

Prameha in Ayurveda: Correlation with Obesity, Metabolic Syndrome, and Diabetes Mellitus. Part 2—Management of *Prameha*

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Abstract

Background: Obesity, metabolic syndrome, and diabetes mellitus are increasing to epidemic proportions globally. *Prameha* is a syndrome described in the ancient *Ayurvedic* texts that includes clinical conditions involved in obesity, prediabetes, diabetes mellitus, and metabolic syndrome.

Materials and methods: Various dietary, lifestyle, and psychologic factors are involved in the etiology of *Prameha*, particularly in relation to disturbances in fat and carbohydrate metabolism.

Results: The Ayurvedic management of *Prameha* emphasizes dietary and lifestyle recommendations and herbal preparations, in accordance with the psychophysiologic constitution of the patient. *Ayurveda* also addresses the management of psychologic factors that contribute to the development of *Prameha*. Ayurvedic treatment known as *Apatarpana* (balanced diet with restricted calories) and *Santarpana* (highly nutritious, high-calorie diet intended to increase weight) are recommended for patients with type 2 and type 1 diabetes, respectively. Various Ayurvedic herbs and herbomineral formulations are utilized, based on the stage and type of disease as well as the psychophysiologic constitution of the patient. A large body of research has been conducted on these Ayurvedic herbs.

Conclusions: Integrating the theory and modalities of *Ayurveda* in the management of these disorders may prove to be beneficial.

Introduction

OBESITY, METABOLIC SYNDROME, and diabetes mellitus are increasing to epidemic proportions globally. *Ayurveda* describes a set of complex clinical disorders with frequent abnormal micturition, collectively called *Prameha*, which correlate in many ways with obesity, metabolic syndrome, and diabetes mellitus. Integrating the theory and modalities of *Ayurveda* in the management of these disorders may prove to be beneficial and has been discussed previously.¹ Elaboration of the etiology, classification, and pathogenesis of *Prameha* has also been discussed previously.² The current discussion centers on the management of *Prameha*.

Management of *Prameha*

Avoiding etiological factors and halting the progression of pathophysiologic events are the main objectives for the management of any disease. The management of *Prameha* depends on multiple aspects such as the psychophysiologic constitution of the patient and the specific etiopathology.³ If the patient is physically strong and suffers with *Apathyani-*

mittaja (acquired) *Prameha*, *Samshodhana* (biopurification) is considered the ideal option. For physically weak patients, *Samshamana* (pacification of the *Doshas*) is recommended. *Samshamana* is also utilized after biopurification in those patients who undergo *Samshodhana*. The measures used for *Sthaulya* (obesity) can be utilized for the management of *Prameha*,⁴ such as *Apatarpana* (balanced diet with restricted calories). Measures that minimize the morbid *Kapha* and *Meda* (fat) will improve the health of the patient. The foods recommended for *Prameha* in the classical Ayurvedic texts should be included in the patient's diet. Balanced nutrition, appropriate physical exercise, and administration of herbal supplements will help to manage *Prameha*.

The dietary regimen and lifestyle management recommendations mainly address the *Doshic* dominance of the disease, as they should be more catabolic in nature for the patients with *Kaphaja Prameha* (*Prameha* in which *Kapha* is the predominant *Dosha*), and more anabolic in nature for those with *Vataja Prameha* (*Prameha* in which *Vata* is the predominant *Dosha*). Both *Charaka Samhita* and *Sushruta Samhita* have recommended anabolic treatments, known as

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Santarpana and *Brimhana*, for patients with *Vataja Prameha*.^{4,5} *Santarpana* refers to a highly nutritious, high-calorie diet intended to increase weight, and *Brimhana* likewise refers to increasing the body bulk or weight.

Dietary management

Ayurveda considers diet to be one of the primary pillars of health. Food is an imperative internal factor that accounts for health as well as disease. As Hippocrates said 2000 years ago, "Let food be your medicine and medicine be your food."⁶ The proper diet imparts physical strength and helps diminish the morbidity of the *Doshas*, thereby maintaining equilibrium of the bodily tissues. Eating a proper diet is a key step in preventing and controlling *Apathyanimittaja* (acquired) *Prameha*. The role of *Ashta Aahara Vidhivishesha*³ and *Aayatana Aahara Vidhividhana*³ (dietetic regulations) has primary importance among the multiple preventive aspects of *Prameha*.

"What you eat." The prime aspect of the dietetic regulations can be referred to as "what you eat." Patients with *Prameha* must eat a diet that pacifies the disease. The best foods to eat are those that are not sweet, not too oily, have the ability to mitigate *Kapha* and *Meda*, and are nourishing. Foods and drinks that are sweet in taste, such as dairy products, *Ikshu* (sugar cane), sugar products, foods with *Guru* (heavy) quality and *Sheeta* (cold) quality (such as ice cream), *Madya* (alcoholic beverages and wines), and so on should be avoided since they further provoke *Kapha* and *Meda*.

In the diet, first and foremost importance should be given to *Yava* (barley).³ A preparation called *Apupa* (a type of cake) made with barley can be eaten. Research shows the consumption of barley kernels and products made from barley flour enriched with β -glucan improves glucose tolerance, reduces insulin responses, and lowers inflammatory markers.⁷⁻¹⁰ Preparation of food from barley grain soaked overnight in a decoction of *Triphala* [an herbal mixture comprised of *Phyllanthus emblica* Linn., *Terminalia bellirica* (Gaertn.) Roxb., and *Terminalia chebula* (Gaertn.) Retz.] helps mitigate *Prameha*. Research on *Triphala* and the herbs that comprise it has shown beneficial antidiabetic effects. In a study on rats with alloxan-induced diabetes, *Triphala* reduced the blood glucose level significantly. It also scavenged hydroxyl and superoxide radicals *in vitro* and inhibited lipid peroxide formation.¹¹ Keeping lipid levels and their oxidation in check is an important aspect in the management of obesity, metabolic syndrome, and diabetes. Research on *Amalaki* (*Amla*; *Phyllanthus emblica*; also known as *Emblica officinalis* Gaertn.) shows that it has antidiabetic, hypolipidemic, and antioxidant properties.¹² *Amla* reduced lipid peroxidation and strongly inhibited production of advanced glycosylated endproducts in rats with streptozotocin-induced diabetes.¹³ In aging rats, *Amla* prevented dyslipidemia and oxidative stress.¹⁴ *Terminalia belerica* reduced alloxan-induced hyperglycemia by 50% in rats and significantly decreased oxidative stress.¹⁵ In a study on experimental myocardial injury induced by isoproterenol, pretreatment with *T. chebula* extract decreased lipid peroxide formation and ameliorated the effect of isoproterenol on myocardial marker enzymes, indicating a reduction in myocardial necrosis.¹⁶

In addition to barley, preparing food from the seeds of *Venu* (bamboo) and *Godhooma* (wheat) soaked overnight in a decoction of *Triphala* may also be beneficial for *Prameha*. Studies conducted on extracts of bamboo (*Bambusa dendrocalamus*) have demonstrated hypoglycemic effects in alloxan-induced diabetes in rabbits¹⁷ and rats.¹⁸ With regard to wheat, foods with a low glycemic index and foods rich in whole grain are associated with a reduced risk of metabolic syndrome, type 2 diabetes, and cardiovascular disease.¹⁹⁻²¹ A possible mechanism relates to the colonic metabolism of indigestible carbohydrates, with a link between gut microbial metabolism and key factors associated with insulin resistance.^{7,8}

An abundance of research has been conducted on the health-promoting properties of spices, including antidiabetic, antioxidant, and lipid-lowering properties.²²⁻²⁵ Turmeric (*Curcuma longa* Linn.) and curcumin, the pigment that gives turmeric its orange-yellow color, have been extensively researched in relation to diabetes. More than 35 years ago, it was shown that curcumin can modulate blood glucose levels in patients with diabetes.²⁶ Current research has shown that turmeric extracts suppress blood glucose levels in mice with type 2 diabetes,²⁷ prevent lipid peroxidation and aortic fatty streak formation in rabbits,²⁸ and increase high-density lipoprotein (HDL) cholesterol.²⁹ Curcumin significantly decreases blood cholesterol and triglycerides in rats with streptozotocin-induced diabetes.³⁰ Tetrahydrocurcumin, an active metabolite of curcumin, significantly reduces blood glucose, increases plasma insulin, and reduces lipid peroxidation, cholesterol, and triglycerides in rats with diabetes.³¹ Curcumin is an effective immunomodulator,³² and it reduces the impact of advanced glycosylated endproducts in diabetes.²⁶ In *Ayurveda*, *Haridra* (turmeric) and *Amalaki* are considered one of the best simple herbal combinations to manage *Prameha*.³ They can be taken in powder form or as part of the diet since *Haridra* is a spice commonly used in the preparation of various dishes and *Amalaki* is a seasonal fruit.

Additional spices with antidiabetic effects include cinnamon, *Jeeraka* (*Cuminum cyminum* Linn., cumin), *Dhanyaka* (*Coriandrum sativum* Linn., coriander), *Shunthi* (*Zingiber officinale* Rosc., ginger), *Methika* (*Trigonella foenum-graecum* Linn., fenugreek), and *Rasona* (*Allium sativum* Linn., garlic). Cinnamon reduces serum glucose, triglycerides, and low-density lipoprotein (LDL) in patients with type 2 diabetes.³³ Cumin reduces levels of blood glucose, glycosylated hemoglobin, plasma cholesterol, and triglycerides in rats with alloxan-induced diabetes. It was more effective in treating diabetes than the drug glibenclamide.³⁴ Coriander significantly decreased lipid peroxide levels and increased the activity of antioxidant enzymes in rats fed a high-fat diet.³⁵ It also significantly decreased levels of total cholesterol and triglycerides, and increased levels of HDL cholesterol.³⁶ Similar pharmacologic actions are seen with ginger. It reduces lipid levels, atherosclerotic lesions, and lipid peroxide levels.³⁷ Fenugreek significantly reduces fasting blood glucose, triglycerides, and very-low-density lipoprotein (VLDL) in patients with type 2 diabetes.³⁸ In a double-blind placebo-controlled study, it improved glycemic control, decreased insulin resistance, decreased serum triglycerides, and increased HDL in patients with type 2 diabetes.³⁹ In a study on patients with type 1 diabetes, fenugreek significantly reduced fasting blood glucose, total cholesterol, LDL, VLDL,

and triglycerides.⁴⁰ In rats with diabetes, it displayed immunomodulatory and neuroprotective actions,⁴¹ reduced oxidative stress,⁴² and showed a significant effect on key carbohydrate metabolic enzymes.⁴³ Garlic lowered fasting blood glucose and serum triglyceride levels in a double-blind placebo-controlled study on patients with type 2 diabetes.⁴⁴ In rats with streptozotocin-induced diabetes, it significantly decreased serum glucose, total cholesterol, and triglycerides. The antidiabetic effect was greater than that of glibenclamide.⁴⁵ Garlic significantly decreased total cholesterol and LDL, and significantly raised HDL, in a randomized, double-blind, placebo-controlled study on male patients with mild hypercholesterolemia.⁴⁶ Similar results were seen in a study on patients with coronary artery disease, in which garlic significantly reduced total serum cholesterol and triglycerides, and significantly increased HDL.⁴⁷

Vegetables that mitigate *Prameha* include *Karavellaka* (*Momordica charantia* Linn.; bitter melon; bitter melon) and *Patola* (*Trichosanthes anguina* Linn.). *M. charantia* administered orally produced a significant hypoglycemic effect in rabbits with alloxan-induced diabetes.⁴⁸ In rats with alloxan-induced diabetes subjected to a chronic sucrose load, *M. charantia* maintained normal glucose levels, reduced triglyceride and LDL levels, and increased HDL levels. It also improved the antioxidant status, as evidenced by low levels of thiobarbituric acid-reactive substances and normal levels of reduced glutathione. Upon termination of the treatment, the rats were under oxidative stress and reverted back to diabetic conditions.⁴⁹ Feeding dried bitter melon powder to rats with streptozotocin-induced diabetes decreased fasting blood glucose by nearly 30%.⁵⁰ An aqueous extract powder reduced fasting blood glucose in rats with diabetes by 48%, an effect comparable to that of glibenclamide.⁵¹ A methanol extract of bitter melon normalized blood glucose, reduced triglycerides and LDL, and increased HDL in rats with diabetes. Discontinuation of the extract resulted in reversion to a diabetic state.⁵² *Ayurveda* advocates using *Tikta Shaka*⁵³ (green leafy vegetables) as a main component of the diet for patients with *Prameha*. Judicious administration of legumes and grains such as *Kodrava* (kodo millet), *Mudga* (green gram, *moong dal*), *Kulatha* (*Macrotyloma uniflorum* Linn., horse gram), *Adhaki Beeja* (pigeon peas, *toor dal*), and so on may be helpful. Oils such as *Sarshapa Taila*⁵⁴ (mustard oil) and *Ingudi* [*Balanites aegyptiaca* (Linn.) Del.] can be used to prevent any further increase in lipid levels.

Ayurveda does not prohibit meat in the diet of *Prameha* patients; however, frying of the meat is not recommended.⁵⁵ *Harina* (venison) and *Shashaka* (rabbit) are the recommended meats for *Prameha* patients. The meat of domesticated animals is not recommended, and this correlates with current research findings. Consumption of red meat and processed meats are associated with an increased risk of diabetes in women.^{55–57} Frequent consumption of processed meat has been associated with an increased risk of diabetes in men.⁵⁸ A systematic review and meta-analysis of studies on red and processed meats concluded that the consumption of processed meats is associated with a higher incidence of coronary heart disease and diabetes mellitus.⁵⁹

Ushnam Asneeyat refers to eating a diet that is warm. This is recommended since it will ease *Kapha*, normalize *Vata*, and stimulate *Pitta* to intensify the power of digestion. However, food that is extremely hot should not be eaten. Leftovers or old food that is reheated should also not be eaten.

Ayurveda recommends the use of *Anupana* (an adjuvant) along with the diet and any herbs that are being utilized. In addition to the action of disease correction, the adjuvant acts as a carrier to transport the therapeutic phytochemicals into the system, and may even act as a catalyst in the interaction of the various phytochemicals. *Sarodaka* and *Kushodaka* are drinks that can be employed in this regard.³ *Sarodaka* is water prepared from *Khadira* [*Acacia catechu* (Linn. f.) Willd.] that has been boiled, then cooled down. *Kushodaka* is water prepared from *Kusha* [*Desmostachya bipinnata* (Linn.) Stapf] that has been boiled, then cooled. These drinks can be taken with meals, with herbs, or whenever the patient feels thirst. They are particularly helpful for obese individuals who are suffering from *Prameha*, since they weaken both *Kapha* and *Meda*. Another recommended drink is called *Raga*. It is usually prepared from small sour fruits such as *Amalaki*, *Kapitha*⁵³ [*Feronia limonia* (Linn.) Swingle], *Jambu* (*Syzygium cumini* (Linn.) Skeels), and so on, along with a modest amount of salt.

“How much you eat.” Another consideration in the dietetic regulations is “how much you eat.” The recommendation in this regard is *Matravat Asneeyat*, which means the food should be eaten in due measure.³ The quantity of food that is appropriate is not the same for everyone. It varies according to the individual’s psychophysiologic constitution and *Agni* (digestive and metabolic process). The ideal amount of food is determined by the individual’s level of satiety. *Guru Aahara* (foods with a heavy quality) should be eaten to half of one’s satiety level, whereas *Laghu Aahara* (foods with a light quality) can be eaten until the individual reaches full satiety.³ With regard to optimal digestion of a meal, one can visualize the stomach as being divided into three parts: One third should be filled with solid food, one third with liquid, and one third should remain empty to allow for the proper movement of the *Doshas* in the digestive process.³ The proper amount of food for the individual will not produce undue pressure on the stomach; will not result in discomfort during activities such as walking, standing, sleeping, talking, and so on; and will satisfy the individual’s hunger and thirst. Eating an excessive amount of food may provoke all the *Doshas*, and eating an insufficient amount will impair the equilibrium of the *Dhatu*s (the fundamental principles that support the various bodily tissues).

“When you eat.” For optimal digestion, it is important to consider “when you eat.” *Jeerne Asneeyat* refers to the recommendation that one should eat only after the previous meal has been fully digested. Untimely ingestion and overeating leads to accumulation of the *Doshas* and overwhelms *Agni* (the digestive power), which contributes to the development of *Apathyanimitaja* (acquired) *Prameha*. Digestion of the previous meal can be ascertained by a feeling of hunger and appropriate evacuation of the bowels and bladder. Following this dietetic recommendation is helpful for keeping the *Doshas* in balance, maintaining an individual’s digestive power, and managing *Prameha*.

Lifestyle management

Ayurveda considers dietary and lifestyle management to be the first line of treatment for *Prameha*. The *Ayurvedic* texts

contain a detailed description of lifestyle management for *Prameha*. *Sushruta Samhita* emphasizes the importance of regular exercise, including brisk walking, jogging, sports, wrestling, fencing, horseback riding, and so on. Patients are advised to avoid laziness and a sedentary lifestyle. It is essential to perform exercise such as walking or jogging to burn extra calories in the body. *Sushruta Samhita* states that if a person follows an active lifestyle, he/she can overcome *Apathyanimittaja* (acquired) *Prameha* within 1 year.⁵ Exercise brings lightness to the body, reduces fat, and improves the ability to work. *Ayurveda* recommends stopping the workout when slight sweating develops on the forehead. The Ayurvedic texts provide a cautionary note about the preservation and maintenance of health for asthenic diabetics (type 1 diabetics) since they are *Vata*-predominant. These patients are not advised to undertake vigorous exercise, as it will further provoke *Vata* and result in a poor prognosis.

Meditation, *Pranayama* (breathing exercises), and *Asanas* (yoga exercises) are beneficial in developing and maintaining a healthy lifestyle.⁶⁰ Research has shown that a comprehensive lifestyle education program that includes these practices reduces risk factors for diabetes mellitus. Subjects with diabetes who participated in the 8-day lifestyle modification program had significantly lower fasting plasma glucose, serum total cholesterol, LDL, VLDL, and total triglycerides, and significantly higher HDL, on the last day of the course compared to the first day of the course.⁶¹ Several studies conducted on patients with type 2 diabetes demonstrated the beneficial effect of a 40-day program of specific *Asanas* (Yoga exercises). There was a significant decrease in fasting blood glucose levels. A significant decrease in waist-hip ratio and changes in insulin levels were also noted, suggesting a positive effect of Yoga *Asanas* on glucose utilization and fat redistribution.⁶² Pulse rate and systolic and diastolic blood pressure decreased significantly.⁶³ There were improvements in pulmonary functions.⁶⁴ Nerve function parameters improved in the group of patients practicing Yoga *Asanas*, while nerve function in the control group deteriorated over the period of study.⁶⁵ A study on 60 patients with type 2 diabetes showed that *Pranayama* (breathing exercises) and Yoga *Asanas* improved cognitive brain functions in patients with diabetes.⁶⁶

Patients are also advised to study the scriptures according to their own religion or tradition (e.g., *Veda*, texts of ancient India that expound upon the laws of nature), which highlight the development of a positive mental attitude and decrease anxiety and stress. Inadequate physical and mental exercise⁵³ are major causes of *Prameha* and *Sthaulya* (obesity). Strictly following these Ayurvedic management principles will be beneficial in the treatment of these disorders.

Management of disturbed psychologic factors

According to *Ayurveda*, psychologic factors play an important role in the development of *Prameha*, similar to their importance in obesity, metabolic syndrome, and diabetes mellitus. Thus, psychologic management is vitally important in the treatment of these disorders. Meditation and *Pranayama* (breathing exercises) help counteract stress and balance the emotions, resulting in a more positive outlook on life.⁶⁰ Various mental health-promoting herbs (*Medhya*) have shown promising results as adjuvants to the principal ther-

apy in patients with diabetes. In a survey study of 100 patients with type 2 diabetes, disturbances in mental health (e.g., anger, grief, worry, fear, anxiety, and so on) were noted. Even though the patients were on antidiabetic medication, their blood glucose was not well controlled. With concomitant administration of the mental health-promoting herbal mixture known as *Saraswata Churna*, a decrease in fasting and postprandial blood glucose was observed. *Saraswata Churna* contains *Ashwagandha* [*Withania somnifera* (Linn.) Dunal], *Shankhapushpi* [*Convolvulus pluricaulis* Choisy], *Brahmi* [*Bacopa monnieri* (Linn.) Pennell], *Vacha* [*Acorus calamus* Linn.], and so on] (Bhatia et al., 2001; see Box 1). The *Medhya* herbs have antistress, antioxidant, and immunomodulation properties.⁶⁷⁻⁷⁵ Thus, they counteract stress-induced neuroendocrine changes (high catecholamines) and lead to better availability of insulin to metabolize blood glucose.^{76,77}

Herbal and herbomineral supplements

Plants are valuable for health in various ways. They are the foundation of both food and medicine. Cultures around the world have utilized different techniques for treating disease based on what is available in their biocultural environment. Most developing countries depend directly on plants for their health care needs. Even in nations where allopathic medicine and the pharmaceutical industry are prominent, plants are being recognized as a valuable resource for the promotion of health and treatment of disease. The World Health Organization has recommended appraisal of the therapeutic utility of plants for conditions in which there is a lack of safe drugs in conventional medicine. Ayurvedic herbal supplements are being utilized globally, since they are effective in managing many chronic disorders, are cost-effective, and lack the toxic side-effects associated with many chemically synthesized drugs. For the treatment of *Prameha*, there are more than 100 medicinal plants *Ayurveda* utilizes, singly or more often in combination. Selection of the herbal treatment is based on the stage and type of disease, as well as disturbances in the psychophysiologic constitution of the patient. Research has shown that many of these herbs have an antidiabetic effect as well as a beneficial effect on the lipid profile.⁷⁸⁻⁸¹

Meshashringi [*Gymnema sylvestre* (Retz.) R.Br.; *Gurmar*] targets several of the etiological factors associated with diabetes, including chronic inflammation, obesity, and pancreatic β -cell function.⁸² In a study on rats with streptozotocin-induced diabetes, *G. sylvestre* treatment resulted in a 30% increase in total pancreatic weight, and a significant increase in the number of islets and number of β -cells per islet. The regenerated pancreatic tissue resulted in complete control of fasting blood glucose levels within 20-60 days. Normal rats in this study did not experience an increase in insulin release when treated with *G. sylvestre* extract, indicating that this herb has a normalizing effect on blood glucose and may therefore be safer than conventional oral hypoglycemic agents such as sulphonylureas.⁸³ Several clinical studies have demonstrated that *G. sylvestre* is effective in decreasing blood glucose levels in patients with type 1 and type 2 diabetes.^{82,84,85} Two (2) clinical trials investigated the effects of combining *G. sylvestre* treatment with conventional therapy, compared to conventional therapy alone. In 22 patients with

BOX 1. RESEARCH IN THESES, CD-ROM, AND WEBSITE

Bhatia S, Chandola HM, Singh G. A clinical study on the role of Manasa Bhava in the etiopathogenesis of Madhumeha and its management by Saraswata Choorna. MD(Ayu) thesis. Institute for Post Graduate Teaching & Research in Ayurveda, Gujarat Ayurved University, Jamnagar, India, 2001.

Plants of Ayurveda, version 1.0, CD ROM on Dravyaguna. Sponsored by Ministry of Environment and Forest, Government of India (New Delhi) and RGUHS (Bangalore). Designed and developed by FRLHT (Bangalore), 2005.

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Marwah B, Singh G, Chandola HM. A clinical study on the role of certain Ayurvedic drugs in management of Madhumeha (diabetes mellitus). MD(Ayu) thesis. Institute for Post Graduate Teaching and Research in Ayurveda, Gujarat Ayurved University, Jamnagar, India, 1990.

Clinical Research on Diabetes mellitus, reported on website of India's Central Council for Research in Ayurveda and Siddha. Online document at: http://ccras.nic.in/Research_Activities/20081015_diabetes.htm Accessed June 12, 2010.

Deka D, Chandola HM, Singh G. A clinical study on Klaibya (male sexual dysfunction) in Madhumeha and Ucharaktachapa and its management by Vajikarana Yoga. PhD thesis. Institute for Post Graduate Teaching and Research in Ayurveda, Gujarat Ayurved University, Jamnagar, India, 2004.

Virani N, Chandola HM, Vyas SN, Jadeja DB. A clinical study on etiopathogenesis of erectile dysfunction (Klaibya) in diabetic and non-diabetic patients and its management with Ashvattha. MD(Ayu) thesis. Institute for Post Graduate Teaching and Research in Ayurveda, Gujarat Ayurved University, Jamnagar, India, 2009.

Dwivedi KN. Effect of Dashamoola on diabetic neuropathy. MD(Ayu) thesis. Institute of Medical Sciences, Banaras Hindu University, Varanasi, India, 1986.

Upadhyaya JM, Singh K. Role of Saptamrita Lauha in Timira with special reference to myopia. MD(Ayu) thesis. Institute for Post Graduate Teaching and Research in Ayurveda, Gujarat Ayurved University, Jamnagar, India, 1993.

Gupta Durgesh P. A clinical study on Akshi Tarpana with and without Nasya on Timira with special reference to myopia. MD(Ayu) thesis. Institute for Post Graduate Teaching and Research in Ayurveda, Gujarat Ayurved University, Jamnagar, India, 2009.

Anil Kumar E. Study on various preparations of Manjishthadi Kvatha and its effect in Tvak Rogas (skin diseases). MD(Ayu) thesis. Government Ayurveda College, Kerala University, Trivandrum, India, 1985.

Shringi MK. Therapeutic efficacy of leech application, Kaishore Guggulu, and Neem oil in skin disorders [in Hindi]. MD(Ayu) thesis. National Institute of Ayurveda, Jaipur, India, 1996.

Hota P. A clinical study on Vatarakta and its management with Kaishor Guggulu. MD(Ayu) thesis. Gopabandhu Ayurved Mahavidyalaya, Utkal University, Puri, India, 1997.

type 2 diabetes, treatment with *G. sylvestre* extract significantly reduced blood glucose, glycosylated hemoglobin, and glycosylated plasma proteins, whereas with conventional treatment alone (i.e., glibenclamide or tolbutamide), these values increased or remained the same. The patients receiving the herbal extract were able to decrease the dosage of their conventional drug, and 5 patients were able to discontinue the drug entirely and maintain their blood glucose levels using only *G. sylvestre*.⁸⁴ In 27 patients with type 1 diabetes, *G. sylvestre* treatment reduced fasting blood glucose, glycosylated hemoglobin, and glycosylated plasma protein levels. Insulin requirements decreased and serum lipids returned to near normal levels. Patients on insulin therapy alone had no significant reduction in serum lipids, glycosylated hemoglobin, or glycosylated plasma proteins.⁸⁵

Aqueous and alcoholic extracts of *Guduchi* [*Tinospora cordifolia* (Willd.) Hook. f. & Thomson] reduced glucose levels in rats with alloxan-induced diabetes. The antihyperglycemic effect may be due to pancreatic islet free-radical-scavenging activity. This herb also lowers the levels of tissue and serum cholesterol, phospholipids, and free fatty acids (Plants of Ayurveda, 2005; see Box 1).⁸⁶⁻⁸⁹ *Kiratatikta* [*Swertia chirata* (Roxb.) Buch.-Ham.; also known as *Swertia chirayita* (Roxb.) H. Karst.] is a potent antidiabetic herb. In a pilot study, *Swertia chirata* produced a significant decrease in fasting and

postprandial blood glucose levels in patients with diabetes.⁸¹ It contains swerchirin, a xanthone found in the *Swertia* species of plants. Xanthones are a unique class of biologically active compounds with antioxidant properties. Research has shown swerchirin produces a significant decrease in blood glucose levels in rat models.⁹⁰⁻⁹⁴ A 60% decrease in blood glucose induced by swerchirin was accompanied by a marked depletion in β -granules and insulin in the pancreatic islets. Glucose uptake and glycogen synthesis by the diaphragm muscle was significantly enhanced *in vitro* by the serum of swerchirin-treated rats. It was therefore concluded that swerchirin lowers blood glucose levels by stimulating insulin release from the islets of Langerhans.⁹⁴

Shilajatu (*Shilajit*, *Asphaltum punjabianum*) is a resinous, mineral-rich substance with vegetative origins that is found in the Himalayan mountains.⁹⁵ It is recommended for many diseases, such as *Prameha*, *Sthaulya* (obesity), *Hridroga* (heart disease), and so on. It is an established treatment for diabetes that not only mitigates morbid *Kapha* and *Meda*, but also has rejuvenating properties.⁹⁶ In a clinical study on patients with diabetes, *Shilajit* significantly reduced lipid peroxidation and significantly increased levels of catalase, an antioxidant enzyme.⁹⁷ In rats with diabetes, *Shilajit* produced a significant reduction in blood glucose levels as well as beneficial effects on the lipid profile. Using *Shilajit* in combination with

glibenclamide or metformin significantly enhanced their ability to lower glucose and improve the lipid profile, compared to administering the drugs alone.⁹⁸ *Shilajit* attenuated streptozotocin-induced hyperglycemia in rats and reduced the decrease in superoxide dismutase activity in pancreatic islet cells. It was postulated that *Shilajit* acts as a free-radical scavenger.⁹⁹

Charaka Samhita recommends *Madhwasaava*, a polyherbal fermented preparation, for patients with *Prameha*. Hypoglycemic effects in animal models have been noted for some of the ingredients of *Madhwasaava*, including *Tejapatra* [*Cinnamomum tamala* (Buch.-Ham.) T. Nees & Eberm.], *Pushkarmula* (*Inula racemosa* Hook. f.), and *Chirayata* (*Kiratatikta*, *Swertia chirata*).^{18,93,100,101} As discussed previously, in a pilot study on patients with diabetes, *S. chirata* produced a significant decrease in fasting and postprandial blood glucose levels.⁸¹ A pilot study on *Tejapatra* showed insulin-releasing activity as well as a decrease in fasting and postprandial blood glucose levels in patients with diabetes.^{102,103}

Mamejjaka (*Ericostema littorale* Blume) is used as a single herb and also as part of an antidiabetic mixture.¹⁰⁴ In a clinical study on patients with type 2 diabetes, *E. littorale* reduced blood glucose and prevented the progression of diabetic complications. There was significant improvement in the lipid profile, blood pressure, and kidney function.¹⁰⁵ It significantly reduced blood glucose and lipid peroxides in rats with alloxan-induced diabetes, and increased superoxide dismutase, catalase, and glutathione peroxidase.¹⁰⁶ In studies on rats with streptozotocin-induced type 1 diabetes, *E. littorale* significantly reduced glucose, cholesterol, and triglyceride levels,¹⁰⁷ and ameliorated diabetic nephropathy. Serum creatinine and urea were significantly decreased, and glomerular function improved.¹⁰⁸ In rats fed a hypercholesterolemic diet, *E. littorale* decreased serum cholesterol, triglycerides, LDL, VLDL, liver and kidney cholesterol levels, and lipid peroxidation levels. There was an increase in HDL, and an increase in reduced glutathione levels.¹⁰⁹

A pilot study on an herbal mixture containing *Tejapatra* (*Cinnamomum tamala*), *Pushkarmula* (*Inula racemosa*), *Mamejjaka* (*E. littorale*), *Meshashringi* (*Gymnema sylvestre*), and *Jambu* (*Syzygium cumini*) seeds with *Karavellaka* (bitter gourd; bitter melon; *Momordica charantia*) juice, administered at a dose of 5 g twice a day before meals, decreased fasting and postprandial blood glucose levels in patients with diabetes (Singh et al., 1992; see Box 1). *Avartaki* (*Cassia auriculata* Linn.) and *Methika* (*Trigonella foenum-graecum*) as single herbs and decoction of *Nimba* (*Azadirachta indica* A. Juss.; *Neem*) have also demonstrated blood glucose-lowering action (Marwah et al., 1990; see Box 1). In a clinical study on patients with type 2 diabetes, *Neem* showed significant hypoglycemic activity.¹¹⁰ In rabbits with alloxan-induced diabetes, the hypoglycemic effect of *Neem* was comparable to that of glibenclamide.¹¹¹

The herbs *Gokshura* (*Tribulus terrestris* Linn.),¹¹² *Asana* (*Pterocarpus marsupium* Roxb.),⁸¹ *Kulatha* [*Vigna unguiculata* (Linn.) Walp.], and *Saptaparna* [*Alstonia scholaris* (Linn.) R.Br.] are also beneficial in treating *Prameha*. These herbs can be used in different combinations, depending on the Doshic involvement and severity of the illness. An herbal mixture comprised of one part each of *Karavellaka* (bitter gourd; bitter melon; *M. charantia*), *Jambu* (*S. cumini*), *Gurmar* (*Meshashringi*, *G. sylvestre*), and *Amra* (*Mangifera indica* Linn.), taken along with *Shilajit*, was investigated in a clinical study on 805 pa-

tients with diabetes. The results showed a statistically significant reduction in fasting and postprandial blood glucose, along with clinical improvement (website of India's Central Council for Research in Ayurveda and Siddha; see Box 1). *Vijayasaradi Kwatha*, *Nishakatakadi Kwatha*,¹¹³ *Katakagadiradi Kwatha*, *Saptaranyadi Vati*, and *Chandraprabha Vati*¹¹⁴ are a few other polyherbal combinations that have an antidiabetic effect. Given the abundance of Ayurvedic herbs that are used to treat *Prameha*, further research and clinical trials in this field may determine which are most effective in managing diabetes mellitus.

Management of complications

Patients with diabetes are at high risk for a number of complications. Ayurvedic herbs that target specific organ functions are helpful in managing these disorders. A large body of research has been conducted on these herbs. For cardiovascular complications, *Arjuna* (*Terminalia arjuna* Linn.),^{115,116} *Guggulu* [*Commiphora wightii* (Arn.) Bhandari],¹¹⁷ *Pushkarmula* (*Inula racemosa*),¹¹⁷⁻¹¹⁹ and *Kushtha* [*Saussurea lappa* (Decne.) C.B. Clarke]^{120,121} can be utilized. *Bilva* [*Aegle marmelos* (Linn.) Corr. Serr.],^{122,123} *Kutaja* [*Holarhena antidysenterica* (Roxb. ex Fleming) Wall. ex A. DC.],^{124,125} and *Haritaki* (*Terminalia chebula*)^{126,127} are helpful in managing diabetic enteropathy. For diabetic nephropathy, *Punarnava* (*Boerhavia diffusa* Linn.),^{128,129} *Gokshura* (*Tribulus terrestris*),¹³⁰⁻¹³³ and *Varuna* (*Crataeva nurvala* Buch.-Ham.)^{134,135} are useful. *Kapikacchu* [*Mucuna pruriens* (Linn.) DC.],¹³⁶⁻¹³⁸ *Ashwagandha* (*Withania somnifera*),¹³⁹ *Shweta Musli* (*Asparagus adscendens* Roxb.) (Deka et al., 2004; see Box 1), *Ashwattha* (*Ficus religiosa* Linn.) (Virani et al., 2009; see Box 1), and *Jatiphala* (*Myristica fragrans* Houtt.) (Deka et al., 2004; see Box 1) can be utilized for erectile dysfunction. For diabetic neuropathy, *Dashamula Kwatha* (Dwivedi, 1986; see Box 1) and *Guggulu*-based formulations are helpful. For diabetic retinopathy, *Saptamrita Lauha* (Upadhyaya and Singh, 1993; see Box 1)¹⁴⁰ and *Mahatriphala Ghrita* (Gupta Durgesh, 2009; see Box 1) are recommended. Local and internal administration of *Mahamanjishthadi Kwatha* (Anil Kumar, 1985; see Box 1) and *Kaishor Guggulu* (Shringi, 1996; Hota, 1997; see Box 1) can be utilized for various skin manifestations. For cerebral diseases such as dementia and Alzheimer disease, *Shankhapushpi* (*Convolvulus pluricaulis*),^{71,141,142} *Mandukaparni* [*Centella asiatica* (Linn.) Urb.],¹⁴³⁻¹⁴⁵ *Brahmi* (*B. monnieri*),^{73,146,147} *Vacha* (*Acorus calamus*),^{148,149} *Jyotishmati* (*Celastrus paniculatus* Willd.),^{150,151} and *Guduchi* (*Tinospora cordifolia*)^{152,153} are recommended.

Conclusions

In *Ayurveda*, *Prameha* is described as a set of complex clinical disorders characterized by frequent abnormal micturition, with the etiology involving genetic predisposition as well as improper diet and lifestyle. The role of stress and obesity in its pathogenesis is also elaborately discussed in the Ayurvedic texts. The clinical conditions described in *Prameha* have much in common with those described in allopathic medicine for obesity, metabolic syndrome, and diabetes mellitus. The Ayurvedic management of *Prameha* emphasizes dietary and lifestyle recommendations and herbal preparations, in accordance with the psychophysiological constitution of the patient. *Ayurveda* also addresses the management of psychologic factors that contribute to the development of *Prameha*.

Ayurveda has a vast array of herbs and herbal mixtures that are used in the treatment of *Prameha*. A large number of these herbs have demonstrated efficacy in research investigations. The herbs have various properties, including hypoglycemic, antihyperglycemic, hypolipidemic, antihyperlipidemic, insulin-promoting, and antioxidant properties. Some of these herbs are capable of counteracting stress-induced catecholamines, which are established insulin antagonists. Hence, the selection of the herb or combination of herbs for the patient depends upon the stage of the disease, disturbances in the psychophysiologic constitution of the patient, and mode of action of the herbs. Further research is needed in the clinical setting to elucidate the Ayurvedic modalities that are effective in the management of obesity, metabolic syndrome, and diabetes mellitus, in light of their similarities with *Prameha*.

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