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Original Research Article

Role of ayurveda detoxification and dietary modification on restoration of euglycemia in T2DM patients

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ABSTRACT

Background: The current study sought to assess restoration of carbohydrate metabolism in known type 2 diabetes patients to achieve good glycemic control without dependency on oral antihyperglycemic agents by implementing the comprehensive diabetes control (CDC) program.
Methods: A retrospective, single-centre observational study was conducted from April 2021 to April 2022. Patients who were known cases of type 2 diabetes mellitus aged 18 years and above who underwent at least 6 sessions of the CDC program were included in this study. Patients with type 1 diabetes mellitus were excluded from the study. Follow-up was conducted after 90 days. Baseline data was compared with follow-up data.
Results: A total of 69 patients were assessed in this study. Of the patients, testing was performed on 95.8% patients, of which. 92.8% patients were found to have negative glucose tolerance and 7.3% were found to have impaired glucose tolerance.
Conclusions: The CDC program can be useful to restore euglycemia in know type 2 diabetic patients by reducing insulin resistance caused by central obesity.

Keywords: Ayurveda, Diabetes mellitus, Panchakarma

INTRODUCTION

Diabetes mellitus is a complex disease characterized by hyperglycemia resulting from the inability of the body to regulate insulin.[1] Symptoms often experienced include excessive thirst, frequent urination, blurred vision, unexplained weight loss, fatigue, and lethargy. Long-term effects of diabetes are decreased functioning of the heart, kidneys, eyes, and nervous system which becomes fatal if untreated.[2] Diabetes is expected to affect 552 million by 2030 according to the International Diabetes Federation (IDF). In India, prevalence of type 2 diabetes is rapidly accelerating with more people suffering from this disease than any other country.[3]

Diabetes mellitus can be managed with prescribed medication, controlled diet, and regular exercise. Currently diabetes is treated using oral medications such as biguanides, sulfonylureas, meglitinide, sodium-glucose, thiazolidinediones, dipeptidyl peptidase-4 (DPP-4) inhibitors, sodium-glucose cotransporter (SGLT2) inhibitors, and α-glucosidase inhibitors.[4] However, despite availability of modern medicine, the associated side effects, mode of administration, and cost are drawbacks.

Ayurveda is a traditional medicinal practice originating in ancient India. The Sanskrit word “Ayurveda” translates to “science of life.” Ayurveda applies the interlinking of

physical (prakriti), spiritual (purusha), and physiological processes to establish balance of mind, body, and spirit. Ayurvedic practices employ alternative methodology to control diabetes, these include herbal medications, physical activity, and therapies.[5] Against this background, the current study sought to to assess restoration of carbohydrate metabolism in known type 2 diabetes patients to achieve good glycemic control without dependency on oral antihyperglycemic agents (OHA) by implementing the comprehensive diabetes control (CDC) program.

METHODS

A retrospective, observational, single-centre study was conducted at Madhavbaug Cardiac Care Clinic from April 2021 to April 2022. A total of 69 patients who were known cases of type 2 diabetes mellitus aged 18 years and above who had completed at least 6 sessions of the CDC program were included in this study. Patients with type 1 diabetes mellitus were excluded from the study. The study conformed to the principles of good clinical practice and the declaration of Helsinki.[6,7] Signed informed consent for data collection and its analysis for research purposes was obtained from each patient prior to the procedure. Patients with body mass index 25.1-28.0, 28.1-30.0, 30.1-32.0, and 32.1-34.0 were categorized as overweight, obese 1, obese 2, and morbid obese, respectively.

Comprehensive diabetes control program

The comprehensive diabetes control (CDC) program consists of a 3-step procedure wherein each session is approximately 65-75 mins. Snehana was the first procedure and included massaging of Neem oil in a centripetal pattern on the hands, legs, shoulders, thorax, and abdomen of the patient. Duration of the procedure is expected to last 15-25 minutes with each body part receiving 15-30 strokes. Swedana, the second procedure involved passive heat therapy with dashmoola decoction while the patient lies in a wooden box, in supine position with the patient's head protruding out of the box. This therapy lasted 10-15 minutes and was followed by a resting period of 3-4 minutes. The third and final procedure, Basti was a medicated enema composed of *Gymnema sylvestre*, *Berberis aristate*, *Glycyrrhiza glabra* combined to form 100 ml. Rectal administration for at least 15 minutes ensures the drug stays in the body and enables maximum absorption. The CDC program continued over a period of 90 days and comprised 6 sessions (4 in the first month, and 1 in the second and third months each). The procedure is performed on patients following a light breakfast. Patients were limited to 800-1000 daily calorie intake. Low carbohydrates, moderate proteins, and low fats constituted the diet plan.

Glucose tolerance test

The glucose tolerance test, also known as oral glucose tolerance test, measures the body's response to sugar (glucose). The glucose tolerance test can be used to screen for type 2 diabetes. This test indicates glucose metabolism strength of an individual, 75 gm of oral sugar infusion was given to the patients after collection of fasting samples, and again after 1 hour and 2 hours, post prandial blood sugar was recorded. Patients were asked to sit in one position for the duration from fasting till 2 hours after sampling. No OHAs or insulin was taken before or during the procedure. Normal glucose tolerance was considered as <90 mg/dl after fasting, <180 mg/dl at 1 hour, and <140 mg/dl at 2 hours. Impaired glucose tolerance was considered as <90 mg/dl after fasting, >180 mg/dl at 1 hour, and <140 mg/dl at 2 hours. Diabetes was considered as >90 mg/dl at fasting, >180 mg/dl at 1 hour, and >140 mg/dl at 2 hours.

Data collection

Medical records provided the relevant data such as patient demographics, anthropometrics, laboratory findings, and medication data for analysis. On day 1 of the CDC program, a detailed patient history was documented and anthropometric measurements and laboratory findings were also documented. Details regarding the patient's antidiabetic medication was also documented. This data collection process was repeated on the day 90 of the CDC program. Data was only collected and analysed from patients who completed 6 complete sessions.

Statistical analysis

Categorial data are indicated as number (percentage) whereas continuous data are indicated as mean±standard deviation. The difference between baseline and follow-up at 90 days was determined with the paired t test. P value ≤0.05 was considered statistically significant. Software used for data analysis was R version 3.4.1.

RESULTS

Glucose tolerance testing

Of the 69 patients, testing was performed on 95.8% patients, of which, 92.8% patients were found to have negative glucose tolerance and 7.3% were found to have impaired glucose tolerance as displayed in Figure 1.

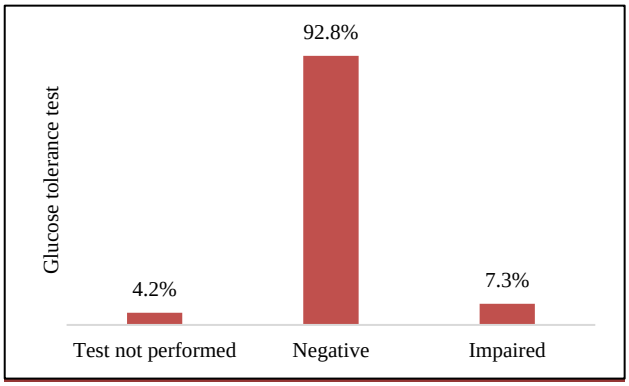

Figure 1: Findings of glucose tolerance test.

Impact of age, gender, body-mass-index, HbA1c, and glucose tolerance test on weight of study patients

According to age, weight of the patients aged 31-50 years and 51-80 years decreased by 11.85% and 10.72%, respectively. According to gender, weight of males and females decreased by 11.34% and 10.81%, respectively. According to body-mass index, weight of normal weight, overweight, obese 1, obese 2, and morbid obese patients decreased by 8.86%, 10.46%, 14.65%, 14.07%, and 11.43%, respectively. According to HbA1c classification, weight of patients in the HbA1c range 4.5-7.0%, 7.1-10%, and above 10% decreased by 9.63%, 12.35%, and 12.66%, respectively. According to glucose tolerance test status, weight of patients with a negative and positive status decreased by 11.32% and 10.27%, respectively as shown in Table 1.

Table 1: Impact of age, gender, body-mass-index, HbA1c, and glucose tolerance test on weight of study patients.

Variables	Day 1 (kg)	Day 90 (kg)	% change
Age, years			
31-50	76.30±11.52	67.26±10.44	-11.85
51-80	69.48±13.07	62.03±10.41	-10.72
Gender			
Males	75.13±12.07	62.61±9.81	-11.34
Female	62.77±10.84	55.99±9.78	-10.81
Body-mass index			
Normal weight	61.17±7.80	55.75±7.24	-8.86
Overweight	72.71±6.16	65.10±5.18	-10.46
Obese 1	81.85±10.32	69.86±11.75	-14.65
Obese 2	82.44±11.42	70.84±8.54	-14.07
Morbid obese	89.53±8.40	79.30±7.13	-11.43
HbA1c classification, %			
4.5-7.0	71.57±12.22	64.67±11.15	-9.63
7.1-10	73.56±15.29	64.48±11.98	-12.35
Above 10	72.12±6.93	62.98±5.21	-12.66
Glucose tolerance test status			
Negative	72.23±12.75	64.06±10.30	-11.32
Impaired	75.14±14.03	67.42±14.90	-10.27

Impact of age, gender, body mass index, HbA1c, and glucose tolerance test on body-mass index of study patients

According to age, body-mass index of the patients aged 31-50 years and 51-80 years decreased by 12.45% and 10.88%, respectively. According to gender, body-mass index of males and females decreased by 11.86% and 11.86%, respectively. According to weight, body-mass index of normal weight, overweight, obese 1, obese 2, and morbid obese patients decreased by 8.95%, 10.23%, 14.72%, 15.92%, and 12.59%, respectively. According to HbA1c classification, body-mass index of patients in the HbA1c range 4.5-7.0%, 7.1-10%, and above 10% decreased by 10.73%, 11.90%, and 13.00%, respectively. According to glucose tolerance test status, body-mass index of patients with a negative and positive status decreased by 11.68% and 10.39%, respectively as detailed in Table 2.

Table 2: Impact of age, gender, body mass index, HbA1c, and glucose tolerance test on body-mass index of study patients.

Variable	Day 1	Day 90	% change
Age, years			
31-50	27.33±3.93	23.92±3.03	-12.45
51-80	25.81±3.80	23.00±3.17	-10.88
Gender			
Males	26.42±3.63	23.28±2.68	-11.86
Female	26.67±4.89	23.84±4.39	-11.86
Body-mass index			
Normal weight	22.37±1.50	20.37±1.41	-8.95
Overweight	26.34±0.89	23.65±1.05	-10.23
Obese 1	28.82±0.59	24.58±2.13	-14.72
Obese 2	31.16±0.64	26.20±1.40	-15.92
Morbid obese	33.80±1.39	29.54±1.57	-12.59
HbA1c classification, %			
4.5-7.0	26.36±3.78	23.53±3.25	-10.73
7.1-10	26.52±3.98	23.37±3.08	-11.90
Above 10	26.63±4.15	23.17±2.98	-13.00
Glucose tolerance test status			
Negative	26.50±4.02	23.41±3.19	-11.68
Impaired	26.06±2.39	23.35±2.44	-10.39

Impact of age, gender, body-mass index, HbA1c, and glucose tolerance testing on postprandial sugar levels

According to age, 1 hour and 2 hours postprandial sugar levels were 157.39±40.00 mg/dl and 128.44±39.91 mg/dl, respectively for patients aged 31–50 years and 165.27±40.57 mg/dl and 132.57±43.26 mg/dl for patients aged 51-80 years, respectively. According to gender, 1 hour and 2 hours postprandial sugar levels were 166.16±43.32 mg/dl and 133.84±44.57 mg/dl, respectively for males and 146.89±22.87 mg/dl and 120.10±28.23 mg/dl, respectively for females. According to body-mass index, 1 hour and 2 hours postprandial sugar levels were 167.17±49.09 mg/dl and 142.72±55.49 mg/dl, respectively for normal weight patients, 157.41±25.81 mg/dl and 128.48±31.05 mg/dl, respectively for overweight patients, 153.67±49.69 mg/dl and 124.33±37.15 mg/dl, respectively for obese 1 patients, 169.50±22.59 mg/dl and 115.23±12.73 mg/dl, respectively for obese 2 patients, and 157.83±35.67 mg/dl and 120.13±19.78 mg/dl, respectively for morbid obese patients as demonstrated in Table 3.

Table 3: Impact of age, gender, body-mass index, HbA1c, and glucose tolerance testing on postprandial sugar levels.

Variable	Fasting (mg/dl)	1 hour (mg/dl)	2 hours (mg/dl)
Age, years			
31-50	95.71±13.98	157.39±40.00	128.44±39.91
51-80	95.71±13.98	165.27±40.57	132.57±43.26
Gender			
Males	94.75±15.24	166.16±43.32	133.84±44.57
Female	99.54±8.24	146.89±22.87	120.10±28.23
Body-mass index			
Normal weight	96.83 14.92	167.17±49.09	142.72±55.49
Overweight	96.68±13.51	157.41±25.81	128.48±31.05
Obese-1	92.58 13.44	153.67±49.69	124.33±37.15
Obese-2	94.88±14.75	169.50±22.59	115.23±12.73
Morbid obese	95.39±12.04	157.83±35.67	120.13±19.78
HbA1c classification, %			
4.5-7.0	94.26±10.36	158.60±41.00	128.94±41.60
7.1-10	97.89±15.51	170.00±38.94	126.97±39.21
Above 10	95.14±18.11	152.64±39.48	143.80±45.67
Glucose tolerance test status			
Negative	94.09±12.85	156.74±37.08	125.00±34.03
Impaired	117.40±11.66	227.00±20.71	204.00±59.29

Table 4: Impact of age, gender, body-mass index, HbA1c, and glucose tolerance test on HbA1c levels.

Variable	Day 1 (%)	Day 90 (%)	% change
Age, years			
31-50	8.76±1.98	5.72±0.55	-34.73
51-80	7.49±1.60	5.67±0.40	-24.26
Gender			
Males	8.24±1.98	5.72±0.51	-30.59
Female	7.35±1.23	5.61±0.27	-23.68
Body-mass index			
Normal weight	7.86±1.96	5.64 0.62	-28.28
Overweight	8.15±1.75	5.71±0.32	-29.96
Obese 1	8.59±2.39	5.76±0.49	-32.95
Obese 2	7.86±1.28	5.66±0.35	-27.98
Morbid obese	7.80±1.45	5.82±0.16	-25.43
HbA1c classification, %			
4.5-7.0	6.46±0.50	5.47±0.31	-15.33
7.1-10	8.37±0.84	5.78±0.47	-30.93
Above 10	11.28±1.06	6.07±0.51	-46.23
Glucose tolerance test status			
Negative	8.00±1.86	5.66±0.46	-29.28
Impaired	8.62±2.03	6.16±0.45	-28.54

Impact of age, gender, body-mass index, HbA1c, and glucose tolerance test on HbA1c levels

According to age, HbA1c levels of patients aged 31-50 years and 51-80 years decreased by 34.73% and 24.26%, respectively. According to gender, HbA1c levels of males and females decreased by 30.59% and 23.68%, respectively.

According to body-mass index, HbA1c levels of normal weight, overweight, obese 1, obese 2, and morbid obese patients decreased by 28.28%, 29.96%, 32.95%, 27.98%, and 25.43%, respectively. According to HbA1c classification, HbA1c levels of patients in the HbA1c range 4.5-7.0%, 7.1-10%, and above 10% decreased by 15.33%, 30.93%, and 46.23%, respectively. According to glucose tolerance test status, HbA1c levels of patients

with a negative and positive status decreased by 29.28% and 28.54%, respectively as described in Table 4.

Adherence to medication

Seven types of medication were adhered to medication at day 1. However, after 90 days complete cessation of all except one medication was observed as shown in Table 5.

Table 5: Adherence to medication.

Medication	Day 1 (%)	Day 90 (%)	Change (%)
Insulin	4.4	0	-100
Alpha-glucosidase inhibitors	2.2	0	-100
Biguanides	26.7	0	-100
Dipeptidyl peptidase-4 (DPP-4) inhibitors	11.1	0	-100
Sodium-glucose transporter (SGLT) 2 inhibitors	4.4	0	-100
Sulfonylureas	20.0	2.2	-88.89
Thiazolidinediones	2.2	0	-100

DISCUSSION

Diabetes mellitus is a complex and chronic major health and socioeconomic concern. The estimated cost of treating diabetes is US$ 215-375 billion and is expected to rise to 561 billion in 2030. The total annual cost of diabetes care in India is attributed to be around Rs. 180,000 million. In addition to the excess health-care expenditure, diabetes mellitus also imposes large economic burden in the form of loss of productivity and foregone economic growth.

The World Health Organization has emphasized on availability of medicine to all diabetic patients. However, the high cost of medication has left this goal unachieved. However, this has led to increased practice of traditional medicine which is a reasonable approach due to the easy accessibility of the plants and herbs implemented in this traditional medicine. Ayurveda, is a traditional medicine system that has been practiced for several years. In several Asian countries, individuals often consult Ayurvedic practitioners for treatment of diabetes mellitus among other health concerns. Nowadays, qualified and registered Ayurvedic practitioners are lead clinical providers and even practice medicine in private clinics. Ayurveda focuses on a patient-specific approach to manage diabetes mellitus- however dietary intake plays a key role. Clinical trials should be the first step in research to incorporate the concepts of the role of dietary intake.[2,8] Hence, the present study sought to assess restoration of carbohydrate metabolism in known type 2 diabetes patients to achieve good glycemic control without dependency on oral antihyperglycemic agents. Our study findings are in line with that of previous studies in which the CDC program was advised.[9-11]

HbA1c is a reliable diagnostic tool to diagnose diabetes mellitus. However, HbA1c estimations should not be the only other index. Other variables are also crucial in the diagnosis and monitoring of such individuals. Adipose tissue damage and dyslipidemia should also be taken into consideration as it has been revealed that diabetes mellitus is associated with irregularities in signalling of lipid metabolism.[2] In view of these observations, the current study also assessed weight of the patients. Weight of the patients decreased from 72.44±12.87 kg to 64.30±10.74 kg. These findings are in line with earlier studies that evidence the CDC program facilitates weight loss in patients.[9-11]

There are a few limitations if the study. These are small sample size and single arm, single centre study design.

CONCLUSION

The CDC program can be useful to restore euglycemia in known type 2 diabetic patients by reducing insulin resistance caused by central obesity.

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