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Steroid-Induced Glaucoma in Asthma: A Case Report Highlighting the Steroid-Sparing and Disease-Modifying Potential of Allergen Immunotherapy

Case Report

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ABSTRACT

Background: *Glaucoma, a leading cause of irreversible vision loss, is a known adverse effect of corticosteroid therapy, including inhaled corticosteroids (ICS). This case highlights the rare occurrence of steroid-induced glaucoma in an asthma patient treated with ICS and the role of allergen immunotherapy (AIT) in achieving steroid-sparing and long-term disease control.*

Case Summary: *A 34-year-old male with asthma developed steroid-induced glaucoma twice while on budesonide/formoterol therapy, with elevated intraocular pressure (IOP) of 32 mm Hg and 28 mm Hg, respectively. Cessation of ICS led to normalization of IOP. Due to intolerance to ICS, he was initiated on subcutaneous immunotherapy (SCIT) for house dust mite allergens. Over three years of SCIT, the patient achieved effective asthma control without requiring ICS or other controller medications. Post-SCIT, he reported only two minor exacerbations managed with short-acting beta-agonists.*

Discussion: *Causality assessment using WHO-UMC criteria and the Naranjo algorithm confirmed the association between ICS and glaucoma. SCIT provided a steroid-sparing alternative, reducing the need for pharmacotherapy and preventing the recurrence of steroid-related ocular complications. This case underscores the importance of pharmacovigilance in ICS use and highlights AIT's disease-modifying potential in asthma management.*

Conclusion: *This case illustrates the rare occurrence of ICS-induced glaucoma and emphasizes the role of AIT in achieving long-term asthma control while minimizing adverse effects of corticosteroids. Future research should further evaluate AIT as a viable therapeutic option for selecting asthma populations intolerant to ICS.*

Keywords: *Steroid-induced glaucoma; Inhaled corticosteroids; Allergen immunotherapy; Asthma management.*

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INTRODUCTION

Glaucoma is a leading cause of irreversible vision loss globally, often progressing silently until substantial optic nerve damage and visual field deterioration occurred. Elevated intraocular pressure (IOP) is a major risk factor for glaucoma, with secondary glaucoma, including steroid-induced glaucoma, recognized as a significant subtype.[1] While corticosteroids are integral to managing various conditions, including asthma, they are associated with adverse ocular effects due to their impact on aqueous humor outflow. Corticosteroids, including inhaled forms, reduce degradation of extracellular matrix material in the trabecular meshwork, increasing outflow resistance and subsequently elevating IOP.[2] Inhaled corticosteroids (ICS), such as budesonide, are cornerstone therapies for asthma and asthma-COPD overlap syndrome (ACO). Their use is particularly critical for mild intermittent or persistent asthma, as they reduce exacerbation frequency and severity, sparing patients from reliance on rescue medications such as short-acting muscarinic antagonists (SAMA) or antihistamines.

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These medications are associated with increased glaucoma risk.[3] Interestingly, large-scale epidemiological studies and meta-analyses have suggested that ICS may even reduce glaucoma incidence through indirect mechanisms, such as avoiding the use of these risk-prone rescue therapies.[4,5] However, isolated reports of steroid-induced glaucoma emphasize the importance of vigilance in ICS use.[6]

Allergen immunotherapy (AIT) is the only causal treatment for allergic airway diseases, including asthma, with evidence supporting its disease-modifying effects. AIT not only restores immune tolerance but also prevents allergen-specific airway hyperreactivity and new sensitizations, achieving long-term disease control. Real-life data underscore its potential in achieving sustained clinical remission, particularly in house dust mite (HDM)-driven asthma, as demonstrated in large cohorts with up to 10 years of follow-up.[7]

This report highlights a rare case of ICS-induced glaucoma in a 34-year-old male with asthma, successfully managed through discontinuation of ICS and initiation of HDM-specific subcutaneous immunotherapy (SCIT). The patient's long-term asthma control without the recurrence of steroid-induced ocular complications underscores the potential of AIT as a steroid-sparing and disease-modifying intervention. This case adds to the growing body of evidence on the ophthalmological risks associated with ICS use and the therapeutic value of AIT in select asthma populations.

Case Presentation

A 34-year-old male presented with asthma and was prescribed budesonide 400 mcg plus formoterol 6 mcg metered-dose inhaler (MDI), two puffs twice daily. After three weeks, he developed dimness of vision that progressed to near blindness within seven days. An ophthalmological evaluation revealed elevated IOP (32 mm Hg) and steroid-induced glaucoma. Budesonide-containing FDC MDI was discontinued, and topical ocular hypotensive medications were initiated. Within one month, his IOP was reduced to 18 mm Hg, and vision was restored.

The patient was transitioned to montelukast 10 mg daily and long-acting beta-agonist (LABA) as indacaterol 150 mcg once daily, with a short-acting beta-agonist (SABA) as needed. However, three months later, the patient experienced an asthma exacerbation, necessitating the reintroduction of budesonide 200 mcg plus formoterol 6 mcg MDI. Within seven days, diminished vision recurred, and ophthalmologic examination confirmed IOP elevation to 28 mm Hg. Budesonide was promptly discontinued, and IOP normalized to 18 mm Hg within one month.

The patient was referred to an allergy clinic. Skin prick testing (SPT) confirmed sensitization to dust mite allergens *Dermatophagoides farinae* and *Dermatophagoides pteronyssinus*. Subcutaneous immunotherapy (SCIT) with a 50:50 mixture of *D. farinae* and *D. pteronyssinus* was initiated, following an up-dosing schedule (1:50,000, 1:5,000, and 1:500 dilutions weekly) for one year, and subsequently maintained at 1:50 dilution for three years. Over the last six months of discontinuation of SCIT, the patient required SABA on two occasions but experienced no exacerbations, he had stopped taking montelukast and no ICS was necessary. This avoided the recurrence of elevated IOP and vision loss.

Causality Assessment

WHO-UMC Criteria[8]

• Certain: The temporal association between budesonide use and the adverse reaction (elevated IOP and glaucoma) is clear, with recurrence upon re-exposure (positive dechallenge and rechallenge). Alternative causes (e.g., primary glaucoma) were excluded by ophthalmologic evaluation.

Naranjo Algorithm[9]

- Did the adverse event appear after the suspected drug was administered? Yes (+2)
- Did the adverse event improve when the drug was discontinued? Yes (+1)
- Did the adverse event reappear when the drug was reintroduced? Yes (+2)
- Are there alternative causes that could explain the event? No (+2)
- Was the reaction confirmed by objective evidence? Yes (+1)

Total Score: 9 (Definite ADR).

DISCUSSION

This case highlights a rare but clinically significant adverse drug reaction (ADR) associated with inhaled corticosteroids (ICS) in a 34-year-old male with asthma. While ICS are the mainstay of asthma management and are generally considered safe, this case demonstrates that even inhaled formulations can cause serious adverse effects, including secondary glaucoma and elevated intraocular pressure (IOP). The temporal association between budesonide administration and glaucoma in this patient was clear, with positive dechallenge and rechallenge responses, as confirmed by both the WHO-Uppsala Monitoring Centre (UMC) criteria[8] and the Naranjo algorithm.[9] This discussion focuses on the implications of ICS-induced ocular complications, the role of allergen immunotherapy (AIT) as a steroid-sparing alternative, and broader considerations for managing asthma in patients at risk of steroid-related adverse effects.

Steroid-induced glaucoma is a well-documented complication of corticosteroid therapy, including systemic, topical, andinhaled forms. Pathophysiology involves corticosteroid-induced changes in the trabecular meshwork, where the degradation of extracellular matrix material is inhibited. This leads to the accumulation of extracellular material, increased outflow resistance, and elevated IOP. Persistent elevation in IOP can result in optic nerve damage, visual field defects, and, if left untreated, irreversible vision loss.[2]

Meta-analyses and systematic reviews have suggested that ICS are not commonly associated with elevated IOP or glaucoma and may even reduce glaucoma incidence through indirect mechanisms.[4,5] These findings are supported by large-scale observational studies and time-to-event analyses, which have proposed that ICS reduce the need for rescue therapies, such as

short-acting muscarinic antagonists (SAMA) and antihistamines, both of which can elevate IOP.[5] However, rare cases of ICS-induced glaucoma, particularly at high doses, emphasize the need for vigilance.[6]

In this case, the patient developed acute steroid-induced glaucoma twice, with symptoms resolving after ICS discontinuation. The recurrence of elevated IOP upon ICS rechallenge underscores the causal relationship. The absence of primary glaucoma or other confounding factors further strengthens the link between budesonide use and the ADR.

Allergen Immunotherapy as a Disease-Modifying Treatment

Given the patient's intolerance to ICS, allergen immunotherapy (AIT) provided a viable and effective alternative. AIT is the only causal treatment for allergic airway diseases, including asthma, and is supported by robust evidence for its disease-modifying effects.[3,7] By modulating the immune response, AIT restores allergen tolerance, reduces airway hyperreactivity, and prevents new sensitizations. AIT is not an alternative to pharmacotherapy; however, its progressive use significantly reduces the long-term need for pharmacotherapy.[10]

In this patient, SCIT with house dust mite (HDM) allergens were initiated after sensitization to *Dermatophagoides farinae* and *Dermatophagoides pteronyssinus* was confirmed via skin prick testing. The patient completed an up-dosing regimen followed by a maintenance phase over three years, achieving significant clinical improvement. During the six months following completion of SCIT, the patient required SABA on only two occasions, and no exacerbations or ICS use were necessary. This highlights the steroid-sparing potential of AIT, which not only mitigated the risk of recurrent steroid-induced ocular complications but also provided effective long-term asthma control.

The efficacy of HDM-specific AIT has been corroborated by real-world data, which demonstrates its ability to achieve disease remission in HDM-driven asthma, with sustained benefits extending beyond 10 years of follow-up.[7] In this case, AIT also played a critical role in reducing the patient's overall medication burden, including the discontinuation of montelukast, further emphasizing its role in achieving comprehensive disease control.

Implications for Clinical Practice and Future Research

This case underscores the importance of individualized asthma management, particularly for patients at risk of steroid-induced adverse effects. Key considerations include:

1. Risk Assessment and Monitoring: Clinicians should be aware of the potential for ICS to cause ocular complications, even in patients without a prior history of glaucoma. Regular ophthalmologic evaluations, including IOP measurements, should be considered for patients receiving long-term or high-dose ICS therapy.

2. Steroid-Sparing Strategies: AIT not only reduces the need for ICS but also provides long-term disease control, as demonstrated in this case. This approach aligns with the goals of precision medicine, ensuring that therapy is tailored to individual patient needs.

3. Research Gaps and Opportunities: While the overall risk of ICS-induced glaucoma appears to be low, further research is needed to identify patient-specific factors that may predispose individuals to this complication. Additionally, studies evaluating the long-term efficacy and cost-effectiveness of AIT in various asthma phenotypes would provide valuable insights for clinical practice.

CONCLUSION

This case report illustrates a rare instance of ICS-induced glaucoma in an asthma patient, effectively managed with the discontinuation of ICS and the initiation of SCIT. The case highlights the importance of pharmacovigilance in ICS use and the potential of AIT as a steroid-sparing, disease-modifying intervention. These findings underscore the need for a personalized approach to asthma management, balancing the benefits of ICS therapy with the risk of rare but serious adverse effects. By integrating AIT into clinical practice, clinicians can achieve long-term asthma control while minimizing the risk of steroid-related complications.

This case contributes to the growing body of evidence supporting the broader adoption of AIT in asthma management and highlights the need for continued research into the mechanisms and management of ICS-induced glaucoma.

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