549      |
| BMI                         | 0.067                   | 0.947      | 1.209      | 0.237      | 1.560      | 0.130      |
| Albumin/creatinine ratio    | 2.897                   | 0.007*     | 2.303      | 0.029*     | 2.989      | 0.005*     |

Note: *P<0.05 (statistically significant).

Abbreviations: BMI, body mass index; IDDM, insulin dependent diabetes mellitus; HBA<sub>1c</sub>, glycated hemoglobin.

following-up those patients is an opportunity to make lifelong changes that will likely decrease their risk of developing chronic complications and enable vascular directed preventive intervention at the earliest possible time.

2) Further work is required to see if the BP load could be one of the predictive parameters in ABPM in normotensive T1DM children. While using 24-hour ambulatory BP in this study, systolic BP load had been observed to be higher than 40% in most of the diabetic patients which is considered, in hypertensive adult patients, an early prognostic marker for cardiovascular events.

Acknowledgments

Many thanks to Mr Amer, the medical technician who helped a lot with regard to ABPM device fixation and calibration for proper analysis.

Disclosure

The authors report no conflict of interest in this work.

References


