Research Article

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# ROLE OF YOGA IN ALIENATING THE MEMORY DECLINE AND FRONTAL LOBE METABOLITE CHANGES IN TYPE 2 DIABETES

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**ABSTRACT**

Recent research studies have established the fact, that glycosylation is causing the memory decline and this is further supported by the alteration of brain metabolite concentrations in diabetes. The present study is hypothesized that yoga is having alienating ability of memory decline and alteration of frontal lobe metabolite concentrations, which are the result of glycosylation in type 2 diabetes. Five type 2 diabetic subjects of both the sex, aged between 35-55 years, who practiced yoga over a period of six months in a yoga institute, were recruited as test group. Age and sex matched five type 2 diabetic subjects were recruited as control group, both the group subjects are on oral hypoglycaemic agents. Glycosylated haemoglobin percentage was estimated with Bio-Rad instrument, frontal lobe metabolites were estimated with Proton Magnetic Resonance Spectroscopy (H-MRS), memory was calculated with PGI-Memory Scale (PGIMS) that is a part of PGI-Battery of Brain Dysfunction (PGI-BBD), which is a neuropsychological battery. Mean glycosylated haemoglobin percentage and memory dysfunction rating in control and test group subjects are 6.9±0.4 & 7.8±1.84 (p=0.03), and 14±1& 6±1 (p=0.0001) respectively. Right and left frontal lobe N-Acetyl Aspartate (NAA) and Myoionositol (mI) concentrations were more or less similar in both the groups. Yoga is having a significant role in alienating the decline in memory caused by glycosylation in type 2 diabetes but not on the alteration of frontal lobe NAA and mI concentrations.

**Key words:** yoga, memory, glycosylated haemoglobin, myoinositol, N-Acetyl aspartate

## INTRODUCTION

In diabetes glycosylation of red blood cells is having regulatory role on the frontal lobe metabolite concentrations[1]. Alteration of frontal lobe metabolite concentrations is the cause for memory decline in type 2 diabetes[2]. Memory is the entire series of process involved in learning and remembering, to the act of learning alone or just to the act of remembering itself[3].Not much data is available on the specific effects of brain metabolite concentrations on memory, particularly that of frontal lobe metabolites. Apart from filling this gap in the research field, the present study is also aiming to study the role of yoga in alienating the memory decline and frontal lobe metabolite changes. Though hippocampus is the centre for memory, frontal lobe is having its significance in memory as well[4,5,6]. Right frontal lobe is responsible for episodic memory retrieval[5,7] and the left frontal lobe is involved in encoding of episodic memory[8]. Concentration of N-Acetyl Aspartate (NAA) indicates the neuronal integrity[9] and myoinositol (mI) concentration indicates the neuroglial functioning[10].

### Aim and objectives of the study

1. To elucidate the effect of glycosylation on frontal lobe N-Acetyl Aspartate (NAA) and Myoinositol (mI) concentrations in type 2 diabetes.
2. To elucidate the effect of type 2 diabetes on memory.
3. To elucidate the relation between frontal lobe NAA and mI concentrations with memory.
4. To elucidate the role of yoga in alienating the memory decline and alteration of frontal lobe NAA, mI concentrations.

## MATERIALS AND METHODS

It is a case control study, and the study was approved by the institutional ethical committee (Dt.14/09/2012 No: FWA00002084). Five type 2 diabetic subjects of both the sex, aged between 35-55 years, who practiced yoga over a period of six months in yoga institute, were recruited as test group. Age and sex matched 5 type 2 diabetic subjects were recruited as control group, both the group subjects are on oral hypoglycaemic agents. To minimize the cultural, socio-economical and educational differences on memory domain, control group subjects were also selected from the same area. Written informed consent was obtained from all the subjects prior to their recruitment in to the study. Inclusion criteria: type 2 diabetic patients who are taking oral hypoglycaemic agents for more than 2 years, age between 35-55 years, both the sex. Exclusion criteria: type 1 diabetes, type 2 diabetic patients who are on insulin therapy, h/o major surgeries in recent times, smokers and alcoholics, Claustrophobics.

Test group subjects have practiced specific yogasanas and pranayama, listed in table 1 at yoga institute under the supervision of a qualified yoga expert, 6 days in a week, 45-60 minutes per day. The set of yogasanas and pranayama included in the study were based on their positive results in diabetic population, which was proved by the earlier studies[11].

**Table 1: List of Yogasanas and Pranayama**

| S.No | Name of the Yogasana | Duration |
|---|---|---|
| 1 | Dhanurasana | 1/2 minute to one minute for the pose being maintained, adding 1/2 minute per week |
| 2 | Naukasana | 2 - 4 turn of each, the pose being maintained for ten seconds adding one turn each, every fortnight |
| 3 | Arthamasthendrasana | ¼ minute to one minute for each side, adding ¼ minute per week |
| 4 | Bhujangasana | 2 - 4 turn of each, the pose being maintained for ten seconds adding one turn each, every fortnight |
| 5 | Shavaasana/Makarasana | Shavaasana/Makarasana 3 turn of each, the pose being maintained for 30 seconds |
| **S.No** | **Name of the Pranayam** | **Duration** |
| 1 | Anuloma-viloma | 2-5 minutes |
| 2 | Surya anuloma-viloma | 5 minutes |
| 3 | Chandra anuloma-viloma | 5 minutes |
| 4 | Nadishuddi pranayama | 10 minutes |

Glycosylated hemoglobin concentration is estimated with Bio-Rad machine that is based on high performance liquid chromatography (HPLC) principle and HbA1c <6% is non diabetic, between 6-7% considered as good control,>8% requires immediate attention[12]. Frontal lobe magnetic resonance spectroscopy was performed on 1.5-Tesla MRI machine (Philips Medical Systems, Best, the Netherlands), using a sense head – 8 Coil. The imaging parameters (FoV, slice thickness, voxel size, TR, TE, scan time) for the various sequences are as follows:- 3D T1 TFE sagittal : 250 x 250mm; 1.2mm with 0.6mm overlap; 1.1mm x 1.1mm x .6mm; 7.4msec, 3.4 msec; 4min 36sec,T2 axials: 230 x 230mm; 5mm, 1.1 mm x 1.1 mm x5 mm; 4533 msec; 100 msec; 4 min 48sec. Frontal lobe metabolism was investigated with proton magnetic resonance spectroscopy using a single voxel technique. A single voxel point resolved spectroscopy (PRESS) sequence was used for volume of interest (VOI) localization (TR/TE =1800 msec/36msec; NSA 96; spectral band width 1000; scan time 3 min 25 sec). Based on the axial T2-weighted image, a voxel (20×20×15 mm) was positioned in the frontal white matter, avoiding the cortex and lateral ventricle. Multiple Optimization Insensitive Suppression Train (MOIST) was used for water suppression in the spectroscopy sequences and spectral correction was done. Memory was estimated with PGI-Memory Scale (PGIMS) and its proforma contains a set of 5 cards for visual retention, a set of 2 cards, one having pictures of 10 common objects and second having pictures of 20 common objects for recognition, stop watch, pencil and erasure. And with PGIMS one can measure the remote memory, recent memory, mental balance, attention-concentration, delayed recall, immediate recall, verbal retention for similar pairs, verbal retention for dissimilar pairs, visual retention and recognition[13]. Obtained raw scores for 10 sub tests for memory should be converted and the converted scores are allotted dysfunction rating, if the converted scores are 0-2, the dysfunction rating is 3, if 3-4, dysfunction rating is 2 and 5+ means '0'(zero) dysfunction. Maximum dysfunction rating score for each sub test is 3 and there are 10 sub tests, so total dysfunction rating score on PGIMS would be 3X10=30[14]. And if there is complete normal memory the total scores will be '0' (zero).

**Statistical Analysis**

Statistical analysis was conducted by using Med Calc Statistical Software version 12.7.8 *(*Med Calc Software bvba, Ostend, Belgium; http://www.medcalc.org; 2014*)*, an unpaired t test was performed to compare the mean difference between test and control group, p value <0.05 was considered as significant.

**RESULTS**

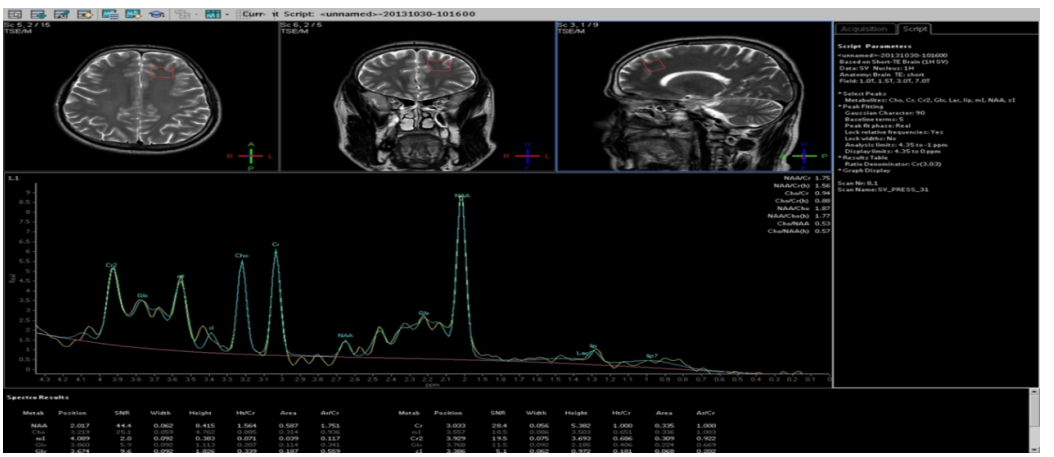

**Figure 1: Right frontal lobe MRS findings in a subject**

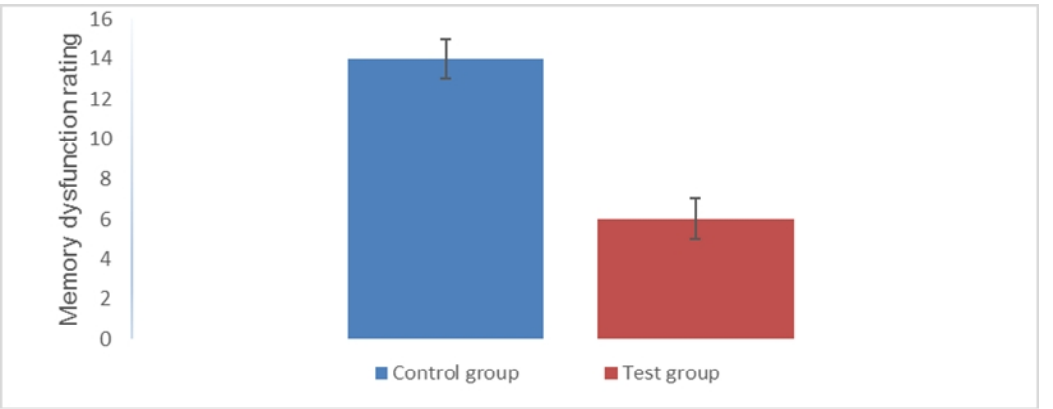


**Figure 2: Mean PGIMS dysfunction rating in control and test groups**

Mean HbA1c percentage in control and test group subjects was 6.9±0.4 & 7.8±1.84 (P=0.03) respectively and mean PGIMS memory dysfunction ratings were 14±1& 6±1 (p=0.0001). Right frontal lobe NAA concentration in control and test group was 1.40±0.50&1.50±0.10 (p=0.84) and mI concentration was 0.61±0.20 & 0.47±0.20 (p=0.30) respectively. Left frontal lobe NAA concentration in control and test group was 1.46±0.17&1.52±0.27 (p=0.68) and mI concentration was 0.57±0.20 & 0.54±0.27 (p=0.99) respectively.

## DISCUSSION

The selected yoga mentioned in table 1 have played a remarkable role in controlling the glycosylated haemoglobin (HbA1c) percentage, this finding is in line with the previous studies[11,15]. Earlier studies have also proved that this regulatory effects of yoga on glycosylated haemoglobin percentage is by stimulating the parasympathetic and inhibiting the sympathetic nervous system that was established with Cardiac Autonomic (CAN) tests[16]. Type 2 diabetes also treated excellently in ayurveda[17]. Right and left frontal lobe NAA concentration in test group is more than in control group, and mI concentration is less in test group, though these changes were not significant statistically. Higher concentration of NAA and lower levels of mI in right frontal lobe of test group subjects in the present study were also in line with the earlier research reports[18]. Though there is more glycosylation in control group, right and left frontal lobe NAA and mI concentrations were not altered much when compared with test group and this finding is in contradiction with the earlier reports[1,19]. NAA and mI concentrations are not much differ between test and control groups but test group subjects are having better memory scores whereas control group are having memory dysfunction rating. With the present sample size it is difficult to say which sub component of memory is affected badly in type 2 diabetes for that it requires larger sample size. It gives insight scope for the authors to probe for the alternative reasons why type 2 diabetic patients are having memory decline with normal frontal lobe NAA and mI concentrations.

## CONCLUSION

Yoga has a positive role in alienating the memory decline in type 2 diabetes but not on the frontal lobe NAA and mI concentrations.

## LIMITATIONS OF THE STUDY

Prospective study with more sample size could have given more scope for observations in relating the frontal lobe NAA and mI concentrations with memory decline in type 2 diabetes and the role played by yoga in alienating these changes.

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