AYURVEDA FOR DIABETES MELLITUS: A REVIEW
OF THE BIOMEDICAL LITERATURE

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Diabetes mellitus is a condition that is extremely serious from both clinical and public health standpoints. The traditional healthcare system of India, Ayurveda, offers a balanced and holistic multi-modality approach to treating this disorder. Many Ayurvedic modalities have been subjected to empirical scientific evaluation, but most such research has been done in India, receiving little attention in North America. This paper offers a review of the English language literature related to Ayurveda and diabetes care, encompassing herbs, diet, yoga, and meditation as modalities that are accessible and acceptable to Western clinicians and patients. There is a considerable amount of data from both animal and human trials suggesting efficacy of Ayurvedic interventions in managing diabetes. However, the reported human trials generally fall short of contemporary methodological standards. More research is needed in the area of Ayurvedic treatment of diabetes, assessing both whole practice and individual modalities. This work was supported in part by the Oregon Center for Complementary and Alternative Medicine, Kaiser Permanente Center for Health Research (Altern Ther Health Med. 2003;10(1):44-50)

Diabetes mellitus is a condition that is extremely serious from both clinical and public health standpoints. The hallmark of the condition is hyperglycemia, caused by varying degrees of insulin deficiency, peripheral insulin resistance, or both. The seriousness of the disease stems from its potential for long term cardiovascular, neurological, ocular, renal, and other sequelae. There are two main types of diabetes mellitus, referred to as type 1 and type 2 disease. Patients with type 1 diabetes mellitus have insulin deficiency, requiring therapy with subcutaneous insulin injections. Many patients with type 2 diabetes mellitus also require oral medications or subcutaneous insulin, in addition to exercise and dietary measures.

While standard allopathic modalities alone can be effective in managing diabetes mellitus, the success of such therapy is sometimes limited. Brown, analyzing 10 years of electronic medical record data from the Kaiser Permanente Northwest diabetes registry, found that secondary failure of sulfonylurea therapy begins within one year of diagnosis and continues at a steady pace, with almost 80% of patients initially treated with sulfonylureas adding or switching to metformin or insulin within 10 year of diagnosis. The study also found that 5-10% of persons with type 2 diabetes mellitus avoid contact with the medical care system altogether.

While the reasons for treatment failure and non-compliance are not clear, it is reasonable to speculate that the addition of complementary interventions could have a favorable impact on these phenomena. First, many of the allopathic treatments have toxicities and side effects. Metformin is frequently poorly tolerated due to its gastrointestinal toxicities, while sulfonylureas and insulin can cause hypoglycemia. A holistic approach, if shown effective, could prove safer and better tolerated. Moreover, the administration of insulin is perceived as unpleasant by many patients. Compliance might improve if natural remedies could be shown to postpone, reduce, or eliminate dependence upon exogenous insulin injections. In addition, fear of insulin therapy may lead some patients to avoid the healthcare system. For such patients, natural remedies might be perceived as less threatening. Finally, because many complementary approaches operate from a holistic level, their application could contribute not only to improved glycemic control, but also to improvements in blood pressure, lipid control, and other factors associated with chronic morbidity in diabetes.

Indeed, complementary and alternative medicine (CAM) applications for diabetes mellitus are receiving increased attention within the mainstream medical community, with related reviews appearing in the biomedical literature, and CAM-related abstracts appearing at professional meetings. Integrated CAM/conventional practice patterns are likewise receiving heightened scrutiny. In one study, Sabo distributed a questionnaire regarding alternative medicine practices to 2,850 members of the American Association of Diabetes Educators, receiving 820 responses. The authors reported that 63% of diabetes educators were recommending some type of alternative therapies to their patients. Interestingly, the data indicated that certified diabetes educators were more likely to recommend alternative therapies than non-certified educators.
THE AYURVEDIC PARADIGM

Ayurveda, the traditional healthcare system of India, offers a persuasive model for CAM integration in view of its long history of use, its compatibility with concurrent allopathic interventions, and the substantial scientific literature validating its modalities. The name Ayurveda derives from the Sanskrit meaning “Knowledge of Life-Span.” From the standpoint of Ayurveda, health is seen as a state of balance, and disease as an imbalance, of 3 fundamental metabolic principles, called doshas. These are known as vata, pitta, and kapha. Vata governs all movement in the mind and body; it is dry, light, quick, and evasive. Pitta governs all digestion and metabolism in the mind and body; it is hot, sharp, and intense. Kapha governs the physical structure of the mind and body; it is heavy, sweet, slow, and dull. Aggravation of one or more of these doshas leads to imbalances that may turn lead to disease. Ayurveda also emphasizes the importance of maintaining excellent digestion, or agni. Weak agni can lead to accumulation of digestive toxins, called ama. This ama then gets deposited in the tissues, or dhatu. Deposition of ama provides home for the localization of the aggravated dosha, leading to disease manifestation.

According to Ayurveda there are 20 types of prameha, or polyuria. Madunecaha, or “honey urine,” is the Ayurvedic diagnosis that approximates the diabetes mellitus label, representing a subgroup of prameha. In the early stages the disease is kapha predominant, with polyuria and aggravation of meda (fat) dhatu. With progression of madunecaha, pitta and then vata doshas become aggravated, with the disease being more difficult to cure at this later stage. Causes of madunecaha include familial predisposition, physical inactivity, and both mental and environmental stress. Dietary habits related to vata dosha, such as irregular meal times, and too much sweet, sour, and salty foods, also play an important etiologic role.

The Ayurvedic treatment for this condition consists of a holistic approach encompassing dietary, behavioral, herbal, and other modalities. Many of these modalities have been subjected to scientific evaluation, but most of this research has been done in India, receiving little attention in North America. This paper offers a review of the English language literature, encompassing herbs, diet, yoga, and meditation as modalities that are accessible and acceptable to Westerners. Articles were given consideration where there was some parameter of glycemic control included as an outcome measure.

HERBAL SUPPLEMENTS

There are dozens of plants that have been proposed for use as anti-diabetic agents within the Ayurvedic materia medica, with many of these have been the subject of modern scientific scrutiny in both animal and human models. The human trials generally fail short of contemporary methodological standards, with only one trial describing randomization, placebo intervention, and blinding. On the other hand, the scientific literature from Asia on this subject is vast, spanning back many decades, and along with voluminous anecdotal evidence gained from centuries of clinical use, provides important information and background for clinicians and investigators.

GYMNEMA SYLVESTRE

Among the herbs, gymnema sylvestre has received perhaps the most scientific attention, having been the subject of biological investigation for over a century. Chewing the leaves of the plant is known to deaden sweet taste sensation; the herb has therefore been given the name “ger-mar” meaning “sugar-destroying.” There are several human studies in the literature related to Gymnema. Shankugusundaram and colleagues evaluated gymnema sylvestre leaf extract in 27 patients with type 1 diabetes mellitus, for the experimental group. A water-soluble extract of the leaf was administered in doses of 400mg/day, in addition to daily insulin therapy. These patients were compared to 37 controls receiving insulin therapy alone. Outcome measures included serum glucose, urine glucose, c-peptide levels, and glycosylated hemoglobin. There was no mention of randomization, blinding, or placebo intervention, and there were 11 dropouts in the first 6 months in the experimental group. Inspection of the data suggests improvement in the gymnema group, with mean glycohemoglobin decreasing from 12.8% to 9.5% at 6-8 months and 9.0% at 16-18 months, compared with a decrease from 12.7% at baseline to 11.8% at 10-12 months in the control group. However, the authors did not provide a statistical comparison of these results. It was noted by the authors that insulin doses had to be reduced in every patient in the gymnema group. C-peptide levels were not drawn at baseline, but after therapy were significantly higher in the gymnema versus the control group, suggesting enhanced endogenous insulin availability with the herb. Patients reported no adverse reactions to the gymnema.

Another paper by the same group assessed gymnema sylvestre for type 2 diabetes. Four hundred mg/day of extract was administered to 22 type 2 diabetic patients in addition to conventional therapy, and 25 type 2 diabetic patients received conventional therapy alone. Again, there was no mention of randomization, blinding, or placebo intervention. The authors noted that virtually all patients in the experimental group required dose reductions in their sulfonylurea therapy. Mean fasting glucose in the gymnema group fell from 174mg/dL at baseline to 124mg/dL at 18-20 months, and glycohemoglobin fell from 11.9% to 8.5% over the same period. Total cholesterol dropped from 260mg/dL to 231mg/dL, and serum triglycerides fell from 170mg/dL to 142mg/dL. The same parameters in the control group actually increased; however, there was no statistical analysis comparing the two groups. Results for the gymnema group at 18-20 months were both clinically and statistically significant compared to the gymnema group at baseline. Similar findings were reported by Khare.

There are also numerous animal studies in the literature investigating the potential effects of gymnema sylvestre as an anti-diabetic and anti-hyperglycemic agent. For example, Sugihara investigated the anti-hyperglycemic action in streptozotocin (STZ) diabetic mice of several triterpene glycosides derived from
the methanol extract of leaves of gymnema sylvestre. He found that gynemenic acid IV at doses of 3.4-13.4mg/kg reduced blood glucose levels 15-30% 6 hours after administration, comparable in potency to glibenclamide. The same extract in a dose of 13.5mg/kg likewise increased plasma insulin levels in STZ-induced diabetic mice. Though there have been some negative studies, most authors have reported similar findings.

Various potential modes of action for the anti-hyperglycemic activity of the herb have been probed in animal models, including stimulation of insulin release, possibly via increased pancreatic beta cell permeability. Evidence suggesting suppression of intestinal glucose absorption has also been reported. Several investigators have attempted to identify and isolate the active ingredients in the plant, with at least 20 different types of gynemene acids and gymnepasaponins having been purified from the herb and chemically characterized. As sweet taste inhibition remains among the herb's more intriguing properties, the mechanism of this phenomenon has been extensively evaluated, as reviewed by Suttisri. Non-competitive binding at the level of gymnema sensitive taste receptors has been suggested as a model.

**PHYLANTHUS AMARUS**

Srividya studied the diuretic, hypotensive, and hypoglycemic effects of Phyllanthus amarus (syn. Phyllanthus niruri) in human subjects. Nine mild hypertensives (4 of whom also suffered from diabetes mellitus) were treated with a preparation of the whole plant of P. amarus for 10 days. Suitable parameters were studied in the blood and urine samples of the subjects, along with physiological profile and dietary pattern before and after the treatment period. Mean serum glucose decreased from 126mg/dl to 106mg/dl in the experimental group. This was a statistically significant change. There was a control group of patients for whom baseline data were reported, but there was no randomization, and there were no follow-up data reported for the control group. Clinical observations revealed no harmful side effects. The authors concluded that P. amarus may be a potential hypoglycemic drug for humans.

Sharma and colleagues studied MA 471, a dietary supplement in tablet form of the herbs Phyllanthus amarus, Arjuna myrobalan, Eucosmisum littorale, Bael fruit, Neem, Bitter gourd, and Blackberry. This was an observational study of 41 human patients with type 2 diabetes mellitus, who clinically comprised 3 groups. Group A consisted of 9 previously untreated patients who were treated with MA 471 alone. Group B consisted of 23 patients previously on oral hypoglycemic agents who were switched to MA 471. Group C consisted of 9 patients previously uncontrolled on oral agents who received the MA 471 in addition to their medication. There was no comparison group. Seventy-one percent of the patients achieved good acceptable control within 3 months. This level of control was achieved in 7/9 patients in group A, 15/23 patients in group B, and 7/9 patients in group C. MA 471 was more effective in patients having disease less than 5 years. Significant declines in glycohemoglobin levels and serum lipids were noted at 6 months. Subjects also reported improved vitality and well-being. The only adverse effect noted was softening of the stools.

While most animal studies of Phyllanthus amarus have focused on its hepatoprotective effects, some authors have reported hypoglycemic activity. In all, there are approximately 18 plants used as anti-diabetic agents within the Ayurvedic materia medica for which there is scientific support in the modern biomedical literature. That literature is summarized in Table 1. Human trials are in italics.

**DIET**

Dietary measures remain a mainstay of therapy for diabetic patients receiving conventional therapy. As in the allopathic model, Ayurveda similarly prescribes that patients with madhumeha reduce or avoid sweet and heavy foods. In addition, however, the Ayurvedic approach advises that diabetics favor bitter, pungent, and astringent tastes, and the addition to the diet of specific fruits, vegetables, and spices, such as bitter gourd, asparagus, spinach, turmeric, fenugreek seeds, black pepper, and ginger, is routinely recommended. This remains a clinically intriguing topic, as it would very useful to know whether the routine addition to the diet of certain foods and spices might treat the disease.
<table>
<thead>
<tr>
<th>Latin</th>
<th>Alternate Name(s)</th>
<th>Model</th>
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<th>Comments</th>
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<tr>
<td><em>Acacia species</em></td>
<td></td>
<td>Animal</td>
<td>Wadood <em>Singh</em></td>
<td>Hypoglycemic effect demonstrated in both rabbits and albino rats.</td>
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<tr>
<td><em>Azadirachta Indica</em></td>
<td>Neem</td>
<td>Animal</td>
<td>Khosla <em>Chattopadhyay</em></td>
<td>Animal data suggests the herb may be useful for both treating and preventing diabetes. There are case reports, however, of adverse events as a consequence of toxic ingestion of neem extracts in humans.</td>
</tr>
<tr>
<td><em>Bombax Ceiba</em></td>
<td>Semul</td>
<td>Animal</td>
<td>Saleem*</td>
<td>Extract showed significant hypoglycemic activity in rats.</td>
</tr>
<tr>
<td><em>Cocculus Indica</em></td>
<td>Cephalandra Indica</td>
<td>Human and animal</td>
<td>Ramble* Azad-Khan* Hossain* Shabib* Singh* Chandrasekar*</td>
<td>Azad-Khan's randomized controlled trial suggests significant improvement in glucose tolerance. Mechanism of action may involve repression of glucose 6 phosphatase.</td>
</tr>
<tr>
<td><em>Emblica Officinalis</em></td>
<td>Indian Gooseberry</td>
<td>Human</td>
<td>Manjunatha*</td>
<td>In a small clinical trial, Chyawanprash, of which Amalaki is a major constituent, reduced post-prandial glycaemia to a significantly greater extent than vitamin C.</td>
</tr>
<tr>
<td><em>Eugenia jambolana</em></td>
<td>Black plum</td>
<td>Animal</td>
<td>Achrekar*</td>
<td>Hypoglycemic activity demonstrated in experimental rats.</td>
</tr>
<tr>
<td><em>Ficus Benghalensis</em></td>
<td>Indian Banyan tree</td>
<td>Animal</td>
<td>Augest* Kumar* Cherian* Geetha* Cherian* Achrekar* Kurnar* Kurnar*</td>
<td>Numerous animal studies have shown significant hypoglycemic activity, with the mechanism of action postulated as stimulation of insulin secretion.</td>
</tr>
<tr>
<td><em>Galega Officinalis</em></td>
<td>Purple Tephrosia</td>
<td>Animal</td>
<td>Füllit*</td>
<td>Caused reductions in both weight and serum glucose in experimental mice.</td>
</tr>
<tr>
<td><em>Gymnema Sylvestre</em></td>
<td>Gurrar</td>
<td>Human and animal</td>
<td>Sattar* Ganesh* Khan* Sugihara* Okayama* Hatsuyama* Noguchi* Dogar* Srivastava* Chattopadhyay* Persaud* Siddiqui* Siddiqui* Suttisiri* Fletcher* Yoshikawa* Ninomiya*</td>
<td>Numerous studies in animal models, but human trials are of limited quality (see text).</td>
</tr>
<tr>
<td><em>Mangifera indica</em></td>
<td>Mango</td>
<td>Animal</td>
<td>Aderibige*</td>
<td>Shown in diabetic rabbits to block the reduction in peripheral utilization of glucose and glycogenolysis effect induced by epinephrine.</td>
</tr>
<tr>
<td><em>Morus indica</em></td>
<td>Bitter Gourd, Karela</td>
<td>Human and animal</td>
<td>Platel* Srivastava* Leatherdale* Platel* Khauna* Kohli* Sitawad* Karunanayake* Vikrant* Calaki* William*</td>
<td>See text.</td>
</tr>
<tr>
<td><em>Musa Spathacea</em></td>
<td>Banana</td>
<td>Human and animal</td>
<td>Lintas* Pari* Pari* Alaron-Aguilara*</td>
<td>See text.</td>
</tr>
<tr>
<td><em>Phyllanthus Amarus</em></td>
<td>Phyllanthus Niruri</td>
<td>Human and animal</td>
<td>Srivastava* Sharma* Ramakrishnan*</td>
<td>See text.</td>
</tr>
<tr>
<td><em>Psidium Guajava</em></td>
<td>Guava</td>
<td>Human and animal</td>
<td>Cheng*</td>
<td>See text.</td>
</tr>
<tr>
<td><em>Pterocarpus Marsupium</em></td>
<td>Vijayasar</td>
<td>Human and animal</td>
<td>KMC* Manickham* Ahmad* Ahmad*</td>
<td>See text.</td>
</tr>
<tr>
<td><em>Tinospora Cordifolia</em></td>
<td>Gachhali</td>
<td>Animal</td>
<td>Stanley* Stamey* Wadood* Grover*</td>
<td>Hypoglycemic effect demonstrated in several animal trials.</td>
</tr>
<tr>
<td><em>Trigonella Foenum-graecum</em></td>
<td>Fenugreek</td>
<td>Human and animal</td>
<td>Puri Khosla* Sharma* 1990 Makor* Ribe*</td>
<td>In an observational study, Madar found that plasma glucose levels were significantly lower at 30, 60, and 120 minutes after a fenugreek meal, compared with the same meal without fenugreek.</td>
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<tr>
<td><em>Withania Somnifera</em></td>
<td>Winter Cherry</td>
<td>Human and animal</td>
<td>Andalla* Bhattacharya*</td>
<td>Hypoglycemic effect comparable to oral agents in one small human trial.</td>
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</table>
MOMORDICA CHARANTIA
Momordica Charantia, also known as karela, or bitter gourd, has received considerable attention in the literature. This is a climbing plant cultivated most everywhere in India, and is a commonly consumed vegetable that is widely recommended in Ayurveda for its anti-diabetic properties. William studied in human subjects blood glucose levels and the corresponding insulin levels in response to three vegetables in common use in India; bitter gourd, curry leaves, and drumstick. There were 8 patients in the bitter gourd group, 7 in the curry leaves group, and 6 in the drumstick group. There was no comparison group, with subjects serving as their own controls. Three interventions were tested: 75g of glucose, a standard meal, and a standard meal with one of the 3 vegetables in question having been added. For both bitter gourd and drumstick groups serum glucose levels were better with the addition of the vegetable, compared with the standard meal. However, this difference was statistically significant only for the drumstick group. Srivastava studied the dried powder of bitter gourd administered to 5 patients for 3 weeks and saw clinically significant declines in the post-prandial blood sugars on the order of 25%, but this result, given the small sample size, was not statistically significant. However, when an aqueous extract from the plant was administered over 7 weeks to another 7 patients, the post-prandial blood sugars fell 54%, a statistically significant drop. Leatherdale studied glucose tolerance related to bitter gourd consumption in 9 patients with type 2 DM. Patients underwent 3 glucose tolerance tests: a standard test, a test with 50cc of bitter gourd juice, and a test after 8-11 weeks of fried bitter gourd ingestion. Bitter gourd juice reduced both the plasma glucose concentration and the area under the mean incremental glucose curves. These improvements were statistically significant. Smaller, but also significant, changes were seen in the group taking the fried bitter gourd as well. Serum insulin levels were not increased with bitter gourd, suggesting an extra-pancreatic effect. Patel likewise studied bitter gourd in 10 diabetic patients and noted improvements on glucose tolerance testing which were not statistically significant. The herb was administered in different forms to different patients, making interpretation of these data more difficult. Khanna isolated a substance he called polyepoxide p from the fruit of the plant, with a molecular weight of approximately 11,000, which showed significant hypoglycemic effect when administered to human diabetic subjects subcutaneously. Kohli studied karmin, a multi-ingredient Ayurvedic anti-diabetic formulation of which bitter gourd is a major ingredient, in patients with type 2 diabetes mellitus. Although there was a high dropout rate, and no placebo control, the results suggested dramatic reductions of blood glucose levels with the supplement.

There are also numerous animal studies of momordica charantia. Sitasawad found that feeding mice with bitter gourd fruit juice caused reduction in STZ-induced hyperglycemia, with other authors reporting similar findings.

In addition to bitter gourd, the consumption of several other and fruits has also been evaluated. Guava (Psidium guava) is a plentiful fruit used in diabetes mellitus in both the Ayurveda and Chinese traditions. Cheng et al. studied the effect of guava juice administered to experimental mice and to human subjects. Guava juice was shown to have a statistically significant hypoglycemic effect in both normal and alloxan diabetic mice. In 14 normal human volunteers, oral administration of guava juice 1g/kg resulted in a lowering effect on fasting glucose levels. In three diabetic patients, the same dosage decreased mean fasting sugars from 214mg/dl to 165mg/dl. There was no randomization, control group, or placebo intervention. Banana (Musa sapientum) in unripe form is held in the Ayurvedic materia medica to be of benefit for diabetes mellitus. Lintas studied glycemic responses to banana in 6 normal patients as well as 6 type 2 diabetics in good control. Bananas were ingested just prior to ripening, and then, a week later, fully ripe bananas were ingested. Plasma glucose and insulin responses to the banana were significantly higher for the ripened as opposed to the unripe fruits. Analysis revealed that, as an effect of ripening, an increase in monoaccharide and disaccharide content from 11.7% to 16.3% was observed in the fruits. The authors concluded that ripening, but not fully ripe, bananas might be appropriate for diabetics to include in their diets. In an animal trial, Pari administered doses of 0.15, 0.20 and 0.25g/kg body weight of the chlorofrom extract of the banana flower for 30 days to rats, showing a significant reduction in blood glucose and glycosylated hemoglobin. Other authors have drawn similar conclusions.

MEDITATION AND YOGA
Ayurveda prescribes regular practice of both yoga asanas and meditation as means to reduce stress and to restore and maintain physiologic balance. Though of limited quality, there are several studies on this topic that have appeared in the diabetes literature.

Salay reported on a series of small human trials his group performed to assess the impact of various yoga interventions for diabetes mellitus. In one trial, 35 diabetic patients were evaluated for the effect of pranayama, a rhythmic breathing exercise. The author reported a significant fall in the fasting and post lunch blood sugar values and a reduction in the dosage of oral drugs and insulin in 17 subjects, though no numeric data were published. The same author also reported on the impact of yoga asana practice on diabetes control. Four different sets of yoga asanas were taught, with 5 or 6 patients assigned to each group. There was no randomization and no control group. The study revealed that patients practicing dishanurasana and ardha masyendrasana showed significant improvements in fasting blood sugar, from a mean of 161mg/dl to a mean of 122mg/dl. The practice of halasana, vajrasana, nukadana, and bhujanganasana also appeared to be helpful, whereas yoga mudra and salabhasana practice appeared to worsen fasting glucose values. No information was provided regarding compliance or duration of treatment. The authors suggested reduced stress and increased personal discipline as possible mechanisms of the hypoglycemic effect.

In another paper, Divakar reported on a yoga intervention in both diabetic and obese patients. Sixty-seven diabetic patients...
were recruited, of whom 83 attended instruction regularly. Patients were trained in a graded course including 8 asanas. There was no control group. Descriptive statistics only were provided. Post-prandial blood glucose fell to less than or equal to 200 mg/dl in all 52 subjects. Eighteen patients required reductions in insulin therapy, and 20 required reductions in oral therapy. In terms of mechanism, the authors speculated that there may be a direct stimulatory effect of abdominal muscular contraction and relaxation on the pancreas, liver, and bowels, through increased circulation.

Jain reported on changes in blood glucose and glucose tolerance testing after 40 days of yoga therapy in 149 type 2 diabetic patients. There was no control or comparison group. Patients were recruited through outpatient clinics and admitted to the institute's hospital for 40 days of therapy. The intervention consisted of a program of 10 yoga positions. In addition, patients were fed a controlled diet, were instructed in pranayama breathing exercises, and were treated with a cleansing protocol. Patients were categorized as having had a good response to therapy, fair response, or poor response, based upon the maximum glucose level, area under the glucose tolerance curve, and whether or not the patient was able to decrease hypoglycemic drug requirements. Seventy-six patients had a good response to therapy, while 28 showed a fair response, and 45 a poor response.

The role of psychosocial stress in aggravating poor diabetic control is well accepted. While there have been some reports related to the impact of biofeedback on glycemic control, there is little such data in the area of meditation. In one study, Maras evaluated the impact of meditation instruction in 8 type 1 diabetics. There was no randomization and no control intervention. Patients received instruction in a variety of meditation systems and were to choose the approach that they felt most comfortable with. There were no changes in glycomic indices noted with the intervention, though patients did report an improved sense of well-being.

The Transcendental Meditation (TM) technique is a popular meditation program originating from the Vedic tradition that has undergone considerable scientific scrutiny in the North American biomedical literature. There are no published data related to the TM technique in managing hyperglycemia in diabetics. However, numerous studies have documented the effect of the program in favorably modifying hypertension, arteriosclerosis, angina, and other cardiovascular risk factors. Because diabetic patients suffer a high incidence of cardiovascular disease, the TM program may thus be of use in reducing overall cardiovascular risk in these patients.

SUMMARY AND CONCLUSIONS

Ayurveda has a long tradition of practice and yet, despite increasing popular demand for integrated conventional and complementary care, many clinicians remain hesitant to recommend Ayurveda interventions. This reluctance may stem not only from concern related to the safety of herbal supplements but also from a lack of familiarity with both the theoretical and empirical justification for Ayurveda modalities. While most of the human trials published in the area of Ayurveda interventions for diabetes mellitus are of limited quality, there is a considerable amount of data and clinical experience suggesting a possible role for this system as an adjunct to conventional diabetes mellitus care. More clinical trials are needed in the area of Ayurveda treatment of diabetes mellitus, assessing both whole practice and individual modalities.

References
