Significance of serum magnesium levels in the auditory status of type II diabetes mellitus patients

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ABSTRACT

Introduction and Aim: Diabetes mellitus is one of the commonest metabolic causes associated with hypomagnesaemia. Magnesium is said to be one of the chief neuroprotective and vasodilatory mineral of the body. The main aim of this study was to establish the potential correlation between the serum magnesium levels and the auditory acuity in type II Diabetes mellitus patients.

Materials and Methods: It is a cross-sectional study done at Sree balaji medical college & hospital, Chromepet, Chennai. In this study we evaluated a total of 200 type II DM cases consisting of 100 cases with poor glycaemic control, and 100 cases under glycaemic control, all are recently diagnosed cases of type II Diabetes mellitus, in the age groups of 40-55 years who had come to the hospital for their regular annual master check-ups. Their serum magnesium levels were measured using the xylidyl blue dye binding method and pure tone audiometry was also done.

Results: Results showed that of the 100 poorly controlled type II DM subjects(i.e. HbA1c >/= 7),65 patients with hypomagnesaemia had sensory neural type of hearing loss & of the 100 type II DM subjects with controlled HbA1c levels(i.e. HbA1c<7), 8 out of the 10 subjects with hypomagnesaemia again had, sensory neural type of hearing loss.

Conclusion: The results of this cross-sectional study proved that hypomagnesaemia results in the impairment of hearing, amidst the type II diabetic population, especially the poorly controlled diabetics are more vulnerable to develop hypomagnesaemia and its associated deafness. Thus periodic assessment of auditory status and serum magnesium levels is also required in all type II DM cases, as an early measure to prevent diabetes and hypo magnesia induced deafness.

Keywords: Type II Diabetes mellitus; serum magnesium levels; auditory status.

INTRODUCTION

In today’s sedentary, gadget dominated society with increased uptake of unhealthy hyper palatable junk foods along with a positive genetic predisposition, has all resulted in the increased prevalence of diabetes at an unprecedented rate globally. In India around 62 million diabetic individuals have been diagnosed & many more are expected to be associated with the subclinical/undiagnosed/neglected forms of diabetes in accordance with the iceberg phenomenon of Diabetes mellitus (1). Chronic DM patients with poor glycaemic control have been proved to be associated with multiple complications affecting almost all the systems of the body over time. Among the various known complications, hearing impairment/ hearing loss and deafness which refers to the partial/total inability to hear is becoming more and more common in type II diabetes patients. Though hearing loss could also
result from multiple other causes such as advancing age associated with repeated exposure to excessive loud noise, local ear infections, ototoxic drugs, physical trauma etc. Most of the diabetic patients with poor metabolic control, identified by their increased glycosylated haemoglobin (HbA1c) levels, had history of bilateral, sensory neural type of hearing loss which is off sudden onset, progressive and irreversible in nature as proven by various previous studies (2).

Diabetes mellitus is one of the commonest metabolic causes associated with hypomagnesaemia (3). Magnesium is said to be one of the chief neuroprotective and vasodilatory mineral of the body. Mg²⁺ aids hearing by crossing the hematocochlear barrier thereby counterchecks the cochlear ischemia which plays a significant role in pathological hearing loss (4). Thus any derangements in the magnesium levels, in general makes the person more susceptible to noise induced hearing loss (NIHL).

Most of the chronic diabetic patients with relatively poorly controlled glycaemic profiles, have been found to have magnesium deficits, mainly due to the increased loss of magnesium in urine & due to the decreased intake of magnesium that ultimately results in Mg²⁺ depletion in the diabetic patients (5).

MATERIALS AND METHODS

The main aim of this study was to establish the potential correlation between the serum magnesium levels and the auditory acuity in type II Diabetes mellitus patients.

It is a cross-sectional study done at Sree Balaji Medical College and Hospital, chrome pet, Chennai. In this study, we evaluated a total of 200 type II DM cases consisting of 100 cases, with poor glycaemic control, and 100 under glycaemic control cases, all were recently diagnosed cases of type II diabetes mellitus, in the age groups of 40-55 years who had come to the hospital for their regular annual master check-up. The participants past history and significant family history were all taken. Exclusion criteria included: other potential causes of hearing loss such as past trauma to the ear/head injury, persons working in highly noisy-constant machinery involved environment, any history of significant ear infection in the past, any drug intake of ototoxic drugs like streptomycin etc., We explained the need and the significance of the study to all the participants, and all their written consents were obtained prior to the study. We measured their Glycaemic index-HbA1c levels by ion exchange chromatography method using the subjects venous blood samples, obtained under sterile aseptic conditions. We also measured their serum Mg²⁺levels, in the biochemistry department of the central laboratory of Sree balaji medical college &hospital. And pure tone audiometry was also done for all the participants in co-ordination with the ENT department of Sree balaji Hospital in Chrome pet, in order to access their auditory status.

Their serum magnesium levels was measured using the xylidyl blue dye binding method, that has a standard normal serum magnesium, reference range of 1.5 to 2.5 mEq/L.

Statistical analysis

All the data entry was done in MS excel sheet. Statistical analysis was done using the software package for the social sciences version Spss 18.

RESULTS

Table 1: Overall comparison of serum magnesium levels in all the 200 type II diabetic subjects

<table>
<thead>
<tr>
<th>Poor glycemic control (HbA1c ≥ 7)</th>
<th>Under glycemic control (i.e. HbA1c &lt; 7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum magnesium levels</td>
<td>No. of subjects</td>
</tr>
</tbody>
</table>

Table 2: Comparison of serum magnesium and auditory status in the 100 diabetic subjects with poor glycaemic control (i.e. HbA1c >/= 7)

<table>
<thead>
<tr>
<th>Serum Magnesium Levels</th>
<th>Auditory Status</th>
<th>Total</th>
<th>Chi Square Value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypomagnesaemia (&lt;1.5 mEq/L)</td>
<td>Normal Hearing</td>
<td>Hearing Loss</td>
<td>67</td>
<td>34.56</td>
</tr>
<tr>
<td>Normal Range (1.5-2.5 mEq/L)</td>
<td>2</td>
<td>65</td>
<td>33</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Comparison of serum magnesium and auditory status in the 100 diabetic subjects who are under glycaemic control (i.e. HbA1c < 7)
DISCUSSION

All the subjects included in this study were in the age group of 40-55 years so as to avoid any sensory neural type of hearing loss that occurs above 55 years mainly due to presbycusis (6). The results showed that of the 100 type II DM subjects with poor glycaemic control (i.e. HbA1c ≥ 7), a total of 67 subjects had hypomagnesaemia where their serum Mg$^{2+}$ levels was below 1.5 mEq/L and the remaining 33 subjects had normal serum Mg$^{2+}$levels. Of the 67(hypomagnesaemia) subjects, 65 subjects had sensory neural type of hearing loss. And of the remaining 33 subjects with normal magnesium levels, only 8 subjects had hearing loss.

Similarly of the 100, type II DM subjects under glycaemic control (HbA1c levels < 7), only 10 subjects had hypomagnesaemia (where their serum Mg$^{2+}$ levels<1.5 mEq/L) and the remaining 90 subjects had normal serum Mg$^{2+}$levels. Of the 10 subjects with hypomagnesaemia, almost 8 subjects had sensory neural type of hearing loss. While of the remaining 90 subjects with normal magnesium levels, only 3 subjects had hearing loss. In both the groups there was a significant p value of 0.0001(i.e. p value of .05) which is considered to be statistically significant.

Thus the results suggested that hypomagnesaemia was more likely associated with hearing loss in type II DM subjects than in the subjects with normal magnesium range. It emphatically proved the association between hypomagnesaemia and hearing loss in type II DM subjects.

Magnesium is one of the chief minerals, that is believed to be an integral part of the various biochemical reactions, involving the multiple systems of the human body such as-for the normal functioning of the nerves and muscles, to boost the body’s defence mechanism-the immune system, adds strength to the bones, enhances the pumping activity of the heart etc. It is also required to maintain certain basic functions such as to regulate the normal blood glucose levels and for protein and energy production in the body (7). Thus it plays an integral part in the body’s homeostasis. The well-known common features of Mg$^{2+}$ deficiency include muscle weakness, fatigue, twitching &cramps, it could also be associated with osteoporosis, high BP, asthma, irregular heartbeats, mental disorders etc.,

One of most neglected complications of hypomagnesaemia seen in type II DM subjects is the sensory neural type of irreversible hearing loss which is off sudden onset and progressive nature. As magnesium deficiency causes increase in the calcium channel permeability, of the hair cells. Thereby increasing the influx of calcium

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<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Hypomagnesaemia(&lt;1.5 mEq/L)</td>
<td>2</td>
<td>8</td>
<td>10</td>
<td>22</td>
</tr>
<tr>
<td>Normal Range(1.5-2.5 mEq/L)</td>
<td>87</td>
<td>3</td>
<td>90</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 4: Comparison of serum magnesium and auditory status in the 100 diabetic subjects who are under glycaemic control (i.e. HbA1c < 7)
resulting in the increased release of glutamate and over stimulation of N methyl D aspartame receptors (NMDA) which are basically glutamate gated iron channels located chiefly in the auditory nerve and cochlea (8). Thus all these cascading metabolic events caused by hypomagnesaemia results in the impairment of hearing.

CONCLUSION

There are various universally accepted diabetic complications such as the micro vascular and the macro vascular complications. The results of this cross-sectional study proved that hypomagnesaemia results in the impairment of hearing, amidst the type II diabetic population. Especially the poorly controlled diabetics (i.e. HbA1c >/= 7), are more vulnerable to develop this hypomagnesaemia and associated deafness. Thus, this study emphasizes the significance and the potential health benefits of maintaining a normal serum magnesium levels in the type II DM patients, who are otherwise prone to develop sensory neural type, of irreversible, sudden onset hearing loss which could hamper their day to day activities.

We would also like to emphasize the need, to have audiometry and serum magnesium levels tested, along with their regular glycaemic parameters, at least once in every three months’ time interval in case of type II DM patients. As awareness and early subsequent intervention plays a significant role in preventing any illness, as prevention is any day always better than cure.

REFERENCES