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Original Article

Effect of Exercise on Glycemic Status of Patients Suffering from type 2 Diabetes Mellitus

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Abstract :

Back ground: The number of people with diabetes is now considered to have reached epidemic proportions. Globally the incidence rate of type 1 and particularly type 2 diabetes are increasing in all societies. Type 2 diabetes is highly prevalent in elderly and is now emerging in childhood and accounts for more than 95% of all diabetes. Due to the rising tide of type 2 diabetes, it is a major international challenge for optimal intervention and prevention strategies. Objective: To see the effectiveness of exercise in type 2 diabetic patient. Materials and Methods: The study was carried out in the department of physiology of Mymensingh Medical College from July 2007 to June 2008. To assess glycemic status we estimate pre and post exercise blood glucose and glycated hemoglobin level of 101 study group whose age ranged from 38-70 years. Result: During the study time in this group of population pre and post exercise blood glucose level was respectively 9.18 mmol/L and 8.05 mmol/L, P value <0.001, indicate the significance of exercise. Regular exercise for a period of 30 to 40 minutes in the form of walking seems to improve the glycemic status in type 2 diabetes mellitus. Conclusion: It can be concluded that regular exercise for a period of 30 to 40 minutes in the form of walking seems to control blood glucose level within normal range in type 2 diabetes mellitus. So, health care professionals must address exercise in those patients as a part of treatment.

Key words: Type 2 diabetes mellitus, exercise, pre and post exercise blood glucose, HbA1C.

Introduction:

Only 80 years ago diabetes mellitus was little known to us. In fact, no one really knew much about the condition, or how to treat it. Banting and Best discovered insulin in 1921 and since then there has been an understandable tendency amongst those with diabetes mellitus to look for information about control and eventually a care of this annoying life long disorder. Diabetes mellitus is a first expanding global health problem but more so in the developing countries[1]. The number of people with diabetes mellitus in the world is expected to double from 171 to 366 million from 2000 to 2030. Diabetes mellitus affects mostly those in the 45 – 64 years age range in developing countries in contrast to the > 64 years age range in developing countries. In 2007, it was estimated that there were 246 million people with diabetes mellitus in the adult population in the seven regions of International Diabetes Federation. In 2003, the total was 194 million[3]. Diabetes mellitus is a syndrome characterized by disordered

metabolism and abnormally high blood sugar resulting from insufficient levels of the hormone insulin secretion or reduced effectiveness of insulin action or both[4]. Type 2 diabetes mellitus (formerly called non-insulin dependent diabetes mellitus or adult onset diabetes) is a metabolic disorder that is primarily characterized by insulin resistance, relative insulin deficiency and hyperglycemia[5].

The journey of a thousand miles begins with a single step. Exercise works the same way. Taking that first step can be hard, especially if you've been diagnosed with diabetes mellitus[6]. The benefits of exercise in diabetic patients have been known for long before and it is one of the cornerstones for management of diabetes mellitus. Aerobic exercise refers to exercise that involves or improves oxygen consumption by the body. Aerobic means "with oxygen" and refers to the use of oxygen in the body's metabolic or energy generating process[7]. The American Diabetes Association now recommends 150 minutes per week of moderate activity and or 90 minutes per week of vigorous aerobic activity and strength training 3 days per week as part of a program to prevent or manage type 2 diabetes mellitus[8]. Exercise increases glucose entry into skeletal muscle in absence of insulin caused by GLUT4 transporters in muscle cell membranes. This increase in glucose entry persist for several hours after exercise, and regular exercise training can produce prolonged increase in insulin sensitivity[9]. Moderate exercising, however, our muscles take up glucose at almost 20 times the normal rate. This lowers blood glucose levels. There are so many complications of diabetes mellitus, such as-

A. Ocular complications- Diabetic cataracts, Diabetic retinopathy, Glaucoma
B. Diabetic nephropathy- Microalbuminuria, Progressive diabetic nephropathy,
C. Peripheral neuropathy- Distal symmetric polyneuropathy, Isolated peripheral neuropathy, Painful diabetic neuropathy Autonomic neuropathy-
D. Cardiovascular complications- Cardiac arrythmia, Myocardial Ischemia, Peripheral vascular disease,
E. Skin and mucous membrane complications.

Therefore, it is evident from the above discussion that diabetes mellitus have many complications if not properly treated or well controlled. So we intended the clinical appraisal to evaluate how much changes of blood glucose level occured by aerobic exercise in type 2 diabetic patient. For these reasons we estimate HbA_1c level as a parameter of glycemic control and blood glucose level before and after aerobic exercise as well. Our prove on this study is in our socio-economic setting; does aerobic exercise is at all beneficial in type 2 diabetic patient to control the glycemic status? We hypothesized that the decrease HbA_1c value would be greater in aerobic exercising population and the findings of this study will show the importance of aerobic exercise.

Materials and Methods:

Total number of 202 (two hundred two) subjects participated in this study. They were grouped into:

a) **Study group:** consist of 101 (one hundred one) cases of diabetic patients of different age group with pre & post exercise blood glucose level and HbA1c.
b) **Control group:** It included 101 (one hundred one) non-diabetic patients of similar age & who performed physical exercise regularly with pre & post exercise blood glucose level and HbA1c.

Exclusion Criteria of Study group: Patients suffering from type 1 diabetes mellitus (usually it occurs before age of 40 years, body weight normal or low and family history of diabetes is uncommon) diabetes mellitus with history of physical inactivity, gestational diabetes mellitus, diabetes mellitus with essential hypertension, Diabetes mellitus with complications.

Inclusion Criteria of Study group: Patients suffering from type 2 diabetes mellitus (Age of onset above 50 years, patients are usually obese and having family history of diabetes.) without any complications and performed exercise regularly.

Data were collected through a preformed data collection sheet (Questionnaire). The study protocol was approved by the ethical review committee, Mymensingh Medical College, Mymensingh. It was convenience sampling. During visit the available diabetic patients and control those who were non-diabetic but they performed exercise regularly, were

interviewed, examined and sample of blood was drawn. The subjects were selected on the basis of history and clinical examination. The subjects were obtained from out door and indoor of department of endocrinology in Mymensingh Medical College and Hospital, Mymensingh, Community Based Medical College Hospital Bangladesh, Diabetic Centre, (Dopakhola and BAU), Shaheb Park, Bangladesh Agricultural University Campus, Mymensingh with due permission of the proper authorities.

Under strict aseptic precaution about 4 ml (pre exercise 2 ml and post exercise 2 ml) of venous blood was collected directly from anticubital vein by disposable syringe (time in the morning from 6.30 am to 8.30 am) with a gentle pull and transfer to an EDTA tube level with name of subject, time and date of collection of blood. The blood samples were carried to the laboratory within 2 hours of collection of the samples. The blood samples (2 ml) were centrifuged at 3000 rpm for 30 minutes. After centrifugation resulting supernatant serum was removed for glucose estimation. The glucose was determined after enzymatic oxidation in the presence of glucose oxidase. Glycosylated Hemoglobin was determined by Ion exchange resin method. With measuring glycosylated hemoglobin we assessed the effectiveness of therapy by monitoring long-term serum glucose regulation. The stability of contents of the Global's glycosylated hemoglobin kit was maintained at 2-8^{0}C temperature till the expiry date which was mentioned. The result were calculated and analyzed by SPSS version 2000, scientific electronic calculator and simultaneously with a computer assisted program like Microsoft Excel. Paired t-test was applied to find the effect of exercise on glycemic status in type-2 diabetic subjects. The value of P is <0.001 was considered highly significant.

Results:

In the results mean pre & post exercise blood glucose level was 9.18 mmol/L and 8.05 mmol/L. The results emphasizing the practice of regular exercise for a period of 30 - 40 minutes will improve glycemic status. Presented Table - I shows highly significant value both study & control groups. Table - II shows pre and post exercise HbA1c levels were statistically in significant, for study (p < 0.178) as well as control group (P<0.465)

Table - I: Pre and post exercise blood glucose level between control and study group

Group	Parameters	n	Mean	SEM	Mean difference	t value	p value
Control group	Pre exercise blood glucose level (m mol/l)	101	4.802	0.084	0.539	12.751	<0.001
	Post exercise blood glucose level (m mol/l)	101	4.262	0.072			
Study group	Pre exercise blood glucose level (m mol/l)	101	9.18	0.305	1.13	12.241	<0.001
	Post exercise blood glucose level (m mol/l)	101	8.05	0.274			

n = Number of subjects
SEM = Standard error of mean
P<0.001 = Highly significant

Table - II: Pre and post exercise HbA_1c level between control and study group

Group	Parameters	n	Mean	SEM	Mean difference	t value	p value
Control group	Pre exercise HbA_1c Level	101	5.013	0.087	0.005	0.734	0.465
	Post exercise HbA_1c Level	101	5.008	0.087			
Study group	Pre exercise HbA_1c Level	101	7.214	0.124	0.016	1.358	0.178
	Post exercise HbA_1c Level	101	7.197	0.121			

n = Number of subjects

SEM = Standard error of mean
P<0.001 = Highly significant

Table – III: Showing general characteristic of two groups

Variables	Study group (type-2 diabetic patient) (Mean ± SD)	Control group (Mean ± SD)
Age (years)	50.23 ± 7.17	45.29 ± 5.30
Body weight (kg)	66.18 ± 9.42	61.32 ± 7.87
Height (m)	1.61 ± 0.08	1.59 ± 0.12
BMI	25.41 ± 4.00	24.27 ± 2.66

Discussion:

The findings of this study provide evidence that good glycemic control can be achieved by change in lifestyle and the study emphasizing the need for regular participation of aerobic exercise. Therefore, individuals who wish to improve good glycemic status will advise to do aerobic exercise as a part of treatment. The study reflected that there were significant changes of pre and post exercise blood glucose levels. Those who perform aerobic exercise regularly HbA1c levels of the participants were also within normal range that is they were in category of good glycemic control. The study documents show that the mean pre and post exercising blood glucose level 9.18 and 8.05mmol/L in case of study group, this is highly significant. Regarding HbA1c level, which was nearer to the target value of good glycemic control in a study group. However, we can assume from this study, fair glycemic control maintained by aerobic exercise by increasing insulin sensitivity, increased peripheral utilization of glucose and also increases cardio respiratory fitness. But the exact mechanism is unclear to us. Therefore, persons with type 2 diabetes who wish to improve their glycemic control through physical activity should be encouraged to perform aerobic training. Adjusted absolute HbA1c values decreased significantly in the aerobic training group compared with the control group (change, – 0.51 percentage point; P = 0.007), observed in other study[10]. Thus aerobic exercise (walking, jogging or cycling) reduced the HbA1c value by about 0.6%, a 1% absolute decrease in the HbA1c value is associated with a 15% to 20% decrease in major cardiovascular events and 37% reduction in micro vascular complications[10]. The highest amount of weekly exercise, with minimal weight change, had widespread beneficial effects. The improvements were related to the amount of activity and not to the moderate intensity of exercise or improvement in fitness[11]. Patients with elevated HbA1c who do not have diabetes may need more careful follow up and possibly aggressive treatment to reduce the risk of diabetes. The annual incidence of diabetes for patients with base line HbA1c ≤ 5.5 was 0.8%, for HbA1c 5.6 to 6.0, 2.5%, for HbA1c 6.1 to 6.9, 7.8%, and obese patients with HbA1c 5.6 to 6.0 had an annual incidence of diabetes of 4.1% found by other researcher[12]. The exercise participants had a 30% improvement in the distance walked in 6 minutes, and an increased in oxygen consumption (VO_2) pick from 3% in the control group to 17% in the exercise group. Blood tests showed that after exercise training, insulin response was reduced by 25%. Almost 60% of those who had exercise training showed improved results from the oral glucose tolerance test, compared with 9% in the control group[13]. Effect of a 4-month moderate-intensity aerobic exercise program on insulin sensitivity and muscle mitochondrial biogenesis in people between the ages of 22 and 87 years. In agreement with previous reports, insulin sensitivity declined with age but improved with exercise training. A key finding of the current study is that the increment in insulin sensitivity due to exercise training was present in younger people but not in middle age and older groups. Abdominal adiposity; which was the best correlate with insulin sensitivity at baseline and plasma triglycerides was decreased by exercise. Thus, insulin sensitivity was the only variable that demonstrated an age-dependent response to exercise training[14]. A study in Japan a total of 459 overweight and obese women (age, 49 ± 9 years; BMI, 28 ± 3 kg/m^2) were recruited for a base line examination to test the relationship between cardio respiratory fitness and metabolic syndrome prevalence among these, 67 subjects with Metasyn were treated with 14 weeks weight loss programs, which included low calorie diet and aerobic exercise. Results suggest that adding aerobic exercise training to a dietary weight reduction program improves Metasyn in obese women,

compared with diet alone[15]. Short term aerobic exercise training can improve whole body insulin sensitivity (that is gains in peripheral, not hepatic insulin sensitivity) in humans with type 2 diabetes mellitus[16]. Physical exercise has variably reduced body weight, visceral fat accumuslation and insulin resistance, improved glucose tolerance and lipid profile and decreased blood pressure[17]. Six months of low intensity tread mill endurance training produces substantial and progressive reductions in the energy expenditure and cardiovascular demands of walking in older patients with chronic hemi paretic stroke suggest that task oriented aerobic exercise may improve functional mobility and cardiovascular fitness profile in this population[18].

Conclusion:

Physical exercise has been considered beneficial in the treatment of both type 1 and type 2 diabetes. Exercise and physical training confer particular metabolic benefits in type 2 diabetes in terms of improved insulin sensitivity and glucose disposal. Improved self-image, maintenance of ideal weight and decreased hypertension and lipid-related cardiovascular risk factors are readily achievable by the diabetic who exercises regularly. So, definitely physical exercise (both aerobic & anaerobic) is considered beneficial for preventing and controlling or at least delaying the type 2 diabetes mellitus.

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