

Research Article

Role of Oral Calcium in the Treatment of Allergic Rhinitis

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ABSTRACT

Background: Allergic rhinitis is a common inflammatory disorder characterised by sneezing, nasal discharge, nasal obstruction and nasal itching. Oral calcium has been suggested as a potential adjunctive treatment, but evidence regarding its clinical effectiveness remains limited.

Objective: To evaluate the effect of oral calcium supplementation on symptoms and absolute eosinophil count (AEC) in patients with allergic rhinitis.

Materials and Methods: This prospective, single-blinded, placebo-controlled, randomised crossover study was conducted in the Department of Otorhinolaryngology, A.J. Institute of Medical Sciences, Mangalore, from August 2016 to October 2018. Eighty patients aged 18-60 years with allergic rhinitis and AEC >400 cells/mm³ were included. Participants received oral calcium 500 mg twice daily for 7 days and a matching placebo for 7 days, separated by a 1-week washout period. Total symptom score, individual symptoms and AEC were assessed at baseline and after each treatment period.

Results: Calcium treatment significantly reduced nasal obstruction (1.56 ± 0.67 to 1.29 ± 0.60 ; $p=0.007745$), nasal discharge (1.62 ± 0.62 to 1.43 ± 0.57 ; $p=0.034697$), and sneezing (1.35 ± 0.64 to 1.15 ± 0.53 ; $p=0.030179$). The total symptom score significantly decreased from 6.36 ± 1.71 to 5.45 ± 1.50 ($p=0.001265$), whereas the reduction with placebo was not significant ($p=0.187967$). No significant improvement was observed in nasal itching, ocular symptoms, palatal/pharyngeal itching or AEC. AEC decreased from 918.85 ± 448.78 to 872.91 ± 412.51 cells/mm³ after calcium treatment, but the change was not significant ($p=0.493824$).

Conclusion: Oral calcium supplementation was associated with significant improvement in selected nasal symptoms and overall symptom burden in allergic rhinitis. However, it did not significantly reduce AEC. Further larger studies with longer follow-up are required to establish its role as an adjunctive treatment.

Keywords: c

INTRODUCTION

Allergic rhinitis (AR) is a common chronic inflammatory disorder of the upper respiratory tract characterised by symptoms such as sneezing, nasal discharge, nasal obstruction and nasal itching, often accompanied by ocular symptoms. It represents an important cause of morbidity and can adversely affect sleep, daily activities, work performance and quality of life. The prevalence of rhinitis varies considerably between populations and geographic regions, with allergic rhinitis accounting for a substantial proportion of cases.[1,2]

The pathophysiology of allergic rhinitis involves an immunoglobulin E (IgE)-mediated inflammatory response following exposure to relevant allergens. Activation of mast cells and release of inflammatory mediators contribute to the early-phase symptoms, while recruitment of

eosinophils, basophils and T-helper 2 lymphocytes contributes to the late-phase inflammatory response.[3] Eosinophilic inflammation is an important feature of allergic rhinitis, and the absolute eosinophil count (AEC) may therefore provide a useful supportive laboratory parameter in selected patients.

The clinical manifestations of allergic rhinitis vary in severity and may involve both nasal and non-nasal symptoms. Nasal obstruction, rhinorrhoea, sneezing and itching are among the characteristic symptoms, while ocular itching and watering may occur as associated manifestations.[4] The disease may coexist with asthma and other allergic disorders, further contributing to its overall clinical burden.[1,5]

Management of allergic rhinitis traditionally includes allergen avoidance, pharmacological therapy and allergen-specific immunotherapy in appropriately selected patients. Current treatment approaches primarily include intranasal corticosteroids, antihistamines and their combinations, with treatment selection depending on symptom severity, disease pattern and individual patient factors.[6,7] Although these therapies are effective, interest continues in additional treatment approaches that may be inexpensive, accessible and well tolerated.

Calcium has historically been used as an adjunctive treatment in certain allergic conditions. Experimental and clinical observations have suggested that calcium supplementation may influence allergic responses. An earlier controlled double-blind study demonstrated a reduction in the skin response to histamine and grass pollen following oral calcium administration.[8] Subsequently, a placebo-controlled crossover study reported that oral calcium significantly inhibited allergen-induced swelling of the nasal mucosa in patients undergoing nasal allergen provocation testing, although sneezing and nasal secretion were not significantly reduced.[9] These findings provided a rationale for further clinical evaluation of oral calcium in allergic rhinitis.

Despite these earlier observations, evidence regarding the clinical effectiveness of oral calcium in patients with allergic rhinitis remains limited. In particular, its effect on the overall symptom burden and individual nasal symptoms in routine clinical patients requires further evaluation.

Therefore, the present study was undertaken to evaluate the role of oral calcium in the treatment of allergic rhinitis. The study assessed changes in individual allergic rhinitis symptoms, total symptom score and absolute eosinophil count following calcium supplementation and compared these findings with placebo treatment in a randomized crossover design.

MATERIALS AND METHODS

Study Design and Setting

This prospective, single-blinded, placebo-controlled, randomised crossover study was conducted in the Department of Otorhinolaryngology, A.J. Institute of Medical Sciences, Mangalore, from August 2016 to October 2018. The study protocol was reviewed and approved by the Institutional Ethics

Committee of A.J. Institute of Medical Sciences for research involving human participants. Written informed consent was obtained from all participants before enrolment.

Study Population

A total of 80 patients aged 18–60 years presenting to the Otorhinolaryngology outpatient department with symptoms suggestive of allergic rhinitis were evaluated. The diagnosis of allergic rhinitis was made according to the Allergic Rhinitis and its Impact on Asthma (ARIA) guidelines. Patients were considered to have allergic rhinitis when they reported at least two recurrent symptoms, including sneezing, watery nasal discharge, nasal obstruction, nasal itching, or red and itchy eyes, occurring for at least one hour on most days or on most days during the relevant season in cases of seasonal symptoms.

A detailed history, including previous medications taken for allergic rhinitis, was recorded at the initial visit. All participants underwent a detailed ENT examination and were assessed using a structured study proforma.

Inclusion Criteria

Patients fulfilling the following criteria were included:

- Age between 18 and 60 years.
- Clinical diagnosis of allergic rhinitis according to ARIA guidelines.
- Absolute eosinophil count (AEC) >400 cells/mm³.

Exclusion Criteria

Patients were excluded if they had:

- AEC <400 cells/mm³.
- Co-existing upper respiratory tract infection.
- Nasal polyps or other significant nasal pathology.
- Use of any anti-allergic medication within one month prior to presentation.
- Renal disease, history of renal calculi, or abnormal renal function tests.

Assessment of Symptoms

The severity of allergic rhinitis symptoms was assessed at baseline and during follow-up visits using a predefined symptom scoring system. The following nasal symptoms were evaluated:

1. Nasal obstruction
2. Nasal discharge
3. Sneezing
4. Nasal itching

Associated non-nasal symptoms assessed were:

1. Watery and itching of the eyes
2. Palatal and pharyngeal itching

Each of the four major nasal symptoms was graded on a 0–3 scale, with higher scores indicating greater symptom severity. Associated ocular itching/watering and palatal/pharyngeal itching were assigned one point each. The individual scores were summed to obtain the total symptom score.

Laboratory Investigations

The following laboratory investigations were performed:

- Absolute eosinophil count (AEC)
- Renal function tests

AEC was measured at baseline and repeated after each treatment period. Renal function tests were performed to exclude patients with renal impairment or other renal contraindications to calcium supplementation.

Randomization and Intervention

Eligible participants were randomly allocated using block randomization into two groups: a study group and a control group.

During the first treatment period, the study group received oral calcium 500 mg twice daily for 7 days, whereas the control group received a matching placebo twice daily for 7 days. Participants were blinded to the treatment received.

At the end of the first 7-day treatment period, patients were reassessed using the symptom scoring system and repeat AEC measurement. This was followed by a 1-week washout period during which no study medication was administered.

Following the washout period, the treatment allocation was crossed over. Patients who had received calcium during the first treatment

period received placebo during the second treatment period, while those who had initially received placebo received calcium 500 mg twice daily for 7 days.

At the end of the second treatment period, patients were again evaluated clinically, and the symptom score and AEC were recorded.

Follow-up and Outcome Assessment

Patients were evaluated at three assessment points: baseline (first visit), following the first 7-day treatment period, and following the second 7-day treatment period. The primary assessment was based on the change in total allergic rhinitis symptom score. Changes in AEC were also evaluated as a laboratory measure of response.

The efficacy of calcium supplementation was assessed by comparing symptom scores and AEC levels before and after treatment and between the calcium and placebo treatment periods in the crossover design.

Data Collection and Statistical Analysis

All relevant demographic, clinical, laboratory, treatment, and follow-up data were recorded in a structured proforma and subsequently entered into a master chart. The data were analysed statistically to assess the effect of calcium supplementation on allergic rhinitis symptoms and AEC levels. The crossover design allowed each participant to serve as his or her own control, thereby facilitating comparison between the calcium and placebo treatment periods.

RESULTS AND OBSERVATIONS

A total of 80 patients with allergic rhinitis were included in the study. The demographic characteristics, individual symptom scores, total symptom score, and absolute eosinophil count (AEC) were evaluated before and after calcium and placebo treatment.

Table 1. Age Distribution of Patients with Allergic Rhinitis

Age Group	Count	Percentage
<20 years	1	1.25
20–30 years	38	47.50
31–40 years	25	31.25
41–50 years	11	13.75
51–60 years	5	6.25
Total	80	100.00

The majority of patients (47.5%) belonged to the 20–30-year age group, followed by the 31–40-year age group (31.25%).

Table 2. Sex Distribution of Patients with Allergic Rhinitis

Sex	Count	Percentage
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Female	42	52.50
Male	38	47.50
Total	80	100.00

Females constituted 52.5% of the study population, while males constituted 47.5%.

Table 3. Comparison of Nasal Obstruction and Nasal Discharge

Symptom	Assessment	Mean $\pm$ SD	p-value
Nasal obstruction	First visit	1.56 $\pm$ 0.67	0.007745
	Calcium	1.29 $\pm$ 0.60	
	Placebo	1.46 $\pm$ 0.71	0.342722
Nasal discharge	First visit	1.62 $\pm$ 0.62	0.034697
	Calcium	1.43 $\pm$ 0.57	
	Placebo	1.57 $\pm$ 0.59	0.646056

Calcium treatment produced a statistically significant reduction in nasal obstruction and nasal discharge, whereas the corresponding changes after placebo were not statistically significant.

Table 4. Comparison of Sneezing and Nasal Itching

Symptom	Assessment	Mean $\pm$ SD	p-value
Sneezing	First visit	1.35 $\pm$ 0.64	0.030179
	Calcium	1.15 $\pm$ 0.53	
	Placebo	1.27 $\pm$ 0.59	0.434416
Nasal itching	First visit	1.04 $\pm$ 0.51	0.289156
	Calcium	1.06 $\pm$ 1.23	
	Placebo	0.99 $\pm$ 0.52	0.539821

Sneezing showed a statistically significant reduction after calcium treatment, whereas nasal itching did not show a statistically significant change with calcium or placebo.

Table 5. Comparison of Itching and Watering of Eyes

Assessment	Mean $\pm$ SD	p-value
First visit	0.38 $\pm$ 0.49	1.000
Calcium	0.38 $\pm$ 0.49	
Placebo	0.38 $\pm$ 0.49	1.000

There was no change in the mean score for itching and watering of the eyes following either calcium or placebo treatment.

Table 6. Comparison of Palatal and Pharyngeal Itching

Assessment	Mean $\pm$ SD	p-value
First visit	0.40 $\pm$ 0.49	0.065799
Calcium	0.26 $\pm$ 0.44	
Placebo	0.31 $\pm$ 0.47	0.250180

A numerical reduction in palatal and pharyngeal itching was observed following calcium treatment; however, the reduction was not statistically significant.

Table 7. Comparison of Total Symptom Score

Assessment	Mean $\pm$ SD	p-value
First visit	6.36 $\pm$ 1.71	
Calcium	5.45 $\pm$ 1.50	0.001265
Placebo	5.97 $\pm$ 1.68	0.187967

The total symptom score decreased significantly following calcium treatment from 6.36 $\pm$ 1.71 to 5.45 $\pm$ 1.50 (p=0.001265). The reduction following placebo was not statistically significant (p=0.187967).

Table 8. Comparison of Absolute Eosinophil Count

Assessment	Mean AEC (cells/mm ³) $\pm$ SD	p-value
First visit	918.85 $\pm$ 448.78	
Calcium	872.91 $\pm$ 412.51	0.493824

Placebo	898.00 ± 429.75	0.750957
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AEC showed a numerical reduction after calcium treatment from 918.85 to 872.91 cells/mm³; however, the reduction was not

statistically significant (p=0.493824). A similar non-significant reduction was observed after placebo treatment.

Table 9. Summary of Individual Symptom Response to Calcium Treatment

Symptom	First Visit Mean	Calcium Mean	p-value	Significant
Nasal obstruction	1.56	1.29	0.007745	Yes
Nasal discharge	1.62	1.43	0.034697	Yes
Sneezing	1.35	1.15	0.030179	Yes
Nasal itching	1.04	1.06	0.289156	No
Eye itching/watering	0.38	0.38	1.000000	No
Palatal/pharyngeal itching	0.40	0.26	0.065799	No

Calcium treatment showed statistically significant improvement in nasal obstruction, nasal discharge, and sneezing, while the other assessed symptoms did not reach statistical significance.

Table 10. Summary of Individual Symptom Response to Placebo

Symptom	First Visit Mean	Placebo Mean	p-value	Significant
Nasal obstruction	1.56	1.46	0.342722	No
Nasal discharge	1.62	1.57	0.646056	No
Sneezing	1.35	1.27	0.434416	No
Nasal itching	1.04	0.99	0.539821	No
Eye itching/watering	0.38	0.38	1.000000	No
Palatal/pharyngeal itching	0.40	0.31	0.250180	No

None of the individual symptoms demonstrated a statistically significant improvement following placebo treatment.

Table 11. Comparative Effect of Calcium and Placebo on Total Symptom Score

Treatment	First Visit Mean ± SD	Post-treatment Mean ± SD	p-value	Interpretation
Calcium	6.36 ± 1.71	5.45 ± 1.50	0.001265	Significant reduction
Placebo	6.36 ± 1.71	5.97 ± 1.68	0.187967	Not significant

The reduction in overall allergic rhinitis symptom burden was statistically significant following calcium treatment but not following placebo treatment.

Table 12. Comparative Effect of Calcium and Placebo on AEC

Treatment	First Visit Mean ± SD (cells/mm ³)	Post-treatment Mean ± SD (cells/mm ³)	p-value	Interpretation
Calcium	918.85 ± 448.78	872.91 ± 412.51	0.493824	Not significant
Placebo	918.85 ± 448.78	898.00 ± 429.75	0.750957	Not significant

Neither calcium nor placebo produced a statistically significant reduction in absolute eosinophil count.

DISCUSSION

Allergic rhinitis is a common inflammatory disorder of the upper airway that produces a considerable symptomatic burden. The present study evaluated the effect of oral calcium supplementation on allergic rhinitis symptoms using a prospective, randomized, placebo-controlled crossover design. A total of 80 patients aged 18–60 years were included, and

the intervention consisted of oral calcium 500 mg twice daily for 7 days, with placebo used as the comparator. The crossover design allowed participants to receive both calcium and placebo during different treatment periods, thereby permitting comparison within the same study population.

In the present study, the majority of participants were young adults. The 20–30-year

age group constituted 47.5% of the study population, followed by the 31–40-year group (31.25%). Females accounted for 52.5% and males for 47.5% of the participants. The predominance of younger adults is compatible with the observation that allergic rhinitis commonly affects younger age groups and can persist over prolonged periods. However, the present study was not designed to determine age- or sex-specific prevalence, and these demographic findings should therefore be interpreted as characteristics of the study population rather than population-level epidemiological estimates.

Effect of Calcium on Nasal Symptoms

The most important finding of the present study was a significant reduction in several major nasal symptoms following calcium treatment. Nasal obstruction decreased from a mean score of 1.56 ± 0.67 at the first visit to 1.29 ± 0.60 after calcium treatment, with a statistically significant p-value of 0.007745. In contrast, the corresponding placebo value was 1.46 ± 0.71 and did not demonstrate a statistically significant change ($p=0.342722$).

Similarly, nasal discharge decreased from 1.62 ± 0.62 at baseline to 1.43 ± 0.57 following calcium treatment ($p=0.034697$). The reduction observed after placebo treatment was smaller and statistically non-significant ($p=0.646056$). These findings suggest that calcium supplementation was associated with improvement in two important manifestations of allergic rhinitis.

The finding of improvement in nasal obstruction is particularly interesting in view of previous experimental evidence. Bachert et al. conducted a placebo-controlled double-blind crossover study and demonstrated that oral calcium significantly inhibited allergen-induced swelling of the nasal mucosa during nasal allergen provocation testing.[9] The improvement in nasal obstruction observed in the present study is therefore broadly consistent with this earlier observation. However, the earlier study did not demonstrate a significant reduction in sneezing or secretion, whereas the present study demonstrated a significant reduction in sneezing as well. Differences in patient characteristics, treatment regimen, clinical setting and outcome assessment may account for this variation.

Effect on Sneezing and Nasal Itching

Sneezing also showed a statistically significant reduction following calcium treatment. The

mean score decreased from 1.35 ± 0.64 at the first visit to 1.15 ± 0.53 after calcium administration ($p=0.030179$). In contrast, the reduction after placebo, from 1.35 ± 0.64 to 1.27 ± 0.59 , was not statistically significant ($p=0.434416$).

The significant improvement in sneezing in the present study differs somewhat from the findings of Bachert et al., who reported significant inhibition of allergen-induced nasal mucosal swelling but no significant reduction in sneezing or secretion following oral calcium.[9] This difference suggests that the clinical effect of calcium may not be uniform across different manifestations of allergic rhinitis and may depend on the population and clinical conditions under which the treatment is evaluated.

Nasal itching did not improve significantly following calcium treatment. The mean score changed from 1.04 ± 0.51 to 1.06 ± 1.23 , with $p=0.289156$. No significant change was also observed after placebo treatment. Thus, the beneficial effect observed in the present study was not consistent across all individual symptoms.

Effect on Ocular and Pharyngeal Symptoms

There was no change in the mean score for itching and watering of the eyes following either calcium or placebo treatment. The mean score remained 0.38 ± 0.49 , with $p=1.000$ for both assessments.

A numerical reduction in palatal and pharyngeal itching was observed after calcium treatment, with the mean score decreasing from 0.40 ± 0.49 to 0.26 ± 0.44 . However, this change did not reach statistical significance ($p=0.065799$). Placebo treatment similarly failed to produce a significant change. These findings indicate that the response to calcium was more evident for selected nasal symptoms than for ocular or pharyngeal manifestations.

Effect on Total Symptom Score

The overall effect of calcium was more clearly demonstrated when the individual symptoms were combined into the total symptom score. The mean total symptom score decreased significantly from 6.36 ± 1.71 at the first visit to 5.45 ± 1.50 following calcium treatment ($p=0.001265$). In comparison, the score decreased from 6.36 ± 1.71 to 5.97 ± 1.68 following placebo, but this reduction was not statistically significant ($p=0.187967$).

This finding is important because the total symptom score provides an overall assessment

of disease burden rather than focusing on a single manifestation. The significant reduction following calcium, together with the absence of a significant placebo response, suggests that calcium supplementation may have produced a clinically relevant reduction in overall allergic rhinitis symptoms in this study.

The finding is also of interest in the context of current allergic rhinitis management. Contemporary guidelines emphasize intranasal corticosteroids, intranasal antihistamines and their combinations as established pharmacological therapies.[6,7] Calcium should therefore not be interpreted as a replacement for established therapy on the basis of the present study. Rather, the findings provide preliminary evidence supporting further investigation of calcium as a possible adjunctive approach.

Effect on Absolute Eosinophil Count

Although calcium treatment was associated with a numerical reduction in AEC, the change was not statistically significant. The mean AEC decreased from 918.85 ± 448.78 cells/mm³ at the first visit to 872.91 ± 412.51 cells/mm³ after calcium treatment ($p=0.493824$). Placebo treatment produced a similarly non-significant reduction from 918.85 ± 448.78 to 898.00 ± 429.75 cells/mm³ ($p=0.750957$).

The absence of a significant change in AEC despite improvement in the total symptom score suggests that symptomatic improvement following calcium treatment was not accompanied by a demonstrable reduction in peripheral eosinophil count during the short treatment period. Allergic rhinitis involves complex local inflammatory mechanisms, including IgE-mediated mast-cell activation and recruitment of eosinophils and other inflammatory cells.[3] Therefore, peripheral AEC may not necessarily parallel short-term changes in clinical symptoms.

Possible Explanation for the Findings

The precise mechanism through which oral calcium might influence allergic rhinitis symptoms remains uncertain. Previous clinical studies have suggested an effect of oral calcium on allergen-induced nasal mucosal swelling.[9] An older double-blind study also demonstrated a reduction in skin wheal responses following oral calcium administration.[8] These observations provide biological and clinical support for further evaluation of calcium, although they do not establish a definitive mechanism for the symptomatic improvement

observed in the present study.

The present findings are particularly relevant because the improvement was observed mainly in nasal obstruction, nasal discharge, sneezing and the overall symptom score, whereas ocular symptoms, nasal itching and AEC did not demonstrate statistically significant improvement. This pattern suggests that the potential effect of calcium may be selective rather than a generalized suppression of all allergic inflammatory manifestations.

Comparison with Placebo

An important strength of the present study was the inclusion of a placebo treatment period. None of the individual symptoms demonstrated a statistically significant improvement following placebo. Furthermore, the total symptom score showed a statistically significant reduction after calcium but not after placebo.

The difference between the calcium and placebo periods strengthens the possibility that the observed improvement was related to the intervention rather than simply to the natural fluctuation of symptoms or nonspecific treatment effects. Nevertheless, because the study duration for each treatment period was only 7 days, the results primarily describe short-term symptomatic response.

Clinical Relevance

The current evidence base for allergic rhinitis supports established therapies such as intranasal corticosteroids and antihistamines, which have demonstrated efficacy in reducing nasal and ocular symptoms.[6,7,10] The present study does not provide sufficient evidence to recommend oral calcium as a primary treatment in place of these established therapies. However, the significant reduction in total symptom score and selected nasal symptoms indicates that calcium may warrant further investigation as a potential adjunctive treatment.

Strengths and Limitations

The randomized placebo-controlled crossover design was an important strength because each participant received both calcium and placebo, allowing within-subject comparison. The study also evaluated both individual symptoms and an overall symptom score, together with AEC as a laboratory parameter.

Several limitations should nevertheless be considered. The sample size was relatively small, the treatment duration was short, and the study was conducted at a single centre. The

study also assessed peripheral AEC rather than more direct measures of local nasal inflammation or allergen sensitization. In addition, the available study data do not establish whether the observed symptomatic improvement persists after discontinuation of calcium or whether it translates into long-term improvement in quality of life. These limitations should be addressed in larger, multicentric randomized controlled trials with longer follow-up and standardized objective measures of allergic inflammation.

CONCLUSION

Oral calcium supplementation was associated with a significant improvement in nasal obstruction, nasal discharge, sneezing, and total symptom score in patients with allergic rhinitis compared with baseline. However, nasal itching, ocular symptoms, palatal/pharyngeal itching, and absolute eosinophil count did not show significant improvement. Oral calcium may have a potential role as an adjunctive treatment for allergic rhinitis, but larger studies with longer follow-up are required to confirm its efficacy.

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