Original Article

Calcium To Magnesium Ratio In Senile Cataract Patients: A Case-Control Study In A Tertiary Care Centre

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Abstract

Background: Cataracts are one of the main causes of vision loss and age-related cataracts are the most common. The role of the ratio of calcium and magnesium in serum (Ca: Mg ratio) in the pathogenesis of senile cataracts remains unclear. So, this study was done as there is a dearth of knowledge about the relationship between senile cataracts and serum calcium: magnesium ratio.

Aim: The aim of the study is to establish the serum calcium: magnesium ratio in senile cataract patients and normal healthy individuals without cataracts and to correlate the calcium: magnesium ratio with the risk of senile cataracts.

Materials And Methods: This is a case-control study with 50 senile cataract individuals and 50 normal healthy individuals without cataracts as controls. Serum calcium was determined by the Arsenazo III method and serum magnesium by the Formazan dye method using Vitros 5600 auto analyzer.

Results: The study shows a significantly decreased concentration of serum magnesium and an increased concentration of calcium-magnesium ratio ($p<0.001$) in ARC (area under the curve) when compared to the control using the ANOVA test.

Conclusion: Increased serum calcium-magnesium ratio were significantly associated with a high risk of cataract formation in patients with age-related cataract.

Keywords: Senile Cataract, Calcium: Magnesium Ratio, Hypercalcemia, and Hypomagnesemia

1. INTRODUCTION

Cataract is the commonest reason for reversible blindness in the world and has been related to various causative risk factors [1]. Senile cortical cataracts are due to colloidal fluid with lens protein. During the early developmental stage, this colloidal fluid along with the lens protein produces an ill-defined cortical haziness. Senile nuclear cataracts are due to extensive dehydration and sclerosis of the nuclear and the cortical material of the lens [2]. Several theories have been proposed for the development of senile cataracts but the well-defined mechanism remains still unclear. Emerging evidence proved the role of dyselectrolytemia in cataract formation with particular concern to serum Calcium concentration. Calcium concentration alteration could play an important role in cataract development [3]. Calcium is an essential cation for the metabolic process of lens fibers [4] and an increased calcium level leads to changes in the micromolecular structures and increased light scattering of the lens [5] which is positively associated with lens opacity [6]. The formation of cataracts in tetany made to believe that the inorganic ion disturbance is enough to affect the transparency of the colloidal fluid of the lens protein. Various magnesium (Mg)-dependent ATPases – a membrane transport system, plays a pivotal role in maintaining lens homeostasis [7]. Thus, it is very clear that the mechanism of senile cataracts is due to lens permeability disturbances. Various structures of the eye are affected like lens fibers, ciliary epithelial membrane, and lens capsule due to physical, and chemical changes or metabolic derangements [2]. Serum magnesium concentration alteration might also be an important factor in the progression and development of senile cataracts is still not known [8]. Diabetic cataracts present with features more or less similar to senile cortical cataracts. According to the World Health Organisation (WHO), around 253 million people in the world are visually challenged, out of which 90% are due to cataract in developing countries [9].50–80% of blindness in India are due to cataract. The visual challenge caused by cataracts leads to economic burden and poor quality of life [10 -12]. Due to its vast impact on public health and socio-economic considerations, cataract has always been an interesting and important area in epidemiologic research [13]. Hence, the

present study plans to investigate the serum calcium: magnesium ratio and their association with the risk of development of senile cataracts compared to normal healthy individuals without cataracts.

2. MATERIALS AND METHODS

Study method:

This case-control study was carried out in the Department of Biochemistry, Saveetha Medical College & Hospital, Thandalam, Tamil Nadu between July 2021 to October 2021 (4 months). This present study population consisted of 50 Age-related cataracts (group I) as cases and 50 normal healthy individuals (group II) as controls of both genders in the age group between 45 to 75 years. The study protocol was approved by the Institutional Human Ethics Committee and an informed consent form was obtained from all participants. The study subjects were selected based on inclusion and exclusion criteria from the ophthalmology outpatient department. All subjects underwent complete eye examination in the Ophthalmology OPD (Saveetha Medical College and Hospital, Thandalam, Tamil Nadu) and the cataract was confirmed by using a slit-lamp examination.

Sample collection and processing:

3ml of venous blood sample (irrespective of the fasting status) was drawn from the subjects in a vacutainer without anticoagulant. The serum was separated by centrifuging at 3500 rpm for 15-20 minutes. The estimation of serum magnesium was done by the Formazan dye method and serum calcium by the Arsenazo III method using Vitros 5600 auto-analyzer. The calcium: magnesium ratio was calculated by dividing serum calcium concentration by serum magnesium concentration.

Inclusion criteria:

Age-related cataracts who had no history of diabetes, Normal healthy subjects without cataracts and having no history of diabetes were recruited from employees of our institute.

Exclusion criteria:

Steroid intake, Renal dysfunction, Hepatic disease, Thyroid disorders, Diabetes mellitus, systemic hypertension, Traumatic cataract, **Drugs known to affect magnesium status –**Aminoglycosides, Amphotericin B, Cetuximab, Cyclosporine, Digoxin, Diuretics, multivitamins & minerals supplement, alcoholics and smokers.

Statistical analysis:

Statistical analyses were performed using SPSS version 21.0. ANOVA was the statistical method used.

RESULTS

Table 1: Frequency Distribution of Calcium and Magnesium Levels among Cases and Control

Parameter	Case	Control
Hypocalcemia	0	24%
Normal calcium level	88%	76%
Hypercalcemia	12%	0
Hypomagnesemia	66%	0
Normal magnesium level	34%	100%

Table 2: Mean value of serum calcium, magnesium and their ratio among cases and controls

Parameters	Case n=50	Control n=50	P value
Serum calcium mg/dl	10.12±0.46	8.85±0.42	0.62
Serum magnesium mg/dl	1.45±0.20	1.94±0.13	0.10
Serum calcium magnesium ratio	7.06±0.82	4.54±0.37	< 0.05*

Serum calcium: magnesium ratio with a p-value is <0.05 between cases and controls is considered significant

Table 3: Comparison of serum magnesium, calcium, and their ratio levels among cases and controls by using one-way ANOVA

Group	Parameter			P value
	Calcium	Magnesium	Calcium: magnesium	
Group 1 - Case	10.12±0.46	1.45±0.20	7.06±0.82	<0.001*
Group 2 - Control	8.85±0.42	1.94±0.13	4.54±0.37	<0.001*

Serum calcium, serum magnesium, and calcium: magnesium ratio between cases and controls with a p-value is <0.001 is considered significant

3. DISCUSSION

The magnesium ion maintains the lens homeostasis mainly. Loss of transparency of the lens is because of lens protein denaturation due to ATPase dysfunction, free radical production, and exhaustion of antioxidants [7]. As calcium along with magnesium plays an important critical role in maintaining lens transparency [15], higher circulating levels of serum calcium has a positive correlation with cataract formation [6]. In our study, we have found that the mean serum calcium and Ca: Mg ratio was significantly high whereas serum magnesium level was reduced in senile cataract patients when compared to the normal healthy volunteers without cataracts. Our results are in positive association with the previous research work reported by Rehab OM Altouhami et al, 2018; AimaIram Batool et al, 2017; Chandrasekar R et al, 2014and Kaliaperumal R et al 2021 which have reported reduced levels of serum magnesium and increased serum calcium concentrations in senile cataract patients as compared to healthy controls [8, 17–20]. In addition, there was a significant negative correlation between serum magnesium with calcium [8]. By performing multivariate logistic regression analysis, our study shows that a high concentration of calcium to magnesium ratio plays a potential risk factor of cataract to genesis in Age-related cataract subjects. Our findings revealed that alteration in serum calcium: magnesium and their ratio were indicating an important role in the pathogenesis of age-related cataracts.

4. CONCLUSION

The study reveals that high concentrations of calcium and low serum magnesium concentration are associated with a very high risk of cataract formation in aged patients. Therefore, the serum calcium: magnesium ratio can be used as a marker to identify and treat age-related cataracts as early as possible.

5. CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

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