EFFECT OF CAMEL MILK ON GLYCEMIC CONTROL, RISK FACTORS AND DIABETES QUALITY OF LIFE IN TYPE-1 DIABETES: A RANDOMISED PROSPECTIVE CONTROLLED STUDY

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ABSTRACT

The efficacy of camel milk on glycemic control risk factors and diabetes quality of life in patients of type 1 diabetes was evaluated. Twenty four randomly selected patients with type 1 diabetes were enrolled in the study. These patients were devided into two groups. Group 1 (N=12) received usual care (diet, exercise and insulin) and group 2 (N=12) received 500 ml camel milk in addition to usual care for 3 months. Frequent blood sugar monitoring was done to maintain euglycemia by titrating the doses of insulin. HbA_1c, Lipid profile, plasma insulin and c-peptide estimation was done at the beginning and after 3 months. BMI, diabetes quality of life questionnaire were prepared every week. In each visit patient was asked for any untoward effects after starting camel milk.

Baseline data of both the groups were similar in demographic and variables. After 3 months of treatment there were significant improvement in fasting blood sugar (9.54 ± 2.1 to 9.08 ± 1.77; $p< 0.002$) and HbA_1c levels (115.66 ± 7.17 to 100 ± 16.2; $p< 0.002$) and significant reduction in insulin requirement (mean doses of insulin 41.16 ± 10.32 to 30 ± 12.6; $p< 0.002$)in patients receiving camel milk. Diabetes quality of life score improved significantly in the form of change in satisfaction score from 28 ± 5.16 to 22.5 ± 3.96 ($p< 0.002$). There was 30% reduction in doses of insulin in 92% of patients of group 2. However, there was no statistically significant changes in lipid profile, plasma insulin and c-peptide.

Camel milk proved effective supplementation in the management of type 1 diabetes as there was significant reduction in doses of insulin along with betterment in BMI, diabetes quality of life however, there was no change in lipid profile and insulin levels.

Key words: Alternative therapy, camel milk, diabetes quality of life questionnaire, glycemic control, type 1 diabetes.

Type 1 diabetes mellitus is an organ specific auto immune disease, characterized by chronic hyperglycemia and disturbances of carbohydrates, fat and protein metabolism associated with insulin deficiency. Cow milk feeding induces primary immunisation to insulin in infants at generic risk for type 1 diabetes (Vaarela et al, 1999). The incidences if diabetes mellitus world wide appear to be increasing (Onkanoma et al, 1999). Prevention and early treatment is important because diabetes interrupts normal developments in children and carries the threat of severe complication in more active period of life (Dahlquist, 1999). Its primary treatment is insulin replacement, however, at present, entire physiological insulin replacement can not be achieved in clinical practice and metabolic disturbances can not be normalised. Insulin therapy is still the best treatment but in our country needle phobia and cost of treatment forces these patients to adopt alternative treatments. In this connection we have heard many folklore stories which describe the use of camel milk in type-1 diabetes mellitus. There is also an account in memories of Emperor Jahangir (1579 – 1627 AD) about usefulness and acceptability of camel milk (Rogers, 1989). It is found that one of the camel milk protein has many characteristics similar to insulin (Beg et al, 1986b) and it does not form coagulum in acidic environment (Wangoh, 1993). This lack of coagulum formation allows the camel milk to pas rapidly through stomach together with the specific like protein/insulin and remains available for absorption in intestine. Radioimmunoassay of camel milk has revealed high concentration of insulin i.e. 52 units/litre (Singh, 2001). The concentration of insulin in human milk is also significantly higher (60.23 ± 41.05 micro u/ml) (Shehadeh et al, 2001) but probably because of coagulation in stomach it is not available for absorption in the intestine.

Materials and methods

Subjects

A total of 24 type 1 diabetic patients were randomly recruited from the outpatient diabetic clinic in PBM Hospital, Bikaner, India. Ethical committee of S.P. Medical College, Bikaner approved the protocol and subjects gave written constant before participation in the study. The patients were advised to follow strict diet, exercise and insulin treatment for 1 month. During this period frequent monitoring of blood sugar was done to maintain euglycemia. After one-month period these patients were again randomly divided into two groups. Group 1 patients (N=12) received usual care i.e. diet, exercise and insulin and the Group 2 patients (N=12) received 500 ml of camel milk in addition to usual care for 3 months. Patients with any acute metabolic complications like hypoglycaemia, ketoacidosis, cardiovascular event, renal or acute infections were not included in the study.

Study Design an Analysis

This was a randomised, open case control, parallel design study. Blood sugar was measured twice in a week before breakfast and before dinner and blood sugar concentration was measured using the glucose oxidase method. Plasma insulin and C-peptide were estimated by fully automated chemi-illuminescence (CLIA test). Anti-insulin antibodies were estimated by radioimmunoassay. HbA_1c was measured by high performance liquid chromatography (HPLC). Plasma total cholesterol, triglycerides, VLDL, HDL and LDL were estimated by fully automated biochemistry analyser. Urine microalbumin was tested by micral test. Body mass index, waist hip ratio, and 'diabetes quality of life' score were also measured every week (Surwit et al, 1992; TDCCTRG, 1996).

Statistical Analysis

As the normality of the variables in the study could not be assured, Wilcoxan matched pair test and Mann-Whitney U test were used instead of t test. The two groups had equal number of participants and they were compared with each other using Mann-Whitney U test after Satterthwaite correction. The variables were compared at the three months to that at start of the study using Wilcoxan matched pair test with cut off value being decided at $p<0.05$.

Results

Demographic characteristics are summarised in table 1. The group 1 (control group) and group 2 (camel milk group) were similar in age (20.33 ± 4.97 Vs 19.5 ± 8.15), sex (10M, 2F in both groups), body mass index (18.43 ± 3.59 Vs 20.21 ± 2.97), fasting blood sugar (117.16 ± 17.73 Vs 115.66 ± 7.17), plasma insulin (16.37 ± 7.57 Vs 16.39 ± 6.57), c-peptide (1.24 ± 0.60 Vs 1.26 ± 0.61) plasma lipids along with different clinical, demographical and biochemical variables (table 1).

After three months of treatment there was statistically significant increase in body mass index (20.21 ± 2.97 to 21.3 ± 2.95, $p<0.05$), and improvement in fasting blood sugar (115.66 ± 7.17 to 100 ± 16.2, $p<0.002$), HbA_1c (9.54 ± 2.1 to 9.08 ± 1.77, $p<0.002$), in the camel milk group. These parameters were either unchanged or there was a slight increase in group 1 patients (table 2). Fasting plasma insulin and C-peptide levels did not reveal a significant change in either group and so were the levels of lipid profile, after 3 months of treatment. The diabetes quality of life questionnaire score changed significantly in favour of camel milk (i.e. satisfaction score 26.08 ± 4.11 to 22.5 ± 3.96, $p<0.05$; impact score 32.5 ± 2.71 to 28.08 ± 5.26, $p <0.05$; and worry score (14.66 ± 1.15 to 11.9 ± 1.24, $p<0.05$). There was a significant reduction in the mean doses of insulin (41.16 ± 10.32 to 30 ± 12.6, $p<0.002$) in patients receiving camel milk (Table 3, Fig. 1). The acceptability of camel milk was very good and only 1 patient complained of mild flatulence for 3-4 days. Mild diarrohea (2-3 semi-solid) was reported by two patients which also subsided spontaneously.

Table 1. Base line characteristics of study groups.

Variables	Group I n=12	Group II n=12	t	p		
	Mean	SD	Mean	SD		
Age (Yrs)	20.33	4.97	19.5	8.15	-1.131	0.257
W/H Ratio	0.75	0.08	0.81	0.05	-1.642	0.109
BMI (kg/m²)	18.43	3.59	20.21	2.97	-0.346	0.729
HbA_1c (%)	9.51	2.089	9.54	2.10	-1.472	0.140
Doses of Insulin (units/day)	40	8.61	41.16	10.32	-0.028	0.976
Mean Blood Sugar (mg/dl)	117.16	17.73	115.16	7.17	-0.812	0.416
T.Cholesterol (mg/dl)	165.83	19.19	164.58	20.69	0	1
HDL (mg/dl)	61.58	9.1	62.58	13.91	-1.944	0.051
LDL (mg/dl)	89.58	14.7	92	11.62	-1.097	0.272
VLDL (mg/dl)	14.41	4.67	13.5	5	-0.433	0.664
T.G. (mg/dl)	72.39	20.71	66.91	25.6	-0.636	0.524
Micro Albuminuria (mg/dl)	22.54	5.62	22.13	5.10	-0.288	0.772
Plasma Insulin (µlU/ml)	16.37	7.57	16.79	6.57	-0.346	0.729
C.Peptide (ng/ml)	1.24	0.60	1.26	0.61	-0.375	0.707
DQOL Score						
Satisfaction	26.16	2.58	28	5.16	-1.687	0.091
Impact	29.58	2.60	34	4.84	-1.285	0.198
Worry	13.0	0.05	15.5	3.20	-1.508	0.131

(Values = Mean ± S.D.) (*p=<0.05)

W/H = Waist/Hip; BMI = Body Mass Index; HbA_1c = Glycosylated haemoglobin; HDL = High Density Lipoprotein; LDL = Low Density Lipoprotein; VLDL = Very Low Density Lipoprotein; T.G. = Tri Glyceride; DQOL = Diabetes Quality of Life.

Table 2. Group I Vs group II at 3 months.

Variables	Group I n=12		Group II n=12		Mann-Whitney U test	
	Mean	SD	Mean	SD	Z adjusted	P value
Age (Yrs)	20.33	4.097	19.5	8.15	-1.131	0.257
W/H Ratio	0.75	0.08	0.81	0.05	-1.379	0.164
BMI (kg/m²)	18.41	3.51	21.3	2.95	-0.328	0.184
HbA_1c (%)	9.48	1.96	9.08	1.77	-1.905	0.056
Doses of Insulin (units/day)	38.5	8.49	30	12.06	-2.139	0.032*
Mean Blood Sugar (mg/dl)	118.16	7.15	100	16.2	-3.935	8.32E-05*
T.Cholesterol (mg/dl)	168.08	15.61	158.33	21.55	-0.433	0.664
HDL (mg/dl)	58.66	15.61	66.66	11.29	-0.115	0.907
LDL (mg/dl)	89.66	12.26	79.16	17.75	-0.981	0.326
VLDL (mg/dl)	14.25	3.16	12.08	5.08	-1.041	0.297
T.G. (mg/dl)	72.0	14.79	60.16	25.16	-0.520	0.603
Micro Albuminuria (mg/dl)	22.9	5.43	25.17	5.43	-0.130	0.817
Plasma Insulin (µlU/ml)	16.31	7.5	16.94	6.54	-0.173	0.862
C.Peptide (ng/ml)	2.28	0.63	2.22	0.5	-0.723	0.469
DQOL Score						
Satisfaction	22.75	2.37	22.5	3.96	-1.687	0.002*
Impact	29.5	3.93	28.08	5.26	-1.285	0.029*
Worry	12.58	1.16	11.91	1.24	-1.508	4.65E-05*

(Values = Mean ± S.D.) (*p=<0.05)

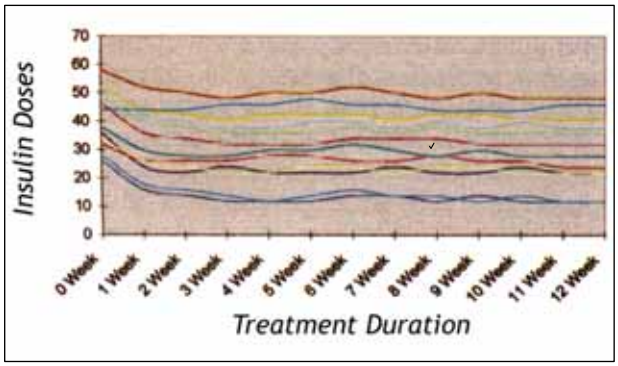
Table 3. Group II before and after treatment.

Variables	0 Month		3 Months		Wilcoxon matched pairs test	
	Mean	SD	Mean	SD	Z	P value
Age (Yrs)	19.5	8.15	19.8	8.15		
W/H Ratio	0.81	0.05	0.81	0.05	1.01	0.312
BMI (kg/m²)	20.21	2.97	21.3	2.95	3.06	0.002*
HbA_1c (%)	9.54	2.1	9.08	1.77	3.06	0.002*
Doses of Insulin (units/day)	41.16	10.32	30	12.06	3.06	0.002*
Mean Blood Sugar (mg/dl)	115.16	7.17	100	16.2	3.06	0.002*
T.Cholesterol (mg/dl)	164.58	20.59	158.33	21.55	1.29	0.195
HDL (mg/dl)	62.58	13.91	66.66	11.29	0.86	0.388
LDL (mg/dl)	92	11.62	79.16	17.75	2.04	0.040*
VLDL (mg/dl)	13.5	5	12.08	5.08	1.42	0.155
T.G. (mg/dl)	66.91	25.6	60.16	25.16	1.02	0.306
Micro Albuminuria (mg/dl)	22.13	5.10	25.17	5.43	0	1
Plasma Insulin (µlU/ml)	16.79	6.57	16.94	6.54	1.17	0.239
C.Peptide (ng/ml)	2.26	0.61	2.22	0.5	1.45	0.146
DQOL Score						
Satisfaction	28	5.16	22.5	3.96	3.06	0.002*
Impact	34	4.84	28.8	5.26	2.93	0.003*
Worry	15.5	3.2	11.91	1.24	3.05	0.002*

(Values = Mean ± S.D.) (*p=<0.05)

W/H = Waist/Hip; BMI = Body Mass Index; HbA_1c = Glycosylated haemoglobin; HDL = High Density Lipoprotein; LDL = Low Density Lipoprotein; VLDL = Very Low Density Lipoprotein; T.G. = Tri Glyceride; DQOL = Diabetes Quality of Life.

Fig 1. Doses of insulin in individual patient of group II (N = 12).



Discussion

The present study was performed to observe the role of camel milk in achieving glycemic control in type-1 diabetic patients. We observed a significant improvement in mean BMI (20.21 ± 2.97 to 21.3 ± 2.95, p<0.002) after three months of camel milk treatment. The positive effects in weight gain may be because of good nutritional value of camel milk (i.e. 2.49-3.1 gm% Vs cow milk 3.79gm%).

We also observe significant reduction in insulin doses to obtain glycemic control along with significant improvement in HbA_1c level at the end of three months. No other studies are available for comparison. Improvement in microalbuminuria may be due to direct effect of camel milk. There was marked improvement in diabetes quality of life score after 3 month of camel milk treatment. It may be because of good glycemic control or anabolic effect of camel

milk. El-Agamy et al (1992) found good amount of lysozyme, lactoferrin, lactoperoxidase, immunoglobulin G and secretory immunoglobulin A in camel milk.

Requirement of mean doses of insulin/day before treatment in patients of group-2 was 41.16 ± 10.32. It came down very fast initially and than gradually to a mean level of 30 ± 12.06, ($p<0.05$). Only one patient out of 12 patients required the same doses of insulin and the other 11 patients had lower requirement to maintain euglycemic blood level. Camel milk was found to contain about 52 units/litre insulin (Singh, 2001) and it may be the reason for lesser requirement of insulin in camel milk group. Oral insulin has been known since many years but the important drawback is its coagulum formation in acidic media in stomach thereby neutralising its potency. The lack of coagulum formation of camel milk may act as an effective vehicle to take the insulin present in it unchanged to the intestine and from there it can be absorbed even if some amount is destroyed in the passage. Beg et al (1986a) has found that amino acid sequence of some of the camel milk protein, is rich in half cystine, which has superficial similarity with insulin family of peptides.

The data of this study shows a significant hypoglycemic effect of camel milk when given as an adjunct therapy. The action is presumed to be due to presence of insulin/insulin like protein in it. Its therapeutic efficacy may be due to lack of coagulum formation of camel milk in acidic media. It has been observed that oral administration of insulin initiated at clinical onset of type 1 diabetes did not prevent the deterioration of beta cell function (Chaillous et al, 2000). Pozzilli et al (2000) in IMDIAB VII study indicates that addition of 5 mg of oral insulin does not modify the course of the disease in the first year after diagnosis and probably does not statistically effect the humoral immune response against insulin (Pozzilli et al, 2000). It is important to note that a certain level of scientific testing on camel milk has already been attempted and documented, particularly, insulin levels in camel milk and this scientific wisdom can be remarkable achievement for diabetic patients.

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