Indapamide in the Treatment of Hypertension in Non-Insulin-Dependent Diabetes

UMBERTO RAGGI, PAOLA PALUMBO, BIANCA MORO, MAURIZIO BEVILACQUA, AND GUIDO NORBIATO

SUMMARY The antihypertensive effect of indapamide, a new thiazide derivative, has a low diuretic effect and a primary action on vascular smooth muscle. It was evaluated in a series of 20 patients with non-insulin-dependent diabetes (age range 47–75 years) who had arterial hypertension of mild to moderate degree treated with hypoglycemic agents and/or diet. Indapamide, 2.5 mg, was given as a single daily dose for 6 months. A statistically significant reduction of systolic and diastolic pressures was observed in both supine and upright positions. This decrease was significant beginning in the first month of therapy (p < 0.001). No significant modifications of fasting glycemia, postprandial glycemia, and glycosylated hemoglobin were noted. No significant changes were observed in serum sodium, potassium, chloride, calcium, and uric acid. Indapamide is an effective and practical treatment of hypertension of mild to moderate degree in patients with diabetes. The absence of effect on glucose metabolism makes it an especially interesting drug. (Hypertension 7 [Supp II]: II-157-II-160, 1985)

KEY WORDS • blood pressure • glucose metabolism • thiazide diuretics • hypokalemia • diabetes mellitus

It is well recognized that hypertensive patients with diabetes have more than double the frequency of heart disease seen in normotensive diabetic patients1 and that blood pressure control over long periods of time delays or prevents many vascular complications.2 In hypertensive nondiabetic patients the reduction of diastolic pressure under 90 mm Hg reduces morbidity and mortality,3 and there is evidence that the same holds true for hypertensive diabetic persons. It has been shown that early and aggressive treatment of hypertension reduces albuminuria in type I diabetic nephropathy.4

Treatment of hypertension in diabetic patients is generally the same as in nondiabetic patients, and the recommendations reported by the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure pertain equally to both.5 Some modifications may be necessary, however, as first-line hypotensive drugs such as diuretics or beta blockers have side effects that may alter glucose control. The exact mechanism by which thiazide diuretics may worsen glucose tolerance is not completely understood, but postulations include either an inhibition of insulin secretion9 or diminished sensitivity to insulin.7

Moreover, insulin secretion may be decreased by thiazide-induced hypokalemia per se,8,9 with a defect in beta cell responsiveness to glucose stimulus. It is interesting that hypokalemia appears to interfere with the conversion of proinsulin to insulin in the beta cell, so that larger amounts of the less active proinsulin are released in the blood. Correction of thiazide-induced hypokalemia has been shown to improve glucose tolerance.10

The use of beta blockers in hypertensive diabetic patients also poses problems because it seems possible that they may mask an hypoglycemic reaction or prolong the recovery phase from a hypoglycemic episode through suppression of the response of the counterregulatory hormones. Attempts to avoid these untoward effects by using selective beta, blockers such as acebutolol or atenolol have been inconclusive,11 and it has been reported that metoprolol does not change glucose tolerance in hypertensive diabetic patients.12

The search for a better diuretic with milder side effects led to the synthesis of indapamide, a derivative of thiazide-type diuretics in which the introduction of a methyl indoline substituent makes the molecule highly lipophilic, with greater affinity for vascular smooth muscle and a direct prevailing vasodilating effect with respect to the retained diuretic action. The vascular action of indapamide has been clearly documented as inhibition of the vascular response to norepinephrine,
epinephrine, and angiotensin II.\textsuperscript{13-15} A decrease in vascular reactivity has been also demonstrated in vivo in experimental animals\textsuperscript{16} and in humans.\textsuperscript{17} The reduction in vascular reactivity may be due to inhibition of transmembrane calcium influx.\textsuperscript{18}

We evaluated the effects of indapamide in a series of patients with non-insulin-dependent diabetes and mild to moderate hypertension to verify the efficacy of indapamide and its possible side effects, particularly on glucose metabolism.

### Materials and Methods

The 20 ambulatory patients studied (8 men, 12 women; mean age 55.85 ± 7.54 [SD], range 47-75 years) had a diagnosis of non-insulin-dependent diabetes according to specifications of the National Diabetes Data Group.\textsuperscript{19} They were being treated with glibenclamide (5-15 mg/day) or diet alone. They also had arterial hypertension of mild to moderate degree demonstrated by supine diastolic arterial pressure between 95 and 115 mm Hg. None was markedly obese and none had significant renal, hepatic, or neurological diseases.

After a 15-day washout period of all hypotensive drugs given previously, the patients received indapamide, 2.5 mg per day, in a single dose in the morning for 24 weeks. Blood pressure was measured by a standard mercury sphygmomanometer according to the directive of the American Heart Association.\textsuperscript{20} The averages of three supine and three subsequent standing blood pressure readings were recorded. The efficacy of treatment was evaluated monthly in terms of changes in baseline values in both supine and standing systolic and diastolic pressures. Before, during, and after the study period, basal glycemia, 2-hour postprandial glycemia, glycosylated hemoglobin, serum sodium, potassium, chloride, calcium, and uric acid were evaluated. Stable glycosylated hemoglobin was evaluated by a microcolumn method as fast hemoglobins measuring HbA\textsubscript{A1c} (Boehringer, Mannheim, West Germany). Removal of labile glycosylated hemoglobin was obtained by incubating red blood cells for 6 hours at 37 °C in 0.9% saline solution prior to chromatography.\textsuperscript{21} The intraassay and interassay coefficients of variation were 5.8 and 9.8% respectively. Statistical analysis was performed by the paired $t$ test.

### Results

Indapamide 2.5 mg daily for 24 weeks induced a stable reduction of both systolic and diastolic blood pressure values in supine and standing positions in non-insulin-dependent diabetic patients (Figure 1). The antihypertensive effect of indapamide was prompt and statistically significant ($p < 0.001$) after the first month of therapy and persisted for the entire treatment period. Fasting glycemia, 2-hour postprandial glycemia, and glycosylated hemoglobin were not significantly affected during treatment (Figures 2 and 3). Baseline and 6-month values (± SEM) for fasting glycemia (FG), postprandial glycemia (PG), and glycosylated hemoglobin (HbA\textsubscript{1c}) were as follows: FG, 152.33 ± 15.84 and 152.73 ± 9.08 mg/dl, NS; PG, 191.50 ± 19.66 and 202.27 ± 19.22 mg/dl, NS; HbA\textsubscript{1c}, 9.34 ± 0.63 and 8.80 ± 0.49%, NS. Levels of serum sodium, potassium, chloride, calcium, and uric acid were not statistically modified by indapamide (Table 1). The moderate increase of serum uric acid concentration, statistically not significant, did not exceed the values of the upper limit of normal range. No variations of mean body weight were recorded (Table 1). No patient required potassium supplements. No unusual or unexpected adverse reactions were noted except a transient headache and nausea in two patients. No patient discontinued treatment because of adverse reaction or abnormal laboratory values.

### Figures

**Figure 1.** Arterial pressure (AP) before and during treatment with indapamide 2.5 mg/day for 24 weeks. ••• = supine position; •••• = standing position; vertical bars = ± SEM; $* p < 0.001$.

**Figure 2.** Blood glucose (BG) before and during treatment with indapamide 2.5 mg/day for 24 weeks. •••• = fasting blood glucose; ••• = 2-hour postprandial blood glucose; vertical bars = ± SEM; $\Delta$ = not significant.
INDAPAMIDE FOR HYPERTENSION IN NON-INSULIN-DEPENDENT DIABETES/Raggi et al. II-159

No significant modifications of serum sodium, potassium, chloride, calcium, and uric acid were observed in our patients. Many previous works showed that hypokalemia is absent or minimal during treatment with 2.5 mg/day of indapamide.26-28 A dose-dependent increase in natriuresis and kaliuresis was demonstrated by Caruso et al.,29 and occurred also with 2.5 mg/day. The minimal action of indapamide on serum potassium is particularly beneficial in hypertensive diabetic patients in whom hypokalemia may suppress insulin release with subsequent carbohydrate intolerance.

In summary, within the limits of an open study, it seems from our results that indapamide is an effective and safe treatment for hypertension in patients with non-insulin-dependent diabetes, and causes no significant alterations on glucose metabolism. Before definite conclusions can be drawn, however, further controlled studies are necessary to verify the safety of the drug for longer periods of time with respect to glucose control.

References

3. Hypertension Detection and Follow-up Program Cooperative Study. Five-year findings of the Hypertension, Detection and Follow-up Program: reduction in mortality of persons with high blood pressure, including mild hypertension. JAMA 1979;242:2562-2577

Table 1. Laboratory Values Before and During Treatment with Indapamide 2.5 mg/day (mean ± SEM)

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>8th week</th>
<th>16th week</th>
<th>24th week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium (mEq/L)</td>
<td>138.58 ± 0.62</td>
<td>137.67 ± 0.81*</td>
<td>138.00 ± 0.69*</td>
<td>139.55 ± 0.53*</td>
</tr>
<tr>
<td>Potassium (mEq/L)</td>
<td>4.05 ± 0.09</td>
<td>4.14 ± 0.12*</td>
<td>4.23 ± 0.15*</td>
<td>4.32 ± 0.16*</td>
</tr>
<tr>
<td>Chloride (mEq/L)</td>
<td>98.42 ± 0.71</td>
<td>98.83 ± 0.58*</td>
<td>100.64 ± 0.98*</td>
<td>98.64 ± 0.69*</td>
</tr>
<tr>
<td>Calcium (mg/100 ml)</td>
<td>9.49 ± 0.12</td>
<td>9.59 ± 0.14*</td>
<td>9.71 ± 0.14*</td>
<td>9.71 ± 0.14*</td>
</tr>
<tr>
<td>Uric acid (mg/100 ml)</td>
<td>4.60 ± 0.61</td>
<td>5.06 ± 0.55*</td>
<td>5.40 ± 0.46*</td>
<td>5.57 ± 0.52*</td>
</tr>
<tr>
<td>Body weight (kg)</td>
<td>69.05 ± 7.50</td>
<td>68.50 ± 7.32*</td>
<td>68.35 ± 7.05*</td>
<td>68.41 ± 6.98*</td>
</tr>
</tbody>
</table>

* Not significant.
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