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A comparative study on the efficacy of Non drug therapy & Mehamudgaravati in the management of Type 2 Diabetes Mellitus

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ABSTRACT

In type 2 diabetes, Insulin resistance is the main problem associated with cluster of conditions as obesity & hyperlipidaemia. The safest method of controlling and preventing Diabetes is through a combination of proper diet, proper behavioral changes, and adequate physical activity. It is better to manage health problems with nutrition & lifestyle intervention as life style change is safer than oral anti diabetic drugs. The present study deals to evaluate the role of dietetics - lifestyle & a classical Ayurvedic formulation - *Mehamudgara vati* (MMV) in breaking the pathogenesis of type 2 Diabetes. One group of patients had been on dietary management based on recommended pathyapalana in the classics for the patients of Prameha. The other group of patients had been treated with MMV, and in combination with western anti diabetic treatment. The results have been assessed on subjective and objective parameters with lowering of blood sugar at fasting and postprandial level in different therapeutic groups.

Key Words: Type 2 Diabetes, *Dosha, Dushya, Agni*, diet, lifestyle, anti hyperglycemic, anti hyperlipidemic

INTRODUCTION

The syndrome of diabetes mellitus is largely covered under the broad heading of *Prameha*. However, *Apathyanimittaja Prameha*[1] and *Sthula Pramehi* (obese)[2] described in *Ayurvedic* literature have similarity with Type-2 Non Insulin Dependent Diabetes Mellitus (NIDDM). Though *Prameha* is *Tridoshaja Vydhi*, *Acharyas* have mainly emphasized on vitiation of *Kaphadosha* and also on *medovriddhi* and *medodhatvagnimandya*. *Meda* has been described to be the anchor seat (important dushya) of this disease. Therefore, a view has been advanced that drugs of Indian Medicine may have altogether different mode of action than insulin.

It is just possible that by correcting lipid disturbance, they might be correcting the glucose disturbance.The concept may completely modify the present method of treatment prevalent in modern medicine.

Diabetes Mellitus (DM) is a chronic disease marked by elevated blood glucose levels. It affects 5-6% of the global adult population. Its prevalence is rising at alarming rates worldwide because of increased urbanization, high prevalence of obesity, sedentary lifestyle and stress, among other factors. The summary published by "World Diabetes Congress" on 14th Nov.; 2009 "World Diabetes Day" represents that Diabetes affects 246 million

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people worldwide and is expected to affect some 380 million by 2025. It is estimated that almost 80% of the 246 million people with diabetes live in developing countries. India has the largest diabetes population in the world with an estimated 41 million people, amounting to 6% of the adult population. India is the kingdom of Diabetes and Gujarat is epicenter accounting for 11.8% Indian diabetics in it. The rising burden of Type 2 diabetes and other non communicable diseases which has occurred with modernization can be understood in the context of 'epidemiological transition'. Rapid socio economic development and coca colonization have resulted in a life style transition from traditional to modern. In virtually all populations, higher fat diets and decreased physical activity have accompanied the benefits of modernization. Exercise has been engineered out of our daily lives, both in the work place & leisure. These lifestyle changes when combined with increasing longevity form the basis of the dynamic Type 2 diabetes epidemic that we are witnessing today. The western lifestyle must have unmasked the effects of pre-existing genes because the consistent result has been diabetes within a few decades.

DIET AND LIFESTYLE VIS A VIS TYPE 2 DIABETES

Dr. Neal D. Barnard, from George Washington University School of Medicine and the president of the Physicians Committee for Responsible Medicine (PCMR), through a new research carried out by a team of American doctors suggested that diabetes can be dramatically checked and even cured by switching to a low fat vagan diet. A vagan diet is distinct from a vegetarian diet so far that it excludes not only meals but also all animal products like milk, butter, curd, cheese, egg etc. For India, this means going back to the traditional vegetarian way of life but without milk products which are rich in fat.[3] In type 2 diabetes, insulin resistance is the main problem which is associated with cluster of conditions as obesity, hypertension and hyperlipidaemia which is a specific entity ('Metabolic Syndrome' or 'Syndrome X') is the primary defect. So apart from reduction in blood sugar level other benefits of going vagan diet include weight loss, hypertension and lower cholesterol levels.[3]

Exercise is extremely important in the management of diabetes because of its effect on blood glucose and free fatty acids. Exercise burns calories and helps to control weight, eases stress and tension, and maintains a feeling of well-being. In addition, regular exercise improves the body's response to insulin and may make oral anti-diabetic drugs and insulin more effective. It also promotes circulation, and lowers cholesterol and triglyceride levels, thus reducing the risk of cardiovascular disease**.** In glucose intolerance condition, lifestyle changes can also prevent the onset of diabetes through weight loss.[4] Physical activity is recommended for diabetics because of its importance in weight loss management and acute & chronic effects on glucose controls. [5,6] Physical activity reduces hyperinsulinemia and improves insulin peripheral activity[7], which shows that even at the age of 65 years, chronic diseases can be fought through a better lifestyle. As central obesity is a major contributor to insulin resistance, reduction of former is of utmost importance. Even without weight loss, physical activity reduces abdominal fat in men.[8] When combined with weight loss, physical activity reduces insulin resistance in addition. A recent meta-analysis showed that exercise reduces glycosylated haemoglobin (HbA1c) levels by an amount that is expected to reduce diabetic complications, without a mean effect on body weight.[9]

In the development of diabetes, obesity and insulin resistance usually precede beta cell failure and insulin deficiency. It is still not clear whether obesity causes insulin resistance, or if insulin resistance causes obesity, or they develop independently. But it is crystal clear that insulin resistance is aggravated by obesity, particularly by central obesity. Physical inactivity also aggravates it. Insulin resistance is partly in genes and partly associated with environmental or life style factors like being overweight and not getting enough exercise.

One can not gain the victory over genetic factors but of course, by diet control & modifying the lifestyle one can definitely prevent or control this disease. And rather than spending too much money on the treatment that do not work, it is wise to spend enough on preventing the disease & managing health problems with nutrition & lifestyle intervention as life style change is safer than oral anti diabetic drugs.

The present study is designed with the objectives to assess**:** i) effect of *Pathyapalana* (and avoiding *apathya)* on the hyperlipidaemia (*medodushti*) and hyperglycaemia; ii) antihyperglycemic & antihyerlipidaemic effect of *Mehamudgaravati*[1] on *Medodushti* in Type 2 Diabetes; iii) synergistic effect of *Mehamudgara vati* when administered with modern antihyperglycemic drug.

MATRIALS & METHODS

Total 75 patients of type – 2 diabetes, attending the O.P.D. / I.P.D. of Institute for Post Graduate Teaching & Research in Ayurveda Hospital, Gujarat Ayurved University, Jamnagar, were selected irrespective of their sex, caste etc. and divided in three groups taking into consideration inclusion and exclusion criteria.

Inclusion Criteria: Patients of type-2 diabetes fulfilling the standard diagnostic criteria of World Health Organization (W.H.O.) for Diabetes Mellitus: Symptoms of diabetes mellitus plus random blood glucose > 200 mg/dl or fasting blood glucose > 126 mg/dl or two-hour post prandial blood glucose > 200 mg/dl during an oral glucose tolerance test. The patients, who were able to understand and sign the Informed Consent form, were included in the present study.

Exclusion Criteria: Patients of *Sahaja Prameha* (Type I diabetes) & Madhumeha suffering from *bala* & *dhatukshaya* (IDDM), complicated with any major heart disease like C.C.F, renal impairment like nephropathy, tuberculosis, carcinoma and HIV positive patients were excluded for the present study including endocrine disorders like, thyrotoxicosis, cushing syndrome etc. were excluded.

Laboratory Investigation: Blood for Hb%, total leucocyte count, defferencial leucocyte count, erythrocyte sedimentation rate & biochemical investigation: fasting & post prandial blood sugar, blood urea, serum creatinine, lipid profile and urine for routine and microscopic examination. The research protocol was approved by 'Institutional Ethics Committee', I.P.G.T. & R.A., Jamnagar.

TREATMENT PROTOCOL

Group A: Controlled Diet Group (Non – Drug therapy Group)

Recently diagnosed mild to moderate cases of type 2 Diabetes **(***Apathya Nimittaja Prameha*) were kept on controlled diet and exercise from *pathya* point of view. They were advised to follow the diet plan of approximately 1000-1600 kilocalories/day made according to *Pathyapathya* described in the classics and also after taking into consideration the glycemic index of those articles wherever it was possible. In addition they were advised for brisk walking for 30 minutes morning and evening and to adopt healthy lifestyle as per their constitution (*prakriti*). They were administered Placebo capsule containing barley powder, one capsule of 500 mg twice a day. The duration of treatment was one month.

Group B: Mehamudgara vati (MMV) Group:

The type 2 diabetic patients as above were administered *Mehamudgara vati* [10] along with *pathyapalana.*

Group C: Integrative Group

Known patients of type 2 diabetes who were already taking modern anti diabetic drug but their blood sugar was not well under control, were administered M.M.V. with *pathyapalana* and had continued their modern anti diabetic drug.

The ingredients of MMV include Lauha Bhasma - 16 parts, Guggulu - Commiphora wightii (Arnott) Bhandari (exudates) - 4 parts and 1- 1 parts each Haritaki-Terminelia chebula (Gaerth.) Roxb. (fruit rind/pericarp), *Bibhitaki* - Terminelia Bellerica (Gaerth.) Roxb. (fruit rind/pericarp), *Amalaki* - Emblica officinalis Gaerth. (fruit rind), *Shunthi* - Zinziber officinalis Rosc. (Rhizome), *Maricha*- Piper nigrum Linn. (fruit), *Pippali* - Piper longum Linn. (fruit), *Trivritta* - Operculina terpethum, Silva, Manso, Enum. Subst. Branz. (root), *Pippali Mula* - Root of the piper longum Linn., Bida lavana, *Bilva* - Aegle marmelos(Linn.) Correa (root/stem bark), *Gokshura* - Tribulus terrestris Linn. (root/ whole plant), *Dadima* - Punica granatum Linn. (fruit bark), *Devadaru* - Cedrus deodara (Roxb. ex D. Don) G. Don) (heart wood), *Rasanjana* - Extrectum berberis aristata DC var. aristata, *Kiratatikta* - Swertia chirayita (Roxb ex Flem) Karst (whole plant), Triphala kwath – as per requirement. First of all *Triphala kwath* was made and then *Guggulu and Rasanjana* were melted in it. All the herbal ingredients were properly mixed with *Lauha bhasma.* After proper mixing of all the ingredients, they were given lavigation of *Triphala kwatha* in end runner and granules were made from the lavigated material. After drying of granules tablets were made.

Drug, Dose & Duration: (For Group B & C)

Drug: *Mehamudgara Vati*[10]

Dose: 3 tab. thrice a day (Each tab. of 250 mg.) after breakfast, lunch & dinner

Anupana: Lukewarm water

Duration: 1 month

Table 1: Diet Plan for diabetic patients
(Providing 1000-1600 Kilocalories / day for group A patients)

Early Morning	One glass – *yava mantha* (2 to 3 tea spoon *yava* roasted & then powdered + 1 glass of warm water – soaking – churning – filtration)
Morning breakfast	1 sweet lemon or 1 orange or ½ apple or 1 pomengranate + 2 *khakhara* made from barley flour or 1 bowl of boiled green gram or bengal gram
Mid day meal	Before commencing the meal one cup of warm, clear, vegetables soup or any green leaf soup; Salad: cabbage, cucumber, radish with rock salt & black pepper powder; 2 – 3 small chapattis made from barley flour or mixed flour of wheat & barley; one small bowl of vegetable; the vegetables advised to be taken: bitter gourd, cabbage, drum sticks, bottle guard, ridge gourd, *parval*, *kankoda*, *methi* (fenugreek leaves); ½ bowl of *Samo* (Panicum frumentaceum); one bowl of daal: *Chana daal, Moonga daal, Tuvar daal (adhaki)*
Afternoon / early evening	1 glass of *yava mantha; Chana* – 50 gm or 2 *khakhara* made from barley flour
Dinner	1 small cup of *Mudga yoosha, Khichadi* made from *Samo / Kodaro* with *munga daal* or *chana daal* or 2 -3 small chapattis made from barley flour; one bowl of any vegetable as advised for lunch

Exercise: The patients were advised for 30 minutes morning brisk walk in fresh air + Soorya namaskara in gradual increasing manner; i.e., 3 times for 3 days, 5 times for 3 days, 7 times for 3 days, 9 times for 3 days, 11 times for 3 days, 12 times for remaining 15 days and to continue after therapy also. They were also advised to have 30 minutes brisk walking in the evening and to avoid day sleep.

The food to be avoided includes: milk & milk products like curd, butter, cheese, ghee etc., oily fried food, sweets, dried fruits, chocolates, bakery products, fermented items, potatoes, sugar, ice cream, fast foods etc.

Criteria for assessment of overall effect of therapy: Overall effect was assessed on the basis of relief in chief & associated complaints, decrease in: FBS & PPBS, serum cholesterol, serum triglyceride & increase in serum HDL level and decrease in urine sugar.

Criteria for assessment of effect of therapy on urine sugar

Grade 0: urine sugar	→	Nil
Grade 1: urine sugar	→	Trace
Grade 2: urine sugar	→	+
Grade 3: urine sugar	→	++
Grade 4: urine sugar	→	+++
Grade: 5 urine sugar	→	++++

Criteria for overall effect of therapy:

Complete remission: 100% relief

Marked Improvement: >75% – <100 % relief

Moderately Improved : >50% – <75 % relief

Improved : >25– <50 % relief

Unchanged : <25% relief

STATISTICAL ANALYSIS

Wilcoxon signed rank method[11] was used to check the significance of subjective criteria & Paired 't' test[12] for objective criteria in single group and to compare the effect of therapy of two groups 'X^2' - test[13] was carried for subjective criteria & Unpaired 't' test[14] for objective criteria. The obtained results were interpreted as –

*Insignificant	> 0.05
*Significant	≤ 0.05
*Insignificant	> 0.05
*Significant	≤ 0.05

OBSERVATIONS & RESULTS[15]

Total 75 patients were registered in the study. Among them 6 patients in group A, 34 patients in group B and 35 patients in group C have completed the treatment.

Table 2: Chief complaints, Associated complaints & Brief Psychiatry Rating Scale wise distribution

Symptoms	Total (n=75)	Group A (n=6)	Group B (n=34)	Group C (n=35)
	No. of pts.	No. of pts.	No. of pts.	No. of pts.
Chief Complaints				
Prabhuta mutrata	45	4	18	23
Kshudhadhikya	23	2	10	11
Trishnadhikya	27	1	10	16
Pindikodweshtana	55	4	24	27
Associated Complaints				
Karapadatala daha	36	2	20	14
Karapadatala Suptata	47	3	19	25
Atisweda	30	2	10	18
Gala talu shoshu	12	0	6	6
Daurbalya	61	4	26	31
Shrama	52	3	20	29
Brief Psychiatry Rating Scale				
Somatic concern	54	2	23	29
Anxiety	50	1	23	26
Tension	63	4	29	30
Guilt	31	1	12	18
Suspiciousness	31	4	13	14
Depressed mood	42	2	15	25

Table 3: Chronicity & BMI wise distribution of 75 patients

Chronicity wise Distribution		Total (n=75)	Group A (n=6)	Group B (n=34)	Group C (n=35)
		No. of pts.	No. of pts.	No. of pts.	No. of pts.
Chronicity	=1yr.	29	4	20	5
	1-5 yrs.	17	2	8	7
	5-10 yrs.	19	0	5	14
	10-15 yrs.	8	0	1	7
	=15 yrs.	2	0	0	2
BMI wise distribution					
BMI	Malnourished(<19)	1	0	0	1
	Normal (20-23)	5	0	3	2
	Overweight (23-25)	15	2	11	2
	Obesity (>25)	54	4	20	30
	Grade I (25-27)	7	0	2	5
	Grade II (>27)	46	4	18	24
	Grade III (>40)	1	0	0	1

Figure 1: Effect on Chief Complaints

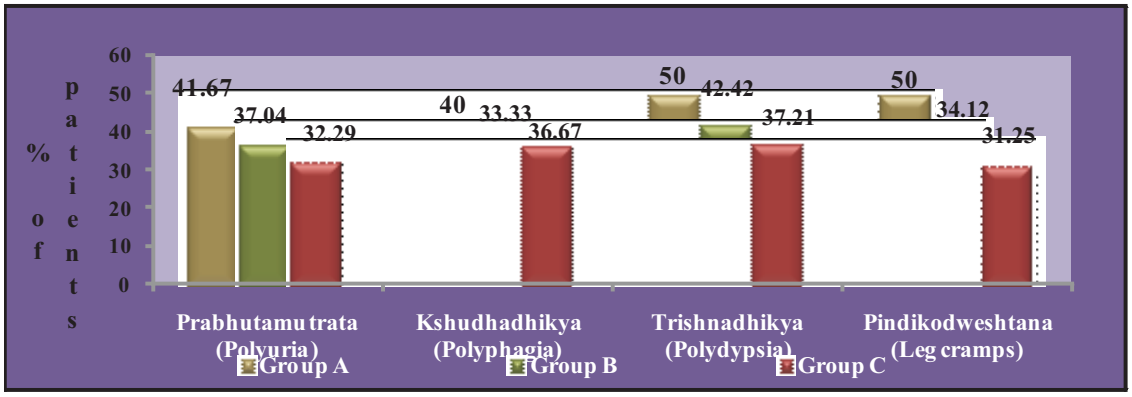
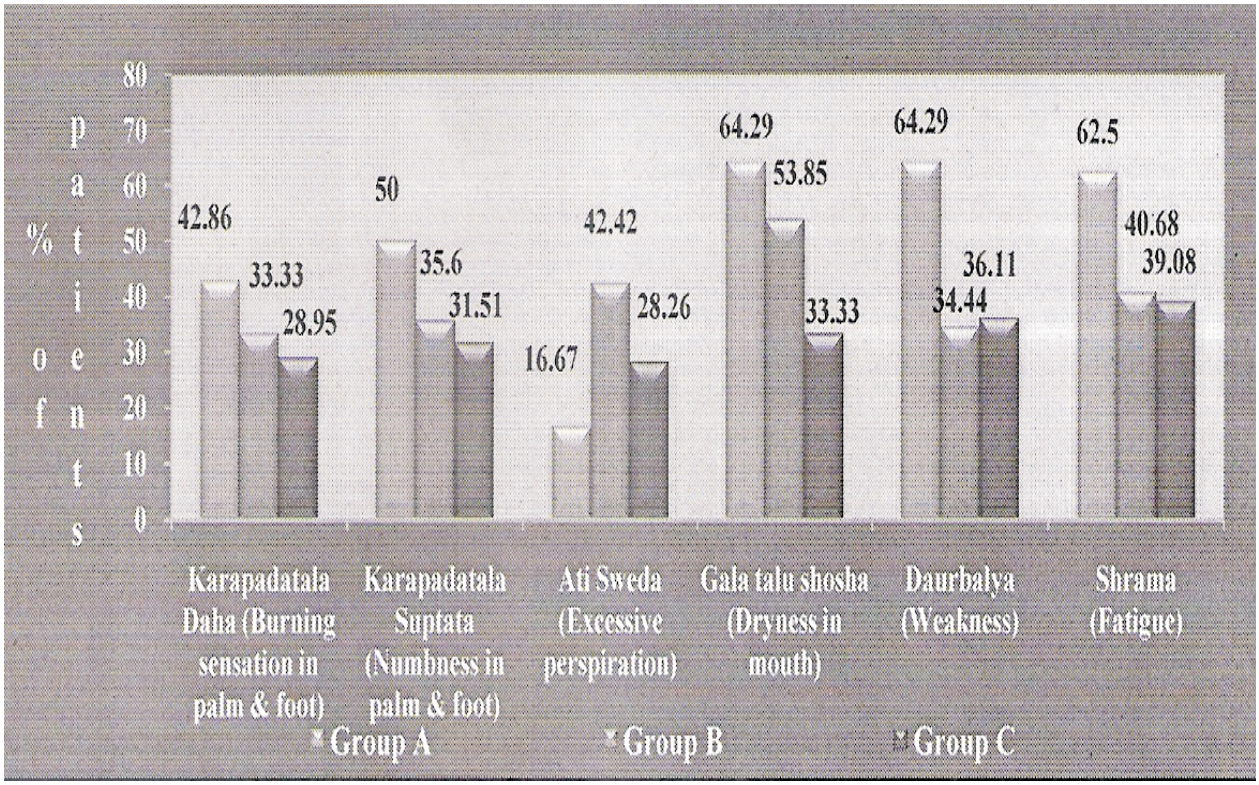


Figure 2: Effect on Associated Complaints



On comparison by Chi-square test, Prabhuta mutrata was relieved significantly better in Group C than Group B ($p<0.05$). Gala talu shosha was relieved significantly better in Group A and in Group B than Group C ($p<0.05$) and Daurbalya was relieved significantly better in Group A than Group B ($p<0.05$).

Table 4: Effect on FBS

FBS (mg %)	Mean BT	Mean AT	Mean Diff	%	SD	SE	t	p	Significance
Group A	150	149.2	0.8	1	24.82	11.10	0.07	<0.1	NS
Group B	195.7	170.3	25.4	13	48.27	8.53	2.98	<0.001	HS
Group C	224.74	194.65	30.10	13.39	70.33	12.63	2.38	<0.02	S

B.T.: Before Treatment, A.T.: After Treatment

On fasting blood sugar, group A has shown 1% decrease which is statistically insignificant. After 1 month group B has shown highly significant decrease ($p<0.001$) by 13% whereas group C has shown significant decrease by 13.39% ($p<0.02$) (Table 4).

Table 5: Effect on PPBS

PPBS (mg %)	Mean BT	Mean AT	Mean Diff	%	SD	SE	T	p	Significance
Group A	208.67	217.83	-9.17	-4	71.53	29.20	-0.31	<0.1	NS
Group B	266.26	236.16	30.10	11.30	82.25	14.77	2.04	<0.02	S
Group C	270.45	254.19	16.26	6.08	103.51	18.59	0.87	<0.1	NS

On PPBS, group A has shown 4% increase which is statistically insignificant. After 1 month group B has shown significant decrease by 11.30% ($p<0.02$) whereas group C has shown 6.08% decrease which is statistically insignificant. On comparison to test the significance of group A & group C by unpaired t test group C was significantly better than group A ($p<0.05$) (Table 5).

Table 6: Effect on Serum Cholesterol

S. Cholesterol (mg %)	Mean BT	Mean AT	Mean Diff	%	SD	SE	t	p	Significance
Group A	193.83	193.83	0	0	35.71	14.58	0	<0.1	NS
Group B	214.87	193.23	21.65	10.07	47.38	8.51	2.54	<0.01	HS
Group C	187.97	185.58	2.39	1.27	33.17	5.96	0.40	<0.1	NS

Though no change in serum cholesterol is observed after 1 month control diet, however 3 patients who had mean S.cholesterol 219.33mg% have shown 7.60% decrease in cholesterol value. Mehamudgara vati has shown highly significant decrease (10.07%) whereas Integrative group has shown 1.27%. decrease in serum cholesterol. However when these patients were splited depending upon serum cholesterol >200mg%, the results were better. The percentage decrease was highly significant in group B (16. 23%, n=17) & group C (4.51%, n=9). While comparing the results of group B & group C by unpaired t test, group B was significantly ($p<0.05$) better than group C (Table 6).

Table 7: Effect on Serum Triglyceride

S. Triglyceride (mg %)	Mean BT	Mean AT	Mean Diff	%	SD	SE	t	p	Significance
Group A	145	167.67	-22.67	-16	39.20	16	-1.42	<0.1	NS
Group B	279.42	255.16	24.26	8.68	249.25	44.77	0.54	<0.1	NS
Group C	192.87	189.52	3.35	1.74	81.87	14.69	0.23	<0.1	NS

After 1 month control diet, 16% increase in serum triglyceride was observed. Mehamudgara vati has shown 8.68% decrease in serum triglyceride level whereas Integrative group has shown 1.74% decrease. However when these patients were splited depending upon serum triglyceride >150 mg%, the results were better. The percentage decrease was 11.12% & 9.44 % respectively in group B (n=22) & group C (n=18). While comparing the results of group A & group C by unpaired t test, group C was significantly ($p<0.05$) better than group A (Table 7).

Table 8: **Effect on Serum HDL**

S. HDL (mg %)	Mean BT	Mean AT	Mean Diff	%	SD	SE	t	p	Significance
Group A	45	45.67	0.67	1	7.94	3.24	0.21	<0.1	NS
Group B	41.23	42.10	0.87	2.11	11.07	1.99	0.44	<0.1	NS
Group C	42.54	43.84	1.39	3.27	10.48	1.88	0.74	<0.1	NS

After 1 month control diet, 1% increase in serum HDL was observed however 2 patients who had mean serum HDL 39 mg% have shown 16.67% increase in HDL value. Mehamudgara vati has increased serum HDL by 2.11% whereas Integrative group has shown 3.27% increase. However when these patients were splited depending upon serum HDL < 40 mg%, the results were better. The percentage increase was 11.54% in group B (n=16) & significant by 18% in group C (n=10). While comparing the results of group A & group C by unpaired t test, group C was highly significantly ($p<0.01$) better than group A (Table 8).

Table 9: Effect of therapy on S. Creatinine

Serum Creatinine	Mean BT	Mean AT	Mean Diff	%	SD	SE	t	p	Significance
Group A	0.97	1.02	-0.05	-5.17	0.22	0.09	-0.56	<0.1	NS
Group B	1.03	1.01	0.02	2	0.1	0.02	1.15	<0.1	NS
Group C	1.07	1.04	0.03	3	0.12	0.02	1.41	<0.1	NS

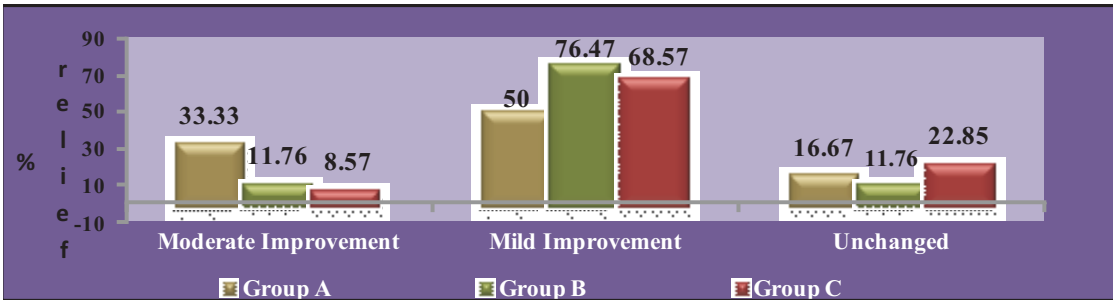
Table 10: Effect of therapy on Blood urea

Blood urea	Mean BT	Mean AT	Mean Diff	%	SD	SE	t	p	Significance
Group A	30	24.67	5.33	17.78	4.84	1.98	2.70	<0.01	HS
Group B	22.58	24.79	-2.20	-10	8.85	1.64	-1.34	<0.1	NS
Group C	24.21	25.71	-1.5	-6	7.33	1.39	-1.08	<0.1	NS

Table 11: Effect on Urine Sugar

Urine Sugar	Mean BT	Mean AT	Mean Diff	%	SD	SE	t	p	Significance
Group A	1.67	1	0.67	40	1.53	0.88	0.76	<0.1	NS
Group B	2.63	2.54	0.08	3.17	1.95	0.40	0.21	<0.1	NS
Group C	2.31	2.35	-0.04	-1.67	2.14	0.42	-0.09	<0.1	NS

Graph 3: Overall effect of therapy



DISCUSSION

The dietary articles *recommended* are mainly *Tikta, Katu, Madhura, Ruksha, Ushna, Laghu, Supachya, Dipana, Pachana, Kaphapittaghna, Medoghna* & *Pramehaghna*. They mainly reduce *Vikrita Kapha* & *Meda* which are the main *Dosha* & *Dooshya* in pathogenesis of *Prameha. Chanaka* (Bengal gram) is *Ruksha*, *Sheeta*, *Madhura*, *Kashaya*, *Kaphapittaghna*.[16] *Kulattha* (horse gram) is *Ushna, Kashaya*, *Katupaki, Kaphapittaghna* & *Medoghna. Adhaki* is *Kaphapittaghna, Naativataprakopaka*.[17] *Shyamaka* (Sanwa millet) & *Kodrava* (Varagu) are *Ushna, Kashaya, Madhura, Ruksha, Katupaki, Kaphaghna* & *Medoghna*.[18] *Kebuka* (Cabbage) is *Dipana, Pachana, Kaphapittaghna & Pramehaghna*.[19]*Moolaka* (Radish) is *Tikshna, Ushna, Katu, Grahi, Dipana, Vataghna, Ruchiprada*.[20]*Patola* (Parval) is *Katu, Tikta, Ushna, Kaphaghna*[21],*Pachana, Laghu* & *Dipana*.[22]

Shigru (drum stick) is *Ushna, Dipana, Pachana, Vatashleshmaghna*.[23] *Karavellaka* (bitter guard) is *Dipana, Bhedaka, Pittakaphaghna, Mehanut* esp. *Kaphamedoghna* and *Dipana*.[24]

Yava (barley) is *Kashaya, Kinchit Madhura, Sheeta, Katu* & *Kaphapittaghna*.[25] *Yava* due to its *Kashayatva* & *Rukshatva*, is beneficial in relieving *Prabhutamutrata*[26] and best as *Sthaulya vilekhaka* substances. It especially reduces *Meda, Vata* and pacifies *Trishna* [27]which indicates its direct action over *Medovaha srotas* by *medo pachana kriya*. *Yava* due to *manthana sanskara* in *Yava mantha*, becomes *Trishna Nashaka, Daha Shamaka* & *Triptikara*[28] so it might have been proved beneficial in relieving the symptoms like, *Kshudhadhikya, Trishnadhikya, Karapadatala Daha, Daurbalya. Mudga* (green gram) is *Kashaya*, *Madhura*, *Ruksha*, *Sheeta*, *Katupaki*, *Laghu*, *Vishada*, *Kaphapittaghna*.[29] *Mudga yoosha* is *laghu* & *supachya* having *Dipana* & *Pachana* properties, which do not give extra burden to pancreatic beta cell and other organs related to digestion though it increases the power of *Jatharagni* & *Dhatwagni* which is not in its normal state in this disease and make the process of metabolism normal. Though *Prameha* is *Medojanya vyadhi*, *Avarana* is also has been taken into consideration in the pathogenesis of this disease. *Vata prakopa* occurs either due to *Dhatu kshaya* or due to *Avarana* by *Kapha* & *Pitta*. To alleviate the *Vata dosha* and to prevent *Dhatu kshaya*, articles having *Madhura rasa* might have been indicated as the main caution to be taken while treating the patients of *Prameha* is always to prevent *Dhatu kshaya*.

All the patients registered in this group were females indulging sedentary lifestyle. Energy requirement of a sedentary woman is 1875 klcal/day. So in addition to 1875 klcal, they were prescribed to consume approximately more 600 klcal/day by 30 minutes of brisk walking two times. They were advised to have expenditure of 1875+600 = 2475 klcal/day. The diet plan given was of approximately 1000-1600 klcal/day. So total 2475 – 1600 = 875 klcal was utilized through catabolism of stored fat. On serum cholesterol, 7.60% decrease was observed in patients having abnormally high cholesterol level & 16% increase in HDL where it was <40 mg/dl, though statistically insignificant due to small sample size and less duration. For evaluating the effect on objective parameters it may require large sample study with longer duration of dietary management.

The probable *rasapanchaka* of MMV according to cumulative properties may be summarized as; *Rasa*: *tikta* (29.41%), *madhura* (27.06%), *kashaya* (24.7%), *Guna*: *ruksha* (22.05%), *guru* (20.47%), *sara* (14.17%), *sheeta* (12.60%), *Veerya*: *sheeta* (51.52%), *Vipaka*: *katu* (76.47%) and *Doshaghnata: kaphapittashamaka* (51.43%). *Agnimandya* is the main cause for formation of *Ama Kapha* & *Aparipakva Dhatus* i.e., *Bahu drava shleshma* & *Abaddha meda*. Due to *Dipana, Pachana* properties of the drugs present in MMV like *Trifala, Trikatu, Dadima, Bidalavana, Kiratatikta* etc. correct the digestive process and do *pachana* of *Amadhatus* thus correct the process of *dhatu* formation. All the *nidanas* mentioned in *Prameha* are *Kapha prakopaka* and *Ap* & *kleda yukta* so by *ruksha* property of the formulation it helps in *Samprapti vighatana* of disease. By *Ruksha* guna & *Tikta rasa* it may prevent provocation

of *Shleshma* & liquefaction of *Meda*. So *dosha dushya sammurchchhana* either will not take place or be of a mild nature. Thus second and third *kriyakalas* will lose their severity. Since *Prameha* involves many *dooshyas* in its pathogenesis so for breaking the *Samprapti*, the formulation by virtue of its *Sara guna* may reach at all sites of *Sthanasamshraya – Dosha-dooshya sammurchchhana* and by *Guru guna* the stability of the drug may increase at the sites of pathogenesis. *Sthana samshraya* of *dosha dushya* complex occurs wherever the *Kha-vaigunya* (organ weakness) takes place. In *Prameha*, the site of *Sthanasamshraya* (localization) is *Mootravaha Srotas - Basti mukha* as it is vitiated by increased *meda* and *kleda*. Here also it acts by virtue of its *Ruksha guna* & *Tikta - Kashaya rasa* and helps in correcting the *Sroto-vaigunya*. Hence it plays a key role in disintegrating the *Samprapti* by prohibiting *Shanasamshraya* of *Dosha-dooshya* complex.

The ingredients of MMV like *Guggulu*[30] , *Haritaki* [31], *Amalaki* [32] & *Shunthi* [33] etc. being hypolipidaemic may reduce fat and thus decrease insulin resistance & increase insulin sensitivity and prevent lipotoxicity. *Amalaki* [32], *Shunthi* [33], *Pippali*[34], *Kiratatikta*[35], *Rasanjana (Daruharidra)*[36], *Dadima*[37], *Bilva*[38], *Devadaru*[39] etc. being hypoglycemic take care of hyperglycemia & prevent glucotoxicity. Furthermore, antiatherosclerotic properties of *Guggulu*[30], *Amalaki*[32], *Shunthi*[33] helps in preventing macro vascular complications like neuropathy. Stress has established insulin antagonist effect and blocks the insulin release in etiopathogenesis of type 2 diabetes. The *Haritaki*[31] & *Bibhitaki*[40] being antistress and *Shunthi* [33] as anti depressant reduce the stress and ultimately control the blood sugar. Similarly the degree of stress signaling pathway is reduced by anti oxidant properties of *Amalaki*[32], *Shunthi*[33], *Maricha*[41], *Dadima*[37]. Likewise; immunomodulator properties of *Amalaki*[32] & *Devadaru*[39] prevent stress induced immunological breakdown of body. The pharmacological studies of Kiratatikta reveal that in vitro, glucose uptake and glycogen synthesis by muscle (diaphragm) was significantly enhanced by the serum of SWI – treated rat. At 100, 10 and 1 μ and 1 μM final concentration, SWI greatly enhanced insulin release from isolated islets. It is therefore concluded that SWI lowers blood glucose level by stimulating insulin release from islets of Langerhans. [42, 43,44,45,4646]

CONCLUSION

Though the sample size of dietary management group is very small to draw any concrete inference; however, its effect within short duration of one month is quite supportive on subjective parameters whereas for objective parameters it may require large sample study with longer diet control period. The patients treated with *Mehamudgaravati* and when given in combination with western conventional anti diabetic treatment has shown almost similar results. The drug has synergistic action when combined with the modern antidiabetic drugs. Healthy dietetics and healthy life style with the use of *Ayurvedic* anti diabetic drugs singularly or in combination with modern drugs, depending upon the need, will contribute significantly to achieve the goal of improvement in the quality of life of patients of diabetes.

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