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Short Communication

Managing Diabetes

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ABSTRACT

Diabetes, or Diabetes Mellitus comprise a group of metabolic diseases manifesting impaired sugar metabolism with symptoms of high blood sugar, frequent urination, increased thirst, and increased hunger. If proper medical treatment is not given it will lead to acute complications such as diabetic ketoacidosis and nonketotic hyperosmolar coma, cardiovascular disease, stroke, chronic kidney failure, foot ulcers, loss of vision etc Traditional therapies existed from time immemorial and have been in use from antiquity to the present day while modern medicine came to existence much later. Some of the alternate therapies such as phytomedicine or herbal medicine, change of life style, Physical Exercises, Ayurveda, Siddha, Homeopathy, Yoga and Naturopathy do help in managing diabetes to aa great extent. The modern medicine goes with analytical approach while the traditional therapies proceed with whole some approach. The beauty of modern medicine is its systematic scientific approach with detailed experimentation and proper validation of the results.

DIABETES - PREVELANCE AND CONCERN

The disease Diabetes has an endemic status in India. It is a chronic condition where the body either doesn't produce enough insulin or can't effectively use the insulin it produces, leading to higher levels of glucose in the blood. Life style of the individuals is a major contributing factor for the manifestation of this disease in many cases. In the year 2021, India had 74.2 million diabetic patients compared to 140.9 million in China, 33.0 million in Pakistan and 32.2 million in the United States. Globally the number of diabetic individuals in 2021 was 537 million [1]. There was a sharp increase in the number of diabetic patients and in 2025 the number of diabetic populations was 124.9 in India, 174.4 million in China, 62.2 million in Pakistan and 36.3 million in United States of America while the number globally rose to 1.3 billion [2]. For 2030, the figures projected are alarming. The predicted figures of diabetics in 2030 for India is 366 million, for China it will be 42.3 million and 39.7 million in the US and globally 643 million [1].

Classifications and Symptoms

Diabetes, or Diabetes Mellitus comprise a group of metabolic diseases with impaired sugar metabolism, where high blood sugar-levels persist over long periods with symptoms of high blood sugar, frequent urination, increased thirst, and increased hunger. If proper medical treatment is not given it will lead to acute complications such as diabetic ketoacidosis and nonketotic hyperosmolar coma, cardiovascular disease, stroke, chronic kidney failure, foot ulcers, loss of vision etc. Diabetes is due to either the pancreas not producing enough insulin or the cells of the body not responding properly to the insulin produced. There are three main types of diabetes

i) Type 1 DM is also referred as "insulin-dependent diabetes mellitus" (IDDM) or "juvenile diabetes". It is due to the failure of pancreas to produce enough insulin.

ii) Type 2 DM is often referred as "non-insulin-dependent diabetes mellitus" (NIDDM) or "adult-onset diabetes" [3,4]. It is due to insulin deficiency as well as insulin resistance where body- cells do not respond to insulin. Lack of physical exercise and obesity could be causative factors for this.

iii) Gestational diabetes, is the third type, it is the condition when pregnant women without a previous history of diabetes develop a high blood sugar level.

Biochemical and Physiological Factors

Several of the recent biochemical, genetic, and clinical studies have revealed that multiple gene defects and polymorphisms, combined with physiological consequences of modern life styles (food habits, nutrition, consumption of food items contaminated with toxic chemicals, consumption of alcohol and beverages, lack of physical exersion and inadequate exposure to sun light etc.) contribute to the risk of diabetes manifested as reduced insulin secretion, reduced insulin sensitivity (insulin resistance), and increased hepatic glucose output – all in turn culminate in increased fasting blood glucose levels, inadequate plasma insulin levels, impaired glucose tolerance, and mis-regulated lipid metabolism. The continuance of the diabetic condition over long period leads to the development of several complications - neuropathy, retinopathy, nephropathy, micro- and macroangiopathies and cardiovascular diseases and mortality [5,6].

Genetics/ Hereditary Factors

More than 36 genes have been found that contribute to the risk of type 2 diabetes. These include *tcf7l2, pparg, fto, kcnj11, notch2, wfs1, igf2bp2, slc30a8, jazf1, hhex* among others. Apart from these, diabetes also arise due to an abnormality in a single gene (known as monogenic forms of diabetes); which include maturity onset diabetes of the young (MODY), Donohue syndrome, and Rabson-Mendenhall syndrome. More than 20 genes have been identified to cause monogenic diabetes. A mutation in any one of these genes can cause a child or adult to develop monogenic diabetes. MODY(caused by mutations in the *hnf1a* gene or the *gck* gene) accounts for 1–5% of all cases of diabetes in the young.Neonatal diabetes is mainly caused by mutations in the *kcnj* [7], *abcc8* or *ins* genes.The risk of diabetes is also results from diabetes, various hereditary conditions such as myotonic dystrophy and Friedreich's ataxia. Wolfram's syndrome is an autosomal recessive neurodegenerative disorder.

Life Style as a Major Factor

Diet and lifestyle influence susceptibility to many diseases including diabetes. Drug abuse, tobacco smoking, and consumption of alcohol, as well as a lack of physical exercise increase the risk of developing several diseases. Environmental factors (diet and body-weight) play a major role in the development of type 2 diabetes in addition to the genetic components. Obesity is one of the major risk factors for type 2 diabetes that may be linked to lifestyle [8,9]. Healthy eating and physical activity are the most important steps to control blood glucose levels and obesity. Hence special care is needed for diet and physical activity for diabetic control. Excess intake of salt, sugar, carbohydrates, and fat should be prevented by restricting the diet. Increased consumption of white flour *(Maida*) which contains alloxan - the compound used to induce diabetes in laboratory animals, could be one of the causes contributing to the higher incidence of the disease to make Kerala state as the Diabetic capital of the India. The vegetarian diet is rich in fibre and essential nutrients such as vitamins and minerals. Exposure to sunlight enriches the body with vitamin D and this vitamin has been reported to have beneficial effects for a variety of diseases including diabetes. The physical activity and exercises and the exposure to sun light are helpful to control the blood glucose levels in the diabetic subjects [10].

Managing Diabetes with Modern Medicines

The strategies of diabetic therapy with modern medicine started with the findings of Frederick Madison Allen. The mile stones of the modern medical management of diabetes include [3]:

i) The discovery of insulin in 1921 as a treatment after a dog, whose pancreas was removed, was successfully treated with it [3].

ii) The pivotal years in diabetes research, researchers in 1940s discovered a vital link between diabetes and long-term health complications such as kidney and eye disease.

iii) The first oral drugs to help lower blood glucose levels became available to patients in 1955.

iv) Diabetes was broken down into two types: Type I (insulin-dependent) and Type II (non-insulin-dependent) in 1959.

v) 1960‘s and 1970‘s there was significant progress in Diabetes treatment technology and the purity of insulin was improved. Developments in home testing for sugar levels in urine gave people greater control over their bodies and the disease.

vi) In 1983 the first biosynthetic human insulin was introduced.

vii) In 1986 the insulin pen delivery system was introduced.

viii) In 1990s came the realization that more frequent insulin doses and personalized treatment regimens based on a patient‘s activity level and eating patterns can delay the onset and progression of long-term complications in individuals with Type I Diabetes. Some of the types of modern drugs used for Diabetic therapy, their mechanism of action and contra indications are listed in Table 1.

Class of drug	Mechanism of action	Contraindications
Sulfonylureas and repaglinide	Increase insulin secretion	Insulinopenia
Biguanides	Decrease peripheral insulin resistance	Obesity + insulin resistance
	Decrease hepatic gluoneogenesis	
Thiazolidenediones	Decrease peripheral insulin resistance	Insulin resistance
	Reduce fatty acids	
α-glucosidase inhibitors	Slow absorption of carbohydrates	Postprandial hyperglycemia

Table 1: Oral agents used in the management of type 2 diabetes mellitus.

Alternate or Complementary Therapies for Diabetes' Management

The term alternate and complementary therapy is a misnomer as these traditional therapies existed from time immemorial and have been in use from antiquity to the present day while modern medicine came to existence much later. Some of the alternate therapies such as phytomedicine or herbal medicine, Ayurveda, Siddha, Homeopathy, Yoga and Naturopathy do help in managing diabetes and other diseases. The modern medicine goes with analytical approach while the traditional therapies proceed with whole some approach. The beauty of modern medicine is its systematic scientific approach with detailed experimentation and proper validation of the results [11].

Herbals or Phytomedicine

Plants and herbs have been used by humans all over the globe from ancient times for treating various ailments and diabetes is no exemption. Even today 80% of the world population depend on plants and herbs for health care, particularly in the developing world. Some of the plants showing antidiabetic activity are listed in the Table 2.

*Azadirachtaindica*A. Juss
Syzygiumcumini(L.) Skeels
*Momordicacharantia*L
*Cinnamomumverum*J. Presl
Cinnamomum cassia Blume
Curcuma longa L.
Andrographispaniculata(Burm. f.) Nees
Gymnemasylvestre R. Br.
*Allium sativum*L.
Carica papaya L.
Tabernaemontanadivaricata(L.) R. Br.
ex Roem. &Schult
*Nymphaeastellata*Willd.
*Gastrodiaelata*Blume
*Trigonellafoenum-graecum*L.
*Litchi chinensis*Sonn.
Anoectochilusroxburghii(Wall.) Lindl

Silybummarianum(L.) Gaertn
Glycyrrhizauralensis Fisch
*Vacciniumcorymbosum*L.
*Dioscoreabatatas*Decne
Astragalusmembranaceus(Fisch.) Bunge
*Pisoniaalba*Span.
*Plumbagorosea*and *Tinosporacordifolia*
Caesalpiniapulcherrima (L.) Sw.
Pileamicrophylla (L.)
Glycosmispentaphylla (Retz.) DC
Smilax zeylanica L.

Table 2: Plants showing antidiabetic activity.

A few of these plants have been screened and active principles or compounds showing antidiabetic activity characterized. Table 3 gives a list of such plants and the active compounds in them [12].

Medicinal Plant	Active compound
CinnamomumverumJ. Presl	Cinnamaldehyde
Trigonellafoenum-graecumL.	Diosgenin
Carica papaya L.	Flavanoids, Alkaloids
GastrodiaelataBlume	Vanillin
Glycyrrhizauralensis Fisch	Amorfrutin 1,4
Tabernaemontanadivaricata (L.) R. Br. ex Roem. &Schult	Conophylline
Silybummarianum (L.) Gaertn	Sylibin, sylidianin, sylichristin

The antidiabetic activity of these plants have been reported in roots, stem, leaves or fruits. Some of these are consumed as food and some are used to treat various disease conditions, not necessarily diabetes. One plant may contain thousands of phytoconstituents which can have multiple benefits by targeting several metabolic pathways related to diabetes. Hence the use of a medicinal herb, alone or in combination with others in combination therapy will be useful for effective control of diabetes. Some of these plants find use as nutraceutical. A scientific screening of medicinal plants based on traditional knowledge against diabetes may be a fruitful strategy for the isolation of potent antidiabetic molecules without side effects.

Ayurveda

The Indian system of medicine Ayurveda is a 5,000-year-old system of natural healing that has its origins in the Vedic period. Ayurveda is presently under a major resurgence in both India and other parts of the world. The Tibetan medicine and the Traditional Chinese Medicine have their roots in Ayurveda. Early Greek medicine also has many concepts taken from the ayurvedic medical texts. More than a mere system of treating illness, Ayurveda is a science of life (Ayur = life, Veda = science or knowledge). Ayurveda generally uses herbs for therapy. Indian healthcare consists of various systems

of medicines and ayurveda still remains dominant compared to modern medicine, particularly for treatment of a variety of chronic disease conditions. The Ayurvedic Pharmacopoeia of India is especially rich in herbal treatments for diabetes (Ayurvedic Pharmacopoeia of India, 2008). Ethnobotanical studies of traditional herbal remedies used for diabetes around the world, have identified more than 1,200 species of plants with hypoglycemic activity although only a few of them have been scientifically studied.

Diabetes mellitus or' Madhumeha' is a disease in which a patient passes sweet urine and exhibits sweetness all over the body i.e. in sweat, mucus, breath, blood etc. Ayurveda texts describe 20 types of diabetes (pramehas) based on the predominant doshas, kaphaja, pittaja, and vataja disorders) [13] and physical characteristics of the urine (e.g., volume, color, odor, taste, sediments, solid particles, presence of seminal fluid, and mucus) as presented in Table 4. Turbid urine is discharged in excessive quantities. Diabetes mellitus is one of these pramehas that may occur in any of the three (vata, kapha, or pitta) body constitutions [14,15].

Kaphajapramehas
a. Udakameha — The urine is clear; is in large amounts; is white, cold, and odorless; resembles water, sometimes with slight urbidity, and slimy.
b. Iksumeha — The urine is like sugarcane juice and is very sweet.
c. Sandra meha — The urine becomes thick when kept overnight.
d. Surameha — The urine resembles beer (sura) with a clear top and a cloudy bottom portion.
e. Pistameha — The urine is white and thick, similar to a solution of corn flour.
f. Sukrameha — The urine is like semen or mixed with semen.
g. Sitameha — The urine is sweet and very cold.
h. Sikatameha — The urine contains sandlike particles.
i. Sanairmeha — The urine is passed very slowly.
j. Laalameha — The urine is slimy and contains threads like that of saliva.
Pittajapramehas
a. Ksarameha — The urine is like a solution of alkali in smell, color, and taste.
b. Kala meha — The urine is black.
c. Nilameha — The urine is bluish.
d. Haridrameha — The urine is yellowish, similar to tumeric.
e. Manjisthameha — The urine is foul smelling resembling manjistha (Rubiacordifolia), a slightly red solution.
f. Raktameha — The urine is foul smelling, slightly salty, and blood red
Vatajapramehas
a. Majjameha — The urine looks like marrow or marrow mixed.
b. Ojasmeha — The urine looks like honey. c. Vasa meha — The urine looks like liquid muscle fat and may be passed frequently.
d. Hastimeha — The urine is like that of an elephant in rut, being discharged continuously without force, mixed with lymph and without obstruction

Table 4: Ayurvedic classification of Diabetes (Premeha).

The Ayurvedic approach to Diabetes mellitus management includes life-style dietary interventions, exercise, and a variety of hypoglycemic herbs and herbal formulas depending upon the predominant dosha.

Diabetes in Homeopathy

Profiling of the patient is the first step in homeopathic treatment. The profile of the patient has to match with the right prescription, some of the common homeopathic drugs found effective in various cases of diabetes are Arsenicum album, Bryonia alba, Rhustox, Nat. Sulph, Phosphorus and Syzygium.

Diabetes in Siddha Medicine

According to Siddha, diabetes is subdivided into 3: Vatha, Pitha and Kapha. Vatha again subdivided into 4, Pitham as 6 types and Kapham as 10 Types. Some of the siddha preparations useful in treating diabetes include Seenthil Kudineer, Seenthi Choornam, Vilva kudineer, Avarai kudineer, Madhumegha choornam, Nyavalkottai Choornam, Silasathu parpam, Abraka chendooram, Triphala Choornam etc. Apart from these preparations several herbs are also useful in controlling diabetes in Siddha system. A list of some of these herbs are given in the Table 5 [16,17].

1.	Tinospora cordifolis or Seenthi or Amrit
2.	Euginea jambolena or Nyaval
3.	Gymnema sylvestre or Sarkarrai kolli
4.	Phyllanthus emblica or Nellikkai or Amla
5.	Aegle marmelos or Vilvam or Bael
6.	Trigonella foenum or Methi or Venthayam
7.	Turmeric or Manjal or haldi
8.	Andrograhis paniculata or Nilavembu
9.	Allium sativum or Garlic

Table 5: Herbs used to manage Diabetes in Siddha system.

Yoga and Naturopathy

In managing diabetes Yoga and naturopathy are very effective in changing life style and preventing as well as controlling several diseases including diabetes. These modalities of treatments prescribe certain exercises, food habits and life style changes [18,19].

CONCLUSION

Life style induced the major contributing factor for the incidence of type 2 diabetes. Changing the life style incorporating physical exercise and healthy food habits, consumption of antioxidant rich foods and drinks can control the prevent or control the occurrence of this dreaded disease to a great extent. Traditional therapies employ several phytoceuticals and plants-based preparations have to treat this disease from ancients' times. The spectacular discoveries of modern medicine have made life easier for diabetic patients suffering from type 1 and type 2 diabetes and that caused by genetic factors. Hope the developments in gene therapy and nanomedicine could offer humanity a complete cure for this and prevent its incidence.

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