EFFECT OF PASSIVE STRETCHING ON BLOOD GLUCOSE LEVEL IN PATIENTS WITH TYPE II DIABETES MELLITUS

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ABSTRACT

Title: Effect of passive stretching on blood glucose level in patients with type II diabetes mellitus.

Background: Diabetes mellitus is a metabolic disorder affecting approximately 65.1 million. Along with diet and medication, exercise therapy has been considered one of the three cornerstones of diabetes therapy. Some studies done on animals suggested that passive stretching of a muscle resulted in increased glucose uptake at cellular level and is beneficial in diabetes.

Objective: To assess the effect of passive stretching on blood glucose level in patients with type II diabetes mellitus.

Methodology: Total 23 subjects with type II diabetes mellitus were recruited. 12 patients were in passive stretching group and 11 subjects were in mock stretching group. In passive stretching group, 10 different muscle groups were stretched passively and in mock stretching group, subjects assumed same stretched positions but without external force for the same repetitions and duration. For both the groups, total duration of the session was 40 min and blood glucose level measured at 0 min, 20 min and at the end of the session.

Results: The blood glucose level was reduced in both the group but more significant reduction was noted in the passive stretching group compared to mock stretching group at both after 20 min and 40 minutes (p values 0.05 and 0.01 respectively)

Conclusion: Passive stretching can significantly lower the blood glucose level and it can be given as adjunct therapy in the treatment of type II diabetes mellitus.

Keywords: Type II diabetes mellitus, exercise, passive stretching physical activity, obesity.

I. INTRODUCTION

Diabetes mellitus is a metabolic disorder of multiple etiologies characterized by chronic hyperglycemia resulting from defects in insulin production, its action or both. It is a major and growing health problem with approx. 65.1 million Indians are affected by diabetes. Every sixth second, a person dies from diabetes in the world. Among different types of diabetes, type II diabetes mellitus is very common. In India more than 90% of diabetics are having type II diabetes mellitus.
Type II diabetes mellitus, is a slowly progressive disease which results from a combination of insulin insensitivity of target tissues especially skeletal muscle which leads to resistance to insulin and/or insulin deficiency. Major risk factors of diabetes are increasing age, sedentary lifestyle and obesity. Patients with this form of diabetes are mostly overweight/obese and obesity itself causes some degree of insulin resistance.

Among the various complications of the diabetes, Stroke and large vessel diseases are the leading causes of mortality and morbidity. The major manifestations of large vessel disease include, Cerebro-Vascular disease, Heart disease and Peripheral Vascular Disease.

Pharmacological approach is the most common approach for the management of type II diabetes mellitus which includes oral hypoglycemic, insulin and other agents that improve glucose control. Since many years, along with medication, exercise and diet has been considered one of the three cornerstones for the management of diabetic patients. Regular physical activity/exercise is widely recommended for patients with type II diabetes mellitus. Exercise is having beneficial effects on certain metabolic risk factors which are responsible for the development of complications in this population. There are several studies which have concluded that exercise alone has some clinical benefits like improved insulin sensitivity & reductions in glycosylated hemoglobin. A considerable amount of literatures has been published in last decade trying to identify safe, feasible and effective exercise program for this population. Physical training also causes adaptations to metabolic system that result in sustained improvements in insulin sensitivity.

Though regular exercises are beneficial to control the blood glucose level in diabetic patients, many people with diabetes mellitus do not exercise. For some patients, secondary complications such as lower limb neuropathy, lower limb amputation, hypertension, kidney disease etc. will make it difficult for the patients to perform exercise and some factors might contraindicate exercise. Also many chronic diabetic patients in extended care facilities are either extremely frail, dependent on wheelchair for mobility or bed bound that do not have sufficient exercise/physical work capacity to perform any kind of exercise thus have problem in maintaining normal blood glucose level. For these kinds of patients, some passive form of activity should be implemented which require very minimal effort from the patient to control the sugar level. Some animal studies suggest that passive stretching of a muscle resulted in increased cellular glucose uptake. A sustained or intermittent, end range stretch force given with slightly overpressure at the end by manually or with mechanical device, elongates a tightened skeletal muscle tendon unit and connective tissues by moving a restricted joint past the available range of motion (ROM). When stretching is applied to the soft tissues the velocity, direction, intensity, frequency and duration of stretch force affect the responses of the various types of soft tissue. There are few animal researches available which suggest passive stretching reduces blood glucose level but very few human studies available to find out effect of passive stretching on blood glucose level. Therefore, the aim of the study is to see the effect of passive stretching on blood glucose level in patients with type II diabetes mellitus.

II. MATERIALS AND METHODS

A prospective, longitudinal, Interventional study was conducted on type II diabetes mellitus patients at Dhiraj Hospital, Vadodara over a period of 1 year. Total 23 subjects (16 males and 7 females) participated in the study.

Inclusion criteria:
- Diagnosed case of type II diabetes mellitus.
- Patients on oral hypoglycemic drug.

Exclusion criteria:
- Patients on insulin therapy.
Any bony block limiting joint motion.
Recent fracture and cases with mal- and non-union.
Evidence of acute inflammatory or infectious process - heat & swelling.
Acute pain with joint movement or muscle elongation.
Hematoma or other indications of tissue trauma.
Unhealed wound or scar around the area to be stretched.
Any musculoskeletal disorder that does not permit stretching and limit ROM.
Any cardiovascular or neuromuscular disorders.

Consecutive patients diagnosed as Type II DM who was on oral hypoglycemic referred was alternatively assigned into two groups; one group received Passive Stretching (experimental group) & other group received Mock Stretching (control group). Patients were unaware of their group allocation. For both the groups stretching session was started two hours after meal.

In passive stretching group, the stretching program was consisting of stretching to six muscles of lower body and stretching of four muscles of upper body. During each stretch, therapist was pushing or pulling the specific body part until she received verbal acknowledgement from the participant. In bilateral stretch, stretching was held for 30 sec. and in unilateral stretch, stretching was held for 15 sec. for each repetition. The therapist repeated each stretch for 4 times. A 15 second rest period was given between two consecutive repetitions and minimum 30 seconds of rest was given to separate the different stretches. In mock stretching, subject assumed same stretch positions like in the experimental group for the same period of time but no tension was placed on the muscles. All the stretching which involve single limb, was performed on right side first and then on the left side. The muscles stretched are hip flexors, extensors, rotators, knee flexor and extensors, plantar flexors, shoulder flexors, extensors, abductors, adductors and elbow flexors and extensors.

For both the groups, time period of one complete session was 40 minutes. Blood glucose level of all the subjects in both groups was tested three times: at the starting of the session, after completing 20 minutes and at the end of the session.

III. RESULTS

Out of 23 subjects, 16 (69.57%) were male and 17 (30.43%) were females. The mean age was 60.92 (±15.64) in passive stretching group. For mock stretching group, mean age was 53.09 (±6.474). The groups were equally...
distributed (p=0.138). The Body Mass Index (BMI) and the time since diagnosis of type II diabetes mellitus, showed no significant difference between two groups p value 0.816 and 0.395 respectively.

Table: 1 Baseline characteristics tested by independent t-test (inter group comparison)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Mean Difference</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Passive Stretching</td>
<td>12</td>
<td>60.92</td>
<td>15.646</td>
<td>7.826</td>
<td>1.540</td>
<td>0.138</td>
</tr>
<tr>
<td></td>
<td>Mock Stretching</td>
<td>11</td>
<td>53.09</td>
<td>6.472</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>Passive Stretching</td>
<td>12</td>
<td>25.029</td>
<td>3.543</td>
<td>-0.35</td>
<td>-0.235</td>
<td>0.816</td>
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<tr>
<td></td>
<td>Mock Stretching</td>
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<td>25.38</td>
<td>3.67</td>
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<tr>
<td>Time since diagnosed (years)</td>
<td>Passive Stretching</td>
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<td>3.708</td>
<td>4.95</td>
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<tr>
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<td>Mock Stretching</td>
<td>11</td>
<td>5.27</td>
<td>3.49</td>
<td>-1.56</td>
<td>-0.869</td>
<td>0.395</td>
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Table: 2 Comparison of blood glucose levels in stretching group

<table>
<thead>
<tr>
<th>Glucose level at</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Mean Difference</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 min</td>
<td>219.58</td>
<td>12</td>
<td>62.531</td>
<td>35.167</td>
<td>5.424</td>
<td>&lt;0.001</td>
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<tr>
<td>20 min</td>
<td>184.42</td>
<td>12</td>
<td>54.090</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 min</td>
<td>219.58</td>
<td>12</td>
<td>62.531</td>
<td>56.333</td>
<td>8.750</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>40 min</td>
<td>163.25</td>
<td>12</td>
<td>59.955</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Table: 3 Comparison of blood glucose levels in mock stretching group

<table>
<thead>
<tr>
<th>Glucose level at</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Mean Difference</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 min</td>
<td>239.91</td>
<td>11</td>
<td>85.640</td>
<td>13.545</td>
<td>1.644</td>
<td>.131</td>
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<tr>
<td>20 min</td>
<td>226.36</td>
<td>11</td>
<td>90.790</td>
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<td></td>
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<tr>
<td>0 min</td>
<td>239.91</td>
<td>10</td>
<td>86.046</td>
<td>26.400</td>
<td>2.979</td>
<td>.015</td>
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<tr>
<td>40 min</td>
<td>205.70</td>
<td>10</td>
<td>86.914</td>
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Table: 4 Comparison in change in blood glucose between group 1 and group 2

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<th>Glucose difference level</th>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Mean Difference</th>
<th>t-value</th>
<th>p-value</th>
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<tbody>
<tr>
<td>0 – 20 min</td>
<td>Passive Stretching</td>
<td>12</td>
<td>35.17</td>
<td>22.461</td>
<td>21.621</td>
<td>2.080</td>
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<td>Mock Stretching</td>
<td>11</td>
<td>13.55</td>
<td>27.333</td>
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<tr>
<td></td>
<td>Passive Stretching</td>
<td>12</td>
<td>56.33</td>
<td>22.301</td>
<td>29.933</td>
<td>2.792</td>
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</tr>
<tr>
<td></td>
<td>Mock Stretching</td>
<td>10</td>
<td>26.40</td>
<td>28.029</td>
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</tr>
</tbody>
</table>

Figure: Average reductions in blood glucose level in both groups
The above graph shows reduction in blood glucose level at three different levels: at 0 min, 20 min and 40 min of the session. In this, PS (passive stretching) group shows more reduction in blood glucose level than MS (mock stretching) group. The blood glucose level lowered in both the group but more significant reduction was noted in the passive stretching group compared to mock stretching group at both after 20 min and 40 min. p values 0.05 and 0.01 respectively.

IV. DISCUSSION

The purpose of this study was to determine the effect of passive stretching on blood glucose level in patients with type II diabetes mellitus. In this study total 23 patients with diabetes mellitus were recruited and divided into two groups: Passive Stretching group and Mock Stretching group. In passive stretching group, there were 12 subjects and in mock stretching group there were 11 subjects with type II diabetes mellitus.

The results show that reduction in the blood glucose level is more significant in passive stretching group compared to that of the mock stretching group. This puts a strong point on the effectiveness of passive stretching for reduction of blood glucose level.

Physical and emotional stress associated with stretching causes release of catecholamines and cortisol. These hormones can raise blood glucose level by activation of glycogenolysis in lever. The are many possible mechanisms that explains why passively stretched muscles yield lowering of blood glucose level. One study suggests that passively stretched muscles exhibit increase oxygen consumption and production of heat. Some other studies found that passive stretching of the skeletal muscles increase carbon dioxide production, increase glycogen breakdown, increase lactic acid production and phosphocreatine concentration. Since increased metabolic activity is related to increase activity of adenosine monophosphate kinase facilitated glucose transporter (GLUT 4) activation pathway. It is possible that the increased metabolic activity accompanying passive muscle stretching could have activated the incorporation of GLUT 4 into the stretched muscles and subsequently reduces blood glucose level. Other studies found that mitogen activated protein kinase activity stimulates muscle glucose uptake and activity of mitogen activated protein kinase directly reflects the magnitude of mechanical stress.

In this study, also there is highly significant reduction in the blood glucose level both after completing 20 minutes and 40 minutes of the session in passive stretching group (p <0.001).

Some reduction in the blood glucose level is also noted in the mock stretching group which is significant only at the end of the session but no significant changes present after completing 20 minutes of the session with p value 0.015 and 0.131 respectively. These findings suggest that even light physical activity which is given in the mock stretching group can start to lower blood glucose.

It is clear that passive stretching of skeletal muscles has significant positive effects on diabetic patients. This results has important application on these patients because majority of chronic patient populations are frail, sedentary, wheelchair or bed bound due to non-availability of equipments or lack of motivation to exercise. Many patients cannot perform active exercises due to secondary complications of diabetes mellitus. Passive stretching is beneficial for such patients and for those who are reluctant to do exercise to control blood glucose level.
Nelson and colleagues (2005) in their study showed that passive stretching increases the metabolic rate similar to the metabolic rate estimated for jogging at 60 meters/min or walking at 40 meters/min. These findings along with the results of this suggest to use daily 20-40 minutes of passive stretching may help a patient to control or lower blood glucose level.²

V. CONCLUSION

Passive stretching significantly lowers blood glucose level and it can be given as the adjunct therapy in the treatment of the patients with type II diabetes mellitus to control the blood glucose level.

Scope for further study

- Study can be conducted by doing long term follow up in blood glucose level after passive stretching exercises.

Conflict of interest

We declare that there were no conflicts of interest in the entire journey of the study

REFERENCES