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Highlights:

Sjogren's Disease and the Cornea: Bridging Disciplines for Enhanced Ocular Health ♦ Microphthalmia and Anophthalmia; A brief review ♦ Ocular manifestation of systemic tuberculosis in children: A Cross sectional study ♦ SD OCT in Benign Intracranial Hypertension: Case series ♦ Retinal revelations: Seeing beyond the eye with AI

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Kerala Journal of Ophthalmology

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Address
Editorial Office
Dr Lathika Vasu Kamaladevi
MS(Ophth) DO FRCS(Glasgow)
Amala Institute Of Medical Sciences, Thrissur, Kerala, India.
Email: lathikamala.v@gmail.com

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The Kerala Journal of Ophthalmology is pleased to introduce **KSOS - KJO appreciation awards** for three outstanding reviewers as well as the most prolific author with maximum number of annual submissions.This initiative is an attempt to celebrate and applaud the excellent work of our reviewers and encourage submissions from aspiring authors. The awards for the year 2024 were given away by Dr Thomas Cherian (President KSOS, 2023-24) during the KJO session at Drishti 2024, the annual conference of the KSOS recently held at Le Meridien Convention Centre Kochi.

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Editorial

The "Brave New World" of biosimilars: Look before you leap!

"Learn from yesterday, live for today, hope for tomorrow. The important thing is not to stop questioning". Albert Einstein

Over the past decades, intravitreal anti-vascular endothelial growth factor (anti-VEGF) therapy has emerged as the cornerstone for the treatment of retinal diseases. Unfortunately, the prohibitive cost of the drugs involved makes it practically inaccessible to a vast majority of the needy, thus resulting in undertreatment and vision loss in vulnerable patients. This is a real challenge of immense relevance to low-middle-income economies like ours. Reports from India suggest that the most common reason for noncompliance to anti-VEGF treatment is unaffordability (41%).[1] In this context, the advent of biosimilars for intravitreal pharmacotherapy is a ray of hope as they are reported to reduce the treatment cost of retinal diseases by 40%.[2] This article aims to highlight key questions pertaining to basic concepts, common concerns in practice, and future challenges of biosimilars in retinal practice. Awareness of these aspects can help clinicians navigate the evolving world of biosimilars with confidence.

What are biosimilars?

A biosimilar is a biotherapeutic agent that is highly similar to a reference biologic/innovator drug, despite minor differences in clinically inactive components.[3] It should have no clinically meaningful differences from the innovator drug in terms of safety, purity, and potency.

Why is there a biosimilar boom at present?

Biosimilars can be marketed only after the patent of the corresponding innovator biologic has expired. India was the first country to approve biosimilar ranibizumab (Razumab) in 2015. It was the expiry of patents of ranibizumab[4] in the United States (in 2020) and in the European Union (in 2022) that opened the gates of the global market for FDA-approved biosimilars. Aflibercept biosimilars, such as Yesafili (aflibercept-jbvf) and Opuviz (aflibercept-yszy), have been approved by the FDA in May 2024 with interchangeability designation. They are expected to hit the market in 2025, once all patent-related legal issues are resolved.

Are biosimilars just cheap copies of the original?

Biosimilars are not just cheap photocopies of the original molecule. They are complex molecules that are developed by step-wise, structured, technology-driven processes involving reverse genetic engineering and are subject to stringent processes for regulatory approval.

Step 1: Product Development: Involves analytical characterization of the structure and function of the reference biologic to develop a biosimilar that matches the fingerprint of the original molecule.

Step 2: Biosimilarity confirmation with the innovator biologic: Biosimilars must prove that the molecule is chemically, structurally, and biologically highly similar to the originator molecule using stringent step-wise comparability exercises. Further, clinical similarity to the innovator is determined by rigorous, adequately powered phase III equivalence studies performed in a patient population representative of approved therapeutic indications of the reference product.

Step 3: Approval based on the totality of evidence generated from all the above processes.

The norms for approval differ across countries and regulatory bodies. Central Drugs Standard Control Organization (CDSCO) in India, the Drug Controller General of India, US Food and Drug Administration (FDA), and the European Medicines Agency (EMA) are some of the regulatory bodies involved in the respective regions.

What makes them economic?

- Compared to the original biologic, the cost involved in their development is less.
- Their approval process hinges on proving biosimilarity to the innovator, the regulatory mandate for clinical efficacy necessitates a smaller number of phase 3 trials compared to a biologic.
- Extrapolation: If no clinically meaningful differences are found, the biosimilar can be approved for all indications of the reference biologic, even if it was not directly studied in comparative clinical trials for these indications. This regulatory principle, referred to as "indication extrapolation," reduces the need for duplicative studies further reducing development costs of biosimilars.

Are they as good as the original drugs?

This is by far the most nagging question that plagues many patients and even clinicians. Equivalence in efficacy, safety, and immunogenicity between ranibizumab innovator and biosimilar has been upheld by robust evidence, including prospective studies, retrospective studies, randomized control trials, real-world evidence, meta-analysis, systematic reviews, and narrative reviews from all over the world.[5] Hence, biosimilars can be confidently mooted as an alternative option in all approved indications of the original biologic.

How to counsel patients?

Many patients may be skeptical about compromised outcomes on using a cheaper product. In fact, clinicians should be aware of the NOCEBO effect (the opposite of the placebo effect), defined as "a negative effect of a treatment that is induced by patients' expectations, unrelated to the physiological action of the treatment." This means that the patient may not appreciate the treatment outcomes though they may be responding well, because of their skepticism toward the cheaper drug. This effect is more relevant when a switch is being made from an innovator drug to a biosimilar due to economic constraints. Physician confidence and proper communication with patients can overcome the NOCEBO effect. Clinicians usually emphasize the economic advantage, but forget to explain that it does not come at the cost of quality. The technical differences in the manufacturing process/branding may be a convincing reason that can be highlighted to skeptical patients. Further, evidence regarding the safety and efficacy of biosimilars can be quoted if needed to further reassure and take patients into confidence.

How safe is a biosimilar—what are the adverse effects expected?

Current evidence reports no new systemic or ocular adverse effects specific to biosimilars compared with the original biologic.[6-8] The ASSET study in a group of wet ARMD patients has reported the incidence of adverse effects during biosimilar use to range between 12.7% and 20.7%. Further evidence from real-world pooled data has reported it as 21.03%, 97.12% of which were nonserious. Common nonserious adverse effects reported were subconjunctival hemorrhage (8.2%), blurring of vision (6.5%), and ocular pain (5.27). Serious ocular and systemic events which constituted merely 0.61% included RPE tears, noninfectious vitritis, endophthalmitis, nonfatal MI, and nonfatal CVA. Awareness combined with growing clinical experience with biosimilars has resulted in increased acceptance of biosimilars among Indian ophthalmologists[9,10]

Off label Bevacizumab vs Ranibizumab biosimilar?

Intravitreal bevacizumab (Avastin) still remains widely used due to its proven efficacy, safety, and economic profile. However, we cannot turn a blind eye to the risk of off-label status and compounding issues of Avastin. Moreover, with biosimilars getting progressively cheaper, the economic advantage of Avastin has come down, resulting in a more questionable rationale for clinicians to use an off-label drug on grounds of affordability. Hence, given the current medicolegal climate and more economically viable drug choices, clinicians are increasingly preferring ranibizumab biosimilars over Avastin as an affordable alternative.

How to choose the right brand?

The biosimilar market is flooded with an avalanche of new molecules and brands. This problem of plenty, though beneficial from an economic point of view, can be confusing and misleading for practitioners. Though each clinician must make choices of their own based on experience, in general, brands backed by more robust evidence, longer market presence, trustworthy peer recommendation, and patient-friendly policies may be preferred. Also, it is important to check the indications for which a particular biosimilar is approved as the regulatory policy of extrapolation is not uniformly applicable across drugs or countries.

Promise or peril—What does the future hold?

The promise of biosimilars is for all to see, but there are some lurking perils too, for there is no rose without thorns. Listed below are some of the concerns most of which can be overcome by apt policy interventions implemented at the right time.

- Nonstandardized regulatory norms, which differ across countries, could lead to nonuniform, noncomparable drug quality and treatment outcomes across the globe.
- Interchangeability designation assigned to selected biosimilars means that they may be substituted for the reference product at the pharmacy level without prior physician approval. The label is intended for improved patient convenience, but there are rising concerns about the implications of physicians being short-circuited from the treatment decision loop.
- Insurer interference forcing step-wise therapy:[11] These "fail first" policies may require doctors to use the insurer's preferred drug (the cheaper biosimilar) and document a failed response before a more expensive drug which the clinician thinks may benefit the patient more can be tried.
- The biosimilar paradox:[12] The possible FDA approval of ophthalmic bevacizumab in the near future may lead to the removal of the more cost-effective, off-label bevacizumab option, thus resulting in a biosimilar-induced, paradoxical increase in expense of intravitreal anti-VEGF therapy.
- Biosimilars have entered the ophthalmic space quite recently and hence need constant pharmacovigilance.

Practice of evidence-based clinical practice is imperative in this context to ensure patient safety. This demands that practitioners remain constantly alert and updated regarding the latest developments on biosimilars reported in the industry and published literature.

- Biosimilars face competition from biobetters, which are biotherapeutic alternatives to biologics with enhanced efficacy, duration of action, or safety profile. Many of them are in different phases of development and regulatory approval. Once approved they can potentially oust biosimilars as the reigning favorites on the scene.

In conclusion, at present, biosimilars seem to be here to stay as they optimize clinical outcomes in retinal care, while providing substantial cost savings. However, the brave new world of biosimilars holds not only promise, but peril and paradox too. Hence, clinicians need to choose wisely and tread with caution. The future role of biosimilars will depend on continued product trust, predictable regulatory frameworks, and sustainable insurance policies that do not force the doctor's hand in deciding what is best for the patient. As of now, let the unseen perils of tomorrow not deter discerning clinicians from embracing the promise of the biosimilar spring today.

After all, tomorrow as they say, is another day!

Lathika Vasu Kamaladevi
Department of Ophthalmology, Amala Institute of Medical Sciences, Thrissur, Kerala, India

Address for correspondence: Dr. Lathika Vasu Kamaladevi, Department of Ophthalmology, Amala Institute of Medical Sciences, Thrissur, Kerala, India.
E-mail: lathikamala.v@gmail.com

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Sjogren's disease and the cornea: Bridging disciplines for enhanced ocular health

INTRODUCTION

Rheumatological conditions, particularly autoimmune diseases such as Sjogren's disease, primary as well as secondary due to rheumatoid arthritis (RA), and systemic lupus erythematosus (SLE), are well recognized for their systemic manifestations. However, their impact on ocular health, especially the cornea, though well known, often remains under evaluated. The cornea, as we all know, plays a pivotal role in vision by refracting light and protecting internal ocular structures. Understanding the intricate connection between rheumatological disorders and their impact on corneal health is essential for preventing vision loss and enhancing the quality of life for affected individuals. This editorial delves into the scientific underpinnings of this relationship, explores the clinical implications, and advocates for a more integrated approach between cornea specialists and rheumatologists.

IMPACT OF SJOGREN'S DISEASE ON THE CORNEA

Dry eye disease (DED) in Sjogren's disease

Sjogren's disease, an autoimmune disorder characterized by lymphocytic infiltration of exocrine glands, leads to significant ocular surface compromise. Primary Sjogren's disease occurs in isolation, while secondary Sjogren's disease is associated with other rheumatological diseases, like RA and SLE. The hallmark ocular manifestation is dry eye disease (DED), predominantly of the aqueous deficient type. The dysfunction of lacrimal glands results in decreased tear production, causing chronic dryness that adversely affects the corneal epithelium.[1,2]

Meibomian gland deficiency and its consequences

In addition to lacrimal gland insufficiency, Sjogren's disease often involves meibomian gland dysfunction (MGD), contributing to evaporative dry eye. The combined aqueous deficiency and lipid layer instability exacerbate tear film disruption, leading to chronic epitheliopathy, epithelial damage, and increased susceptibility to infections. Ocular surface staining, using dyes like fluorescein and lissamine green, reveals punctate epithelial erosions of the cornea and conjunctiva, indicative of underlying dryness and inflammation.

Symptom–sign discordance

A particularly challenging aspect in managing DED in rheumatological patients is the symptom–sign discordance. Advanced aqueous deficient dry eye may present with minimal subjective symptoms despite significant corneal damage [Figure 1]. This disconnect underscores the necessity for routine objective assessments and dry eye screening, such as Schirmer's test and ocular surface staining—corneal as well as conjunctival, to accurately diagnose and monitor disease progression. Relying solely on patient-reported symptoms may delay intervention, leading to severe dryness and its consequences.

Corneal complications beyond dryness

While DED is the most prevalent ocular manifestation, Sjogren's disease can precipitate severe corneal complications. Peripheral ulcerative keratitis (PUK), characterized by stromal thinning and peripheral corneal ulceration, is strongly associated with RA and SLE. PUK poses a high risk for corneal perforation, necessitating prompt and aggressive management to prevent vision loss.

Sterile stromal melts, another severe complication, involve the rapid degradation of corneal stroma without infectious etiology, most likely secondary to the aqueous deficiency dry eye. Conditions, like RA, can trigger these melts through persistent dry eye-induced inflammation, often requiring tectonic interventions such as cyanoacrylate glue application, amniotic membrane transplantation, Tenon's patch graft, or corneal transplantation.

Scleritis, particularly necrotizing and non-necrotizing forms, can occur, at times threatening the anatomic integrity of the globe. Necrotizing scleritis, marked by severe inflammation and tissue necrosis, can extend to the cornea, increasing the risk of perforation. Effective management requires a multidisciplinary approach to control systemic inflammation and stabilize the ocular surface.

THE ROLE OF CORNEA AND OCULAR SURFACE SPECIALISTS IN RHEUMATOLOGICAL CONDITIONS

Evaluation

Patients with rheumatological conditions require a comprehensive ocular surface evaluation to assess the

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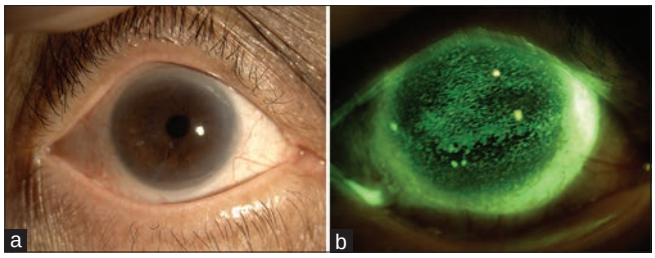


Figure 1: The importance of corneal staining in a quiet largely asymptomatic eye to be able to grade the status of dry eye (a). Yellow barrier filter enhances the fluorescein staining of the cornea, in addition to enabling evaluation of conjunctival staining. Corneal staining of severe grade in an eye in a patient with rheumatoid arthritis (b)

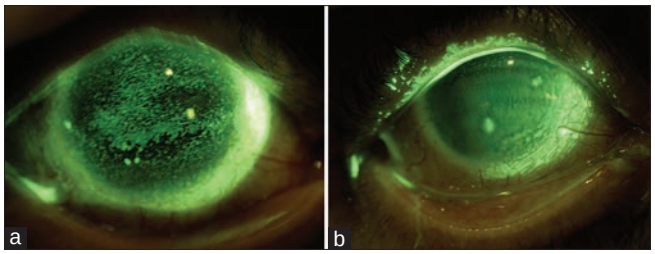


Figure 2: (a and b) The post-punctal cautery resolution of punctate epitheliopathy in the same eye as Figure 1. Pre-cautery Schirmer's test 1 wetting of 1 mm improved to 4 mm post-cautery

extent of dry eye and other potential corneal complications. A detailed assessment includes measuring tear volume using Schirmer's test and performing ocular surface staining with fluorescein, lissamine green, or yellow barrier filters to determine the extent of corneal and conjunctival damage. Special attention should be given to active lacrimal gland secretion through Direct Active Tear Secretion (DATS) and the presence of punctate epithelial erosions or superficial punctate keratopathy of the cornea. In most cases, these eyes are not associated with conjunctival cicatrization; thus, any evidence of cicatrization should prompt further investigation into other causes of aqueous-deficient dry eye, that coexist with the underlying rheumatological condition or otherwise.

Management

In terms of management, artificial tear substitutes remain the cornerstone of treatment for patients with dry eye associated with rheumatological conditions. A stepwise approach is recommended, starting with tear supplementation and advancing to tear retention methods, such as punctal occlusion. In severe cases, punctal cautery is indicated to retain tears and improve ocular surface moisture [Figure 2]. Anti-inflammatory therapies, such as topical cyclosporine, play an essential role in controlling surface inflammation. While topical steroids can be effective in reducing inflammation, their use should be judicious and limited to avoid complications, such as steroid-induced glaucoma or cataracts.

Systemic immunosuppression

Systemic immunosuppression/DMARD is an integral part of managing ocular manifestations in patients with rheumatological conditions. Treatment is always initiated by rheumatologists to ensure a comprehensive and safe approach. In cases of vision-threatening or globe-threatening conditions, such as peripheral ulcerative keratitis or necrotizing scleritis, immediate intervention is critical. These conditions, both associated with underlying vasculitis, not only pose a significant risk to ocular health but can also be life-threatening. Management typically involves intravenous methylprednisolone in conjunction with modifications to systemic immunosuppressive therapy. Prompt and aggressive treatment of these conditions is necessary to prevent severe ocular morbidity or mortality, underscoring the importance of multidisciplinary collaboration between ophthalmologists and rheumatologists.

PSYCHO-SOCIO-ECONOMIC IMPACT OF DRYNESS

Chronic dry eye, particularly in patients with rheumatological conditions, can have a profound psycho-socio-economic impact. The persistent discomfort, visual disturbances, and sensitivity to light can significantly reduce the quality of life, leading to anxiety, depression, and social withdrawal. Many patients struggle with performing daily tasks, reducing their work productivity and, in some cases, leading to job loss or financial strain. The ongoing need for treatment, including artificial tears, medications, and frequent medical visits, further compounds the economic burden. It is crucial for clinicians to recognize and address these broader impacts, providing not only medical care but also emotional support and guidance on coping strategies to improve overall well-being.

THE NEED FOR A CORNEA–RHEUMATOLOGY COLLABORATION

Mandatory screening for dry eye in Sjogren's disease

Early detection and management of DED are crucial in preventing corneal complications. It is imperative to incorporate routine dry eye screening protocols for patients diagnosed with Sjogren's disease and related rheumatological conditions. Regular assessments using objective measures, like tear break-up time (TBUT), Schirmer's test, and ocular surface staining, should be standard practice to identify and address dryness before significant corneal damage occurs. More importantly, this screening serves as feedback to the rheumatologists regarding the disease activity in extraarticular organs.

Hydroxychloroquine screening

Hydroxychloroquine (HCQ) is a cornerstone therapy for many rheumatological disorders, including Sjogren's disease. While HCQ is generally well tolerated, long-term use necessitates regular ocular screening to monitor for potential retinal toxicity. Establishing baseline ocular assessments and periodic follow-ups are essential to mitigate the risk of HCQ-induced ocular complications.

Presurgical collaboration

Ophthalmic surgeries, both elective and emergency, require meticulous planning in patients with rheumatological conditions. One needs to ensure that the ocular surface is stabilized, and the dryness is addressed appropriately prior to surgical interventions.[3] Collaboration between cornea specialists and rheumatologists ensures that the systemic inflammation is well controlled prior to surgical interventions. This interdisciplinary approach enhances surgical outcomes, reduces the risk of postoperative complications, and preserves visual function.

IMPROVING THE CORNEA–RHEUMATOLOGY CONNECT

Enhancing communication

Effective communication between cornea specialists and rheumatologists is fundamental to comprehensive patient care. Implementing standardized referral pathways facilitates timely consultations and ensures that ocular symptoms are promptly addressed within the broader context of the patient's systemic condition.

Integrating rheumatologists into the perioperative management of ophthalmic patients with autoimmune conditions ensures that systemic disease activity is optimized before major interventions. This collaboration can guide the adjustment of immunosuppressive therapies, and minimize the risk of flare-ups, thereby enhancing surgical success and reducing postoperative morbidity.

Educational initiatives and shared resources

Developing joint educational programs and shared resources can bridge knowledge gaps between specialties.

Educational initiatives and shared resources Developing joint educational programs and shared resources can bridge knowledge gaps between specialties. Organizing joint meetings, seminars, and conferences under one roof aims to develop preferred practice patterns that integrate ocular and systemic management. This initiative also encourages the sharing of best practices, research findings, and clinical insights, ultimately enhancing integrated patient care through unified efforts.

Patient awareness programs

Empowering patients through education is a cornerstone of effective disease management. Collaborating with patient forums to educate patients about the ocular manifestations of rheumatological conditions provides patients with valuable information on early symptoms, available treatments, and the importance of regular ocular evaluations. By fostering a well-informed patient community, these initiatives facilitate early diagnosis and timely intervention, reducing the burden of corneal complications.

PERSONAL PERSPECTIVE: SHAPING THE FUTURE OF CORNEA–RHEUMATOLOGY COLLABORATION

Throughout our career as cornea and dry eye specialists, we have witnessed firsthand the profound impact rheumatological conditions can have on ocular health. Patients with Sjogren's disease and other autoimmune disorders often present with complex ocular manifestations that require nuanced and coordinated management.

Advocating for integrated care models

We firmly believe that the future of ocular health in Sjogren's disease lies in integrated care models that seamlessly combine the expertise of cornea specialists and rheumatologists. By advocating for such models, we can ensure that patients receive holistic care that addresses both systemic and ocular aspects of their conditions. This approach not only enhances clinical outcomes but also improves the overall quality of life for patients grappling with these chronic diseases.

Empowering patients and providers alike

Ultimately, the success of collaborative initiatives hinges on the collective commitment of healthcare providers and the active participation of patients. By fostering a culture of mutual respect, continuous learning, and shared responsibility, we can create a supportive ecosystem that empowers both patients and providers. This collaborative spirit is essential in overcoming the complexities of managing corneal complications in rheumatological conditions and in paving the way for a future where optimal ocular health is achievable for all affected individuals.

CONCLUSION

The intricate relationship between rheumatological conditions and corneal health underscores the necessity for a collaborative, interdisciplinary approach to patient care. By recognizing the profound impact of diseases like Sjogren's disease on the cornea and implementing strategies to enhance communication and cooperation between cornea specialists and rheumatologists, we can significantly improve clinical outcomes and preserve

vision for countless patients. Initiatives, such as ENCORE, exemplify the potential of unified efforts in transforming preferred practice patterns and fostering a more holistic approach to ocular and systemic health.

As cornea specialists, it is our responsibility to advocate for these changes, drive innovation, and collaborate closely with our rheumatological counterparts to ensure that patients receive the comprehensive care they deserve.

Geetha Iyer, Bhaskar Srinivasan

CODE Eye Care-Institute of Excellence for Cornea, Ocular Surface and Dry Eye, Chennai, Tamil Nadu, India

Address for correspondence: Dr. Geetha Iyer, CODE Eye Care-Institute of Excellence for Cornea, Ocular Surface and Dry Eye, 112, Sir Thyagaraya Road, Chennai, Tamil Nadu - 600 017, India.
E-mail: drgeethaiyer@gmail.com

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Review Article

A brief review on microphthalmia and anophthalmia

ABSTRACT

Anophthalmia and microphthalmia are congenital eye abnormalities characterized by the absence or underdevelopment of one or both eyes, respectively. These conditions pose significant challenges to affected individuals, impacting both visual function and cosmetic appearance. The etiology of anophthalmia/microphthalmia is multifactorial, involving genetic, environmental, and developmental factors. Diagnosis typically relies on clinical examination and imaging studies, with prenatal detection becoming increasingly feasible through advanced ultrasound techniques. Surgical management forms the cornerstone of treatment, aiming to optimize orbital and ocular growth, enhance cosmetic outcomes, and maximize residual vision. Despite advancements in understanding and management, anophthalmia and microphthalmia remain major causes of childhood blindness, highlighting the ongoing need for research to elucidate underlying mechanisms and develop novel therapeutic strategies.

Keywords: Anophthalmia, childhood blindness, genetics, microphthalmia, orbit

INTRODUCTION

Anophthalmia, the absence of one or both eyes, can be congenital or acquired. Congenital anophthalmia occurs during fetal development and includes three types: primary, secondary, and tertiary. In primary congenital anophthalmia, the eye fails to form at all, often due to genetic factors. Secondary anophthalmia arises when the early eye structure (optic vesicle) forms but is later reabsorbed. Tertiary anophthalmia occurs when the eye begins to develop but then degenerates due to issues with blood supply or other environmental factors. Acquired anophthalmia, by contrast, occurs after birth and can result from trauma, infection, tumors, or surgical removal of the eye. Both types present challenges that often require medical and cosmetic interventions.

BASIC DIAGNOSTIC CRITERIA

The mean maximum axial lengths of the human eye are approximately 17 mm at birth and 23.8 mm in adulthood.[1] The majority of eye growth occurs within the first 3 years after birth, mainly in the posterior segment, which accounts for over 90% of postnatal growth. Anophthalmia and microphthalmia, defined by the International Clearinghouse for Birth Defects Monitoring Systems, indicate either absent or small eyes, typically with some normal adnexal elements and eyelids present. Microphthalmia specifically refers to cases where the corneal diameter is less than 10 mm and the antero-posterior diameter of the globe is less than 20 mm.[1,2]

PREVALENCE

The estimated occurrence of anophthalmia and microphthalmia at birth is roughly three and 14 cases per 100,000 individuals, respectively, although some studies suggest a combined prevalence of up to 30 cases per 100,000 individuals. Epidemiological findings point to maternal age exceeding 40, multiple births, low birth weight, and premature birth as potential risk factors for these conditions. There is no apparent bias regarding race or gender. Typically,

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Jayasri Periyandavan, Mary Stephen[1]
Department of Ophthalmology, Indra Gandhi Medical College and Research Centre, Puducherry, [1]Department of Ophthalmology, SVMCH & RC, Puducherry, India

Address for correspondence: Dr. Mary Stephen, Department of Ophthalmology, SVMCH and RC, Puducherry - 605 006, India.
E-mail: stephen6752@gmail.com

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both anophthalmia and microphthalmia affect both eyes, except for isolated cases of microphthalmia, which usually affect only one eye. Microphthalmia is documented in 3.2% to 11.2% of blind children.[3]

CLASSICAL DESCRIPTION

Anophthalmia indicates the absence of ocular tissue in the eye socket. When ocular tissue is not visibly present during clinical examination, histological analysis has revealed residual neuroectoderm in some cases. Consequently, terms, such as "true anophthalmia," "clinical anophthalmia," and "extreme microphthalmia," may actually describe a continuum between anophthalmia and microphthalmia. From a clinical standpoint, it is customary to classify an eye as microphthalmic if its axial length falls two standard deviations below the mean for the population's age. Typically, this equates to an axial length below 21 mm in adult eyes. Simple microphthalmia refers to a structurally normal yet small eye and has been used interchangeably with the term "nanophthalmia."[2,4] The thickening of the sclera in these eyes, along with subsequent alterations in blood flow, is thought to be accountable for the heightened occurrence of uveal effusions and choroidal detachments observed. Microphthalmia can also be associated with additional ocular conditions, referred to as complex microphthalmia. These conditions may affect either the anterior segment, such as sclerocornea and Peters anomaly, or the posterior segment, including persistent hyperplastic primary vitreous and retinal dysplasia. Both anophthalmia and microphthalmia can manifest in isolation or as part of a syndrome, occurring in roughly one-third of cases. Learning disabilities are present in about 20% of cases. Complex microphthalmia, in particular, displays extensive phenotypic diversity.

ETIO-PATHOGENESIS

The precise cause of anophthalmia and microphthalmia remains uncertain. Anophthalmia may originate early in gestation due to the failure of the anterior neural tube to develop (referred to as secondary anophthalmia) or the optic pits to enlarge and form optic vesicles (referred to as primary anophthalmia). Another category, known as consecutive or degenerative anophthalmia, applies to cases where optic vesicles degenerate and disappear post-formation. Observations of optic nerves, chiasm, and/or tracts in individuals with anophthalmia may suggest regression of a partially developed eye rather than the complete absence of the optic vesicle(s). This viewpoint is supported by findings in seemingly anophthalmic orbits displaying extraocular muscle insertion into a fibrous mass, possibly indicating an aborted eye. Additionally, the posterior



Figure 1: Clinical photograph of the patient showing acquired anophthalmia with no distinct ocular structures



Figure 2: Clinical photograph of the patient showing marked enophthalmos due to lack of support to eyelids because of anophthalmia and can be compared with normal eye



Figure 3: Axial computed tomography sections showing orbit with the absence of ocular contents on one side in case of acquired anophthalmia

segment of microphthalmic eyes is more affected than the anterior segment. They proposed that postnatal ocular growth plays a vital role and suggested that factors, such as reduced size of the optic cup, altered proteoglycans in the vitreous, low intraocular pressure, and abnormal production of growth factors, may contribute to the development of simple microphthalmia. They also suggested that inadequate

production of secondary vitreous could lead to complex microphthalmia.[5-7]

Epidemiological research has suggested that both genetic and environmental factors play a role in the development of anophthalmia and microphthalmia. This review primarily focuses on genetic causes, as evidence for environmental influences is more indirect and accounts for a smaller portion of cases. Chromosomal duplications, deletions, and translocations have been linked to both conditions and are often associated with specific syndromes. Among the genetic causes, SOX2 stands out as a significant gene implicated in anophthalmia/microphthalmia. Studies have identified the SOX2 locus at 3q26.3, and heterozygous loss-of-function point mutations, predominantly resulting in bilateral anophthalmia, account for 10–20% of severe cases. The "SOX2 anophthalmia syndrome" encompasses various ocular issues, such as sclerocornea, cataracts, persistent hyperplastic primary vitreous, and optic disk dysplasia, along with non-ocular manifestations, such as intellectual disability, neurological abnormalities, facial anomalies, postnatal growth delay, esophageal abnormalities, and genital anomalies in males.[8,9]

PAX6, located on chromosome 11p13, has undergone more thorough investigation compared to many other genes associated with eye development. Loss-of-function mutations in PAX6 typically lead to aniridia (OMIM 106210), a congenital eye condition affecting the entire eye and causing severe visual impairment.[10] However, PAX6 was also the first gene identified in human anophthalmia cases. While PAX6 mutations are a rare cause of anophthalmia, recent research has sparked interest in a potential cooperative relationship between PAX6 and SOX2. PAX6 and SOX2 work together to regulate a specific element responsible for lens induction in chicks, suggesting that failure of lens induction could contribute to microphthalmia in individuals with mutations in these genes. Further investigations have shown that interactions between PAX6 and SOX2 also play a role in lens induction in mammals, affecting the γ-crystallin gene. Ultrasound biomicroscopy studies are needed to determine whether aphakia is commonly associated with microphthalmic SOX2 cases. As expected for genes expressed during brain development, individuals with inherited mutations in PAX6 and SOX2 often display malformations of the central nervous system, in addition to dominantly inherited anophthalmia/microphthalmia. Notably, mutations in the FOXE3 gene (located on chromosome 1p32), linked to congenital primary aphakia (OMIM 610256), were identified in three siblings with microphthalmia. In all three cases, the phenotype was attributed to lens agenesis.

Mutations in three genes expressed in the retina are linked to anophthalmia/microphthalmia, possibly due to disruptions in retinal development. Heterozygous loss-of-function mutations in OTX2 (located on chromosome 14q22, exhibiting autosomal dominant inheritance) are associated with a broad spectrum of ocular conditions, including anophthalmia, microphthalmia, and retinal abnormalities. Patients with OTX2 mutations often have central nervous system malformations and intellectual disability. RAX, found on chromosome 18q21.32, accounts for approximately 2% of inherited cases of anophthalmia/microphthalmia. Similarly, mutations in CHX10 (located on chromosome 14q24.3) contribute to about 2% of isolated cases of microphthalmia. Mutations in both genes typically result in recessively inherited traits.[11,12]

DIAGNOSIS AND WORK-UP

Diagnosis typically relies on clinical and imaging criteria [Figures 1 and 2] and may be confirmed through histological examination if a postmortem procedure is conducted.

Ocular evaluation

Diagnosing anophthalmia can pose clinical challenges, whereas microphthalmia is usually identified through visual inspection and palpation of the eye under the eyelids. Determining corneal diameter, typically ranging from 9 to 10.5 mm in neonates and 10.5 to 12 mm in adults, aids in this diagnosis. Microphthalmia accompanied by a cyst often presents with lower eyelid bulging. Electrodiagnostic tests may provide valuable insights, especially in cases where retinal development remains unaffected. It is also essential to examine the eyes of both parents and carefully investigate the family history for any eye anomalies.

Genetic evaluation

Given the diverse array of presentations associated with anophthalmia/microphthalmia, it is essential to assess these patients within multidisciplinary teams consisting of pediatricians and clinical geneticists. Further investigations hinge on the specific clinical profile. If no syndrome is detected during infancy, it is advisable to conduct additional evaluations around the age of 3 or 4, as many syndromes tend to manifest more clearly by this stage.

Cytogenetic examinations can be performed using fetal cells obtained from amniotic fluid, typically collected after 14 weeks of gestation, or from chorionic villus sampling specimens, usually taken around 10 to 12 weeks into pregnancy. Through a 650-band karyotype analysis, they identified a 46, XX, del(3)(q26.3q28) interstitial deletion on chromosome 3's long arm. Subsequent fluorescence

in situ hybridization (FISH) analysis confirmed the interstitial deletion of 3q27, encompassing the SOX2 locus.[11-14]

Imaging modalities

Ultrasound is commonly used to measure the length of the eyeball in cases of microphthalmia. Computed tomography (CT) and magnetic resonance imaging (MRI) scans are valuable for diagnosing anophthalmia, revealing the absence of an eyeball within the orbit, although they may detect soft, shapeless tissue (exhibiting intermediate T1 signal intensity and low T2 signal intensity on MRI scans, and intermediate density on CT scans). The presence of neural tissue forming the visual pathway and extraocular muscles varies. Orbital dimensions and volume are typically diminished. In simple microphthalmia, a small yet normal eyeball is observed, displaying typical signal/density characteristics of the lens and vitreous, within a smaller-than-normal orbit.[15,16]

Detection of anophthalmia/microphthalmia is feasible as early as the early second trimester, although recent findings suggest transvaginal ultrasound may achieve this as soon as around 12 weeks. During ultrasound assessment, fetal eyes are ideally observed in coronal, axial, and coronal-axial planes, appearing symmetrically on each side of the nose. Lenses appear as smooth circular lines with hypoechogenic content on axial and coronal views. Eye size can be evaluated by visualizing the maximum coronal or axial planes of the orbit and comparing them against established eye growth charts [Figure 3].

Treatment

Observation

Measurable retinal function might be evident in instances of microphthalmia, particularly those associated with SOX2 mutations. It is essential to perform refraction assessments on these eyes and address any underlying amblyopia. In unilateral cases, protecting the unaffected eye and appropriately managing any visual deficiencies are imperative.

Surgical

Surgical treatment is typically the cornerstone of managing anophthalmia/microphthalmia. During growth from birth to adolescence, the globe triples in volume, paralleled by growth in the bony orbit. Both congenital conditions result in a smaller orbital volume compared to peers, potentially leading to facial asymmetry. Enucleation in children and adults has been found to reduce orbital volume. Reconstructive strategies aim to address soft tissue hypoplasia and asymmetric bone growth simultaneously.

Early treatment initiation maximizes overall development. Mild/moderate microphthalmia may be managed conservatively with conformer insertion, gradually increasing in size to accommodate orbital growth. Severe microphthalmia and anophthalmia are typically treated soon after birth with conformers to enlarge the palpebral fissure, conjunctival cul-de-sac, and orbit. Volume replacement with implants can stimulate bony orbit expansion, often starting around 6 months of age. Implants and expanders may be complemented with dermis-fat grafts. Static orbital implants may require replacement before puberty and may pose challenges, such as wound complications or inadequate bone growth stimulation.

Expandable orbital implants are effective in promoting bony growth and socket enlargement. However, inflatable expanders may struggle with sustained expansion and direction control, while self-expanding hydrogel spheres lose force when fully hydrated.[17] Orbital osteotomies may be necessary in severe cases.

Ocular prostheses are used once the orbit has developed sufficiently and replaced regularly to accommodate ongoing expansion. Conjunctival sac and eyelid reconstruction may improve cosmetic appearance.[18] Microphthalmia with cyst is typically addressed around age 5, utilizing cyst-induced orbital expansion until the orbit approaches adult volume, then removed for cosmetic reasons when the child starts school. Surgical excision with prior decompression is common, although cyst aspiration carries a higher risk of recurrence.

CONCLUSION

The potential for visual development in individuals with microphthalmia hinges on the extent of retinal development and other ocular characteristics. Treatment goals prioritize maximizing existing vision and improving cosmetic appearance rather than restoring sight. The etiology of anophthalmia/microphthalmia is deeply intertwined with the entire process of ocular formation, an area where our understanding is rapidly expanding. Despite advancements, there is still much research required to unravel the complex mechanisms underlying these conditions, which significantly contribute to childhood blindness. Even with future insights into these processes, the ability to develop new therapies to prevent these conditions may be constrained by the early stages of ocular development in the fetus.

Declaration of patient consent

The authors certify we have obtained appropriate patient consent forms. The patient has given her consent and other clinical information to be reported in the journal in the forms. The patient understands that their names and initials will not

be published, and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Ethical approval

Written informed consent form obtained from the patient.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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Unfolding macula pucker: The mystery beneath

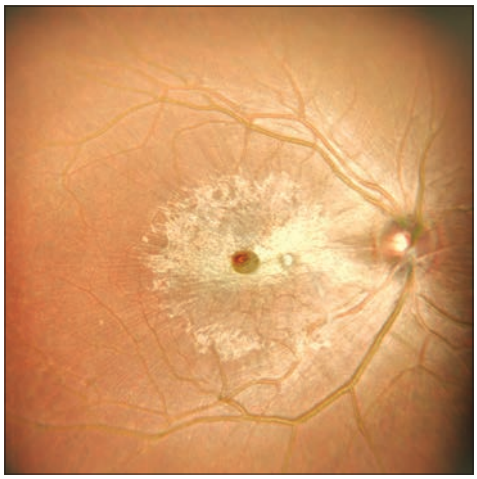


Figure 1: Fundus photo of a 40 year old man

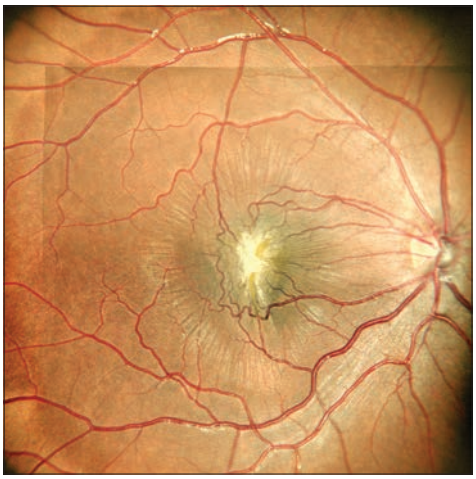


Figure 2: Fundus photo of a 16 year old boy

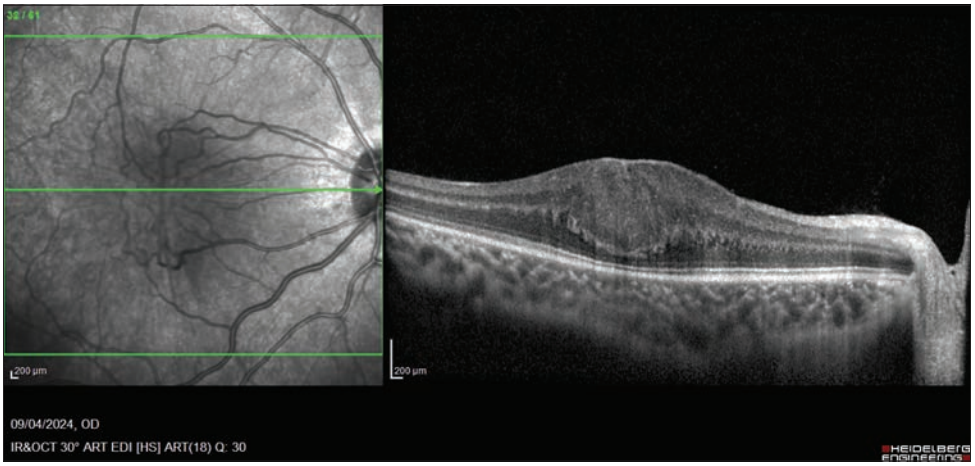


Figure 3: OCT image of Figure 2

In the above pictures, Figure 1 is color fundus photograph (pseudocolor) of the right eye of a 40-year-old man with nil systemic illness who presented with defective vision (BCVA 6/18) for six months. Figure 2 is the right eye of a six-year-old boy with BCVA 6/9 referred for an accidental finding of macular puckering. Figure 3 is the OCT of Figure 2. The rest of the fundus appeared normal in both cases. Which one of the below statements is true?

a. Both have the same diagnosis but only differ in severity.
b. Figure 2 may have systemic associations.
c. Surgical management in both cases has a good prognosis.
d. Figure 2 requires immediate management as it progresses fast.

Answer: choice b

Figure 1 is an idiopathic epiretinal membrane (ERM) with pseudohole. Figure 2 is a combined hamartoma of the retina and RPE with a secondary epiretinal membrane. A combined hamartoma should be excluded in all young patients with epiretinal membrane or vitreomacular adhesion. A combined hamartoma of the retina and RPE (CHRRPE) is a rare congenital benign tumor that is commonly unilateral. Tumor has been described to arise from undifferentiated ectopic progenitor cells destined for the RPE that fail to complete differentiation due to a lack of necessary homeostatic factors, leading to hyperplasia and accumulation within the neurosensory retina.[1] The trans-differentiation from glial and RPE cells into myofibroblastic preretinal cells alters the vitreoretinal interface, leading to the formation of an ERM.[2] The ERMs

are a common feature of CHRRPE. In some cases, it can be difficult to distinguish ERM from CHRRPE.

Typical CHRRPE comprises of slightly raised lesions at the posterior pole with proliferation of membrane, leading to vascular distortion. Some CHRRPE lesions appear to predominantly contain vascular cells (mostly red color). Other CHRRPE contains prominent melanocytic cells (mostly black color) and some have a predominance of glial cells (mostly white color). It can occur at disk, macula, or periphery. Hyperpigmentation, abnormal vasculature, and young age are rarely present in idiopathic ERM as compared with CHRRPE, which helps in clinical differentiation.[3]

Less common presentations are mild retinal exudation, detachment, macular edema, choroidal neovascularization (CNV), retinoschisis, retinal holes, vitreous hemorrhage, and preretinal neovascularization. It may be misdiagnosed as an idiopathic epiretinal membrane, uveal melanoma, RPE adenocarcinoma, and retinoblastoma. OCT is a helpful tool when evaluating the CHRRPE. OCT findings include ERM with secondary retinal folds and striae, retinal thickening with retinal disorganization, and saw-tooth appearance of the inner retina [Figure 3].

Even though most cases are sporadic, CHRPE has been reported to occur in association with neurofibromatosis types 1 and 2,[4] tuberous sclerosis, Gorlin syndrome,[5] branchio-oculo-facial syndrome, nasopharyngeal angiofibroma, and Poland syndrome. Surgery for associated ERMs is a subject of debate since visual acuity may not improve despite membrane removal. It may not be possible to remove the whole ERM without damaging the retina. Generally, CHRRPE requires no treatment in the absence of symptoms as it is a slow-growing tumor.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

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There are no conflicts of interest.

Hema VK, Prakash VS, Dhileesh P Chandrasekharan

Department of Vitreoretinal Surgeries, Comtrust Eye Hospital, Puthiyara, Calicut, Kerala, India

Address for correspondence: Dr. Prakash VS, Department of Vitreoretinal Surgeries, Comtrust Eye Hospital, Puthiyara, Calicut - 673 004, Kerala, India.
E-mail: prakash@comtrusteyehospital.org

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Consents in medical practice—Case examples

Consent is an important element of medical practice. It has evolved over the years based on many real-life incidents. In different countries, consent has different interpretations. Let us look at the different aspects of consent in a broad view based on case studies and real-life scenarios.

Schloendorff V society of New York hospital 1914 (103) NE 92: In the words of Justice Cardozo "every human being of adult years and sound mind has the right to determine what should be done to your body and a surgeon who performs an operation without patients consent commits an assault for which he is liable in damages." This forms the basis of consents in clinical practice.[1]

The landmark judgment of the Supreme Court of India in the case of Samira Kohli vs Dr. Prabha Manchanda and Anron January 16, 2008 has summarized principles relating to consent as follows in section 32. In this case, without the consent of an adult person under anesthesia, additional procedure was performed after informing the relatives. Supreme Court ruled in favor of the patient. The important observations were as follows.[2]

"A doctor has to seek and secure the consent of the patient before commencing a treatment (the term treatment includes surgery also). The consent so obtained should be real and valid, which means that: the patient should have the capacity and competence to consent; his consent should be voluntary; and his consent should be on the basis of adequate information concerning the nature of the treatment procedure, so that he knows what is consenting to".

The adequate information to be furnished by the doctor (or a member of his team) who treats the patient, should enable the patient to make a balanced judgment as to whether he should submit himself to the particular treatment as to whether he should submit himself to the particular treatment or not. This means that the Doctor should disclose (a) the nature and procedure of the treatment and its purpose, benefits, and effect; (b) alternatives if any available; (c) an outline of the substantial risks; and (d) adverse consequences of refusing treatment. However, there is no need to explain the remote or theoretical risks involved, which may frighten or confuse a patient and result in the refusal of consent for the necessary treatment. Similarly, there is no need to explain the remote or theoretical risks of refusal to take treatment which may persuade a patient to undergo a fanciful or unnecessary treatment. A balance should be achieved between the need for disclosing necessary and adequate information and at the same time avoiding the possibility of the patient being deterred from agreeing to a necessary treatment or offering to undergo an unnecessary treatment.

Consent given only for a diagnostic procedure cannot be considered as consent for therapeutic treatment. Consent given for a specific treatment procedure will not be valid for conducting some other treatment procedure. The fact that the unauthorized additional surgery is beneficial to the patient, or that it would save considerable time and expense to the patient, or would relieve the patient from pain and suffering in future, are not grounds of defense in an action in tort for negligence or assault and battery. The only exception to this rule is where the additional procedure though unauthorized, is necessary to save the life or preserve the health of the patient and it would be unreasonable to delay such unauthorized procedure until patient regains consciousness and takes a decision.

There can be a common consent for diagnostic and operative procedures where they are contemplated. There can also be a common consent for a particular surgical procedure and an additional or further procedure that may become necessary during the course of surgery.

Nizam's Institute of Medical Sciences vs Prasanth S. Dhananka and Ors on May 14, 2009[3]

The respondent Prasanth S. Dhananka was then 20 years of age and a student of Engineering V Nizam Institute of Medical Sciences. The patient became paraplegic after the removal of a tumor supposedly neurofibroma. The complainant filed a complaint before the National Consumer Redressal Commission on April 5th, 1993, alleging utter and complete negligence on the part of Dr. P.V. Satyanarayana and the other attending doctors. It was also pleaded that the consent that had been taken was only for the purpose of an excision biopsy which was an exploratory procedure, but Dr. Satyanarayana had carried out a complete excision removing the tumor mass and the fourth rib, thereby destroying the intercostal blood vessels leading to paraplegia, and had a neurosurgeon

been associated with the operation, this problem could well have been avoided.

The observations of the court regarding consent were important.

"Consent that is given by a person after receipt of the following information: the nature and purpose of the proposed procedure or treatment; the expected outcome and the likelihood of success; the risks; the alternatives to the procedure and supporting information regarding those alternatives; and the effect of no treatment or procedure, including the effect on the prognosis and the material risks associated with no treatment. Also included are instructions concerning what should be done if the procedure turns out to be harmful or unsuccessful."

A surgeon performs an operation without his consent on a patient temporarily rendered unconscious in an accident, he should do no more than is reasonably required, in the best interests of the patient, before he recovers consciousness.

The Court also considered the possibility that had the patient been conscious during surgery and in a position to give his consent, he might have done so to avoid a second surgery but observed that this was a nonissue as the patient's right to decide whether he should undergo surgery was inviolable. This is what the Court had to say:

"It is quite possible that had the patient been conscious, and informed about the need for the additional procedure, the patient might have agreed to it. It may be that the additional procedure is beneficial and in the interests of the patient. It may be that postponement of the additional procedure (say removal of an organ) may require another surgery, whereas removal of the affected organ during the initial diagnostic or exploratory surgery, would save the patient from the pain and cost of a second operation. Howsoever practical or convenient the reasons may be, they are not relevant. What is relevant and of importance is the inviolable nature of the patient's right in regard to his body and his right to decide whether he should undergo the particular treatment or surgery or not. Therefore, at the risk of repetition, we may add that unless the unauthorized additional or further procedure is necessary in order to save the life or preserve the health of the patient and it would be unreasonable (as contrasted from being merely inconvenient) to delay the further procedure until the patient regains consciousness and takes a decision, a doctor cannot perform such procedure without the consent of the patient."

Judgment was in favor of the complainant.

Take Home Message: The stare decisis or judge-made laws from apex courts clearly indicate the importance of consents in medical practice. It reiterates the autonomy of the patient to decide what to do with his or her own body. The majority of the litigations succeeding against doctors are due to flaws in consents before any treatment.

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Mahesh Gopalakrishnan, Ashok Nataraj[1]

Vitreoretinal Services, Giridhar Eye Institute, Kochi, [1]Vitreoretinal Services, Precise Eye Care, Trivandrum, Kerala, India

Address for correspondence: Dr. Mahesh Gopalakrishnan, Vitreoretinal Services, Giridhar Eye Institute, Kochi, Kerala, India.
E-mail: maheshgopalakrishnan@yahoo.com

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Original Article

Anterior chamber parameters after laser iridotomy in primary angle-closure spectrum

ABSTRACT

Aim: To evaluate anteriorchamber parameter after laser iridotomy in primary angle closure disease spectrum. **Objectives:** To study central anterior chamber depth morphology (CACD) anterior chamber volume (ACV), anterior chamber angle (ACA) in primary angle closure disease patients using rotating scheimpflug camera (pentacam) before and after laser PI. **Methods:** 91 eyes of 50 patients having PACD changes in CACD, ACV, ACA were evaluated using rotating scheimpflug camera before and after laser peripheral iridotomy. **Results:** The parameters as measured by Pentacam were mean CACD increased from 1.99 ± 0.21 to 2.03 ± 0.23 mm after LPI among PACS group with P = 0.01. There was no statistically significant increase in CACD among PAC and PACG groups. The change in the ACA was not statistically significant among all three groups. However, the average ACV increased from 77.50 ± 18.46 to 94.22 ± 16.62 mm3 in PACS, 82.09 ± 25 to 100.27 ± 25.76 mm3 in PAC, and 87.13 ± 19.32 to 101.62 ± 18.84 mm3 in PACG groups, respectively. **Conclusion:** Changes in anterior chamber parameter pre and post laser can be quantified adequately using pentacam.

Keywords: Laser peripheral iridotomy, Pentacam, primary angle-closure disease

INTRODUCTION

Glaucoma is the second leading cause of world blindness after cataract and accounts for 15% of global blindness. Asians represent 47% of those with glaucoma and 87% of those with angle-closure glaucoma (ACG).[1] The proportion of all cases suffering from significant loss of vision is three times higher in primary ACG (PACG) than primary open-angle glaucoma as considerable damage can occur before symptoms become apparent.[2]

Laser peripheral iridotomy (LPI) is the standard first-line intervention in both acute and chronic forms of PACG. It is successful in preventing the recurrence of acute attacks and virtually eliminates the risk of an acute attack in the fellow eye. The mechanism of action is relief of relative pupillary block, allowing the convex iris to flatten and widening of the anterior chamber angle (ACA).[3]

It is essential to evaluate the response to LPI by studying changes in anterior segment morphology. Advances in anterior segment imaging have allowed for quantitative and reproducible measurement of the parameters. There are many studies which have documented change in anterior chamber anatomy post-LPI. In our study, we evaluated the changes in anterior chamber parameters, using rotating Scheimpflug camera before and after LPI.

MATERIALS AND METHODS

Ethics

After approval of the institutional ethics committee, 91 eyes of 50 patients with primary angle-closure disease (PACD) who presented to Prabha Eye Clinic and Research Centre,

B. S. Chetana, Y. M. Manjula

Department of Ophthalmology, BGS Global Institute of Medical Sciences, Bengaluru, Karnataka, India

Address for correspondence: Dr. Y. M. Manjula,
No. 466, H Road, Ideal Homes 2nd Stage, R R Nagar,
Bengaluru - 560 098, Karnataka, India.
E-mail: manjumahesh50@gmail.com

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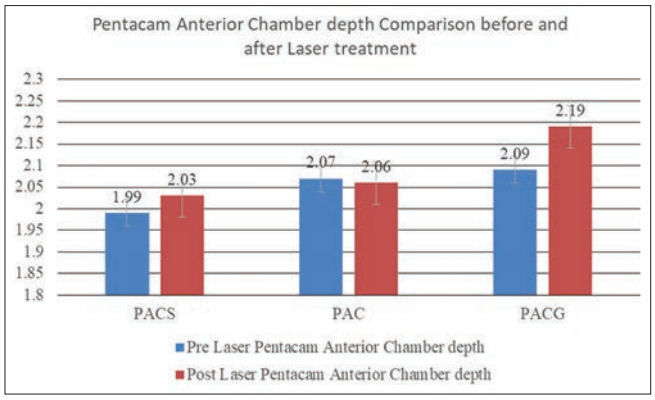


Figure 1: Increase in central anterior chamber depth by rotating Scheimpflug camera measurement in the subset of eyes with primary angle-closure suspect (*P*=0.01). No significant increase in anterior chamber depth in both the primary angle closure (*P*=0.329) and primary angle-closure glaucoma group (*P*=0.193)

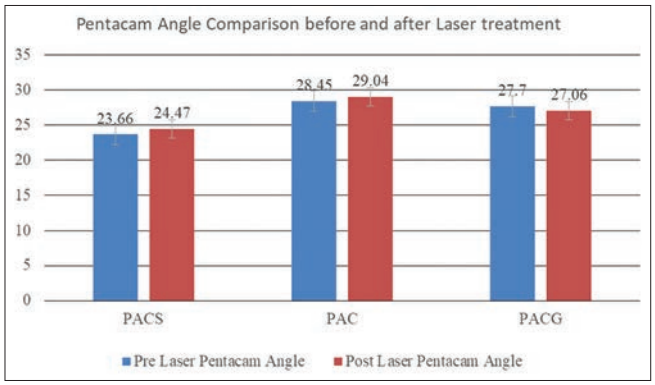


Figure 2: No significant difference in mean anterior chamber angle pre and postlaser peripheral iridotomy among all the three groups as measured by rotating Scheimpflug camera. Primary angle-closure suspect (*P* = 0.06), primary angle-closure (*P* = 0.627), and primary angle-closure glaucoma (*P* = 0.469)

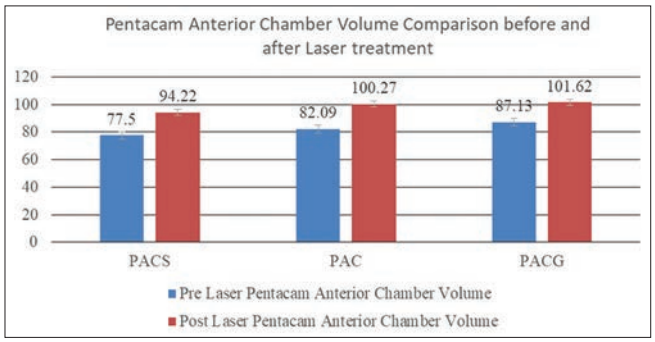


Figure 3: The anterior chamber volume measurement by rotating Scheimpflug camera showed statistically significant increase in all the three groups postlaser iridotomy with *P* = 0.001

Bangalore, India, were included into the study. It was conducted in accordance with the Declaration of Helsinki. Informed consent was obtained from all the participants.

Study design

This is a comparative, interventional, longitudinal study. The study cohort included 91 eyes of 50 patients having PACD. Changes in central anterior chamber depth (CACD) morphology were evaluated using rotating Scheimpflug camera before and 1–2 weeks after LPI. In addition, changes in anterior chamber volume (ACV) and ACA were also recorded using rotating Scheimpflug camera (Pentacam).

Patients with shallow anterior chamber depth (ACD) on slit-lamp examination and confirmed to have narrow angles by Dr. Rajendra Prasad Centre for Ophthalmic Sciences (RPC) gonioscopy grading system underwent ophthalmic examination before recruitment.[4] The study subjects underwent a comprehensive ophthalmic examination before and 1–2 weeks after LPI. The baseline evaluation included medical and ophthalmic history, best-corrected visual acuity measurement and intraocular pressure (IOP) by applanation tonometry, gonioscopic grading of ACA by Zeiss 4 mirror lens or Sussman lens (with and without indentation), stereoscopic examination of the optic nerve head with 78 diopter lens, and anterior segment imaging with Pentacam.

The participants were classified into primary angle-closure suspect (PACS), primary angle closure (PAC), and PACG groups according to the International Society for Geographical and Epidemiological Ophthalmology guidelines.[5]

The subjects who fulfilled the diagnostic criteria of PAC spectrum were included in the study. Patients with coexistent retinal pathology, previous intraocular operations, ocular trauma, uveitis, and patients with secondary ACG were excluded from the study. The ocular abnormalities that precluded imaging or evaluation of the optic disc were excluded.

One drop of 2% pilocarpine was instilled to the eyes for about 4 times, 1 h before LPI. The Q-switched neodymium-doped: yttrium aluminum garnet (Nd:YAG) laser (1064 nm) and Abraham lens with normal saline as coupling agent were used. The following setting was applied for laser iridotomy: 2–3 shots/burst using energy; 1–3 mJ/burst to the treatment site. Patency of the iridotomy was confirmed by the gush of aqueous through iridotomy from posterior to anterior chamber along with pigment dispersion. After LPI, all patients received 0.1% dexamethasone 4 times a day for 4 days. None of the patients showed spike in IOP, measured after 1 h of LPI.

Statistics

Data were entered into Microsoft Excel datasheet and were analyzed using Statistical Products and Services Solution version 22.0 (IBM Corporation; Armonk, NY, USA). Continuous

data were represented as mean and standard deviation. Paired *t*-test was used as test of significance for paired data such as before and after LPI. $P < 0.05$ was considered statistically significant.

RESULTS

The patients who fulfilled the above-mentioned inclusion criteria were enrolled in the study. The patients were divided into PACS, PAC, and PACG groups which included 64, 11, and 16 eyes, respectively. Nineteen patients were male and 31 were female. The mean age of patients was 60.26 ± 12.4 years.

The parameters as measured by Pentacam were as follows: mean CACD increased from 1.99 ± 0.21 to 2.03 ± 0.23 mm after LPI among PACS group with $P = 0.01$. There was no statistically significant increase in CACD among PAC and PACG groups as shown in Figure 1. The change in the ACA was not statistically significant among all three groups as shown in Figure 2. However, the average ACV increased from 77.50 ± 18.46 to 94.22 ± 16.62 mm^3 in PACS, 82.09 ± 25 to 100.27 ± 25.76 mm^3 in PAC, and 87.13 ± 19.32 to 101.62 ± 18.84 mm^3 in PACG groups, respectively as shown in Figure 3.

DISCUSSION

LPI is the first line of treatment in the management of eyes with narrow angles. It is known that iridotomy relives relative pupillary block by providing an alternate pathway for the aqueous humor to drain from the posterior to ACAs.[6]

The Van Herick method is a noninvasive and simple outpatient procedure in assessing ACD. However, it is imprecise and subjective. We have not used the Van Herick technique in our study.

Assessment of angles by gonioscopy involves enumerating the posterior most angle structure visible in the angle and the angle between the peripheral cornea and iris. Although more precise than the Van Herick technique, gonioscopy is also associated with inter and intraobserver variability.[7]

Advances in anterior chamber imaging such as, anterior segment optical coherence tomography, rotating Scheimpflug camera have allowed for quantitative and reproducible measurement of anterior segment parameters.

The Pentacam images the anterior segment of the eye by a rotating Scheimpflug camera system. This rotating process allows rapid capture of images in different meridians and therefore three-dimensional elevations. Pentacam performs an angle-to-angle assessment of the anterior segment in <2 s. Scheimpflug cameras have been widely employed, primarily in refractive surgery and secondarily in glaucoma screening.[8]

In the study conducted by Lopez-Callabero *et al*., they observed significant deepening of CACD after LPI in patients with narrow angles and PACG using rotating Scheimpflug camera.[9] Talajic *et al*. concluded in their study that although an increase in CACD was noted after LPI, it was statistically insignificant among patients with PACS.[10] Grewal *et al*. in their study concluded that extent of the LPI-induced peripheral ACD increase was enhanced with increasing distance from the optical axis but no change occurred in CACD.[11]

Razeghinejad *et al*. concluded in their study that there is no significant increase in rotating Scheimpflug camera ACA after LPI.[12] This finding is similar to our study.

Pakravan *et al*. concluded that ACA had lower sensitivity and specificity for discriminating fellow eyes of cute angle-closure patients from normal individuals as compared to ACV and ACD.[7]

Boker *et al*. previously reported that the rotating Scheimpflug camera was unable to directly visualize the ACA, i.e. on rotating Scheimpflug camera images, it is difficult to identify the most peripheral part of the iris and the base of the ACA. Because the rotating Scheimpflug camera assumes and automatically localizes the apex of the ACA, the ACA and adjacent far-peripheral ACD measurements can be incorrect and unreliable.[13]

By selecting individual Scheimpflug images, an examiner is permitted to acquire an estimation of the ACA at any position within the anterior chamber. The technology is based on the penetration of light through the structure of interest, and as such, is unable to visualize accurately the angle recess, peripheral-most iris, and retroiridal structures. For this reason, the ACA and ACV are computed using an interpolation method where the corneal and iris contour lines are extended to form the angle and anterior chamber boundary.[14]

Scheimpflug photographic techniques have not been documented to reliably image a variety of angle configurations. In addition, the ACA cannot be entirely visualized and only the angle approach can be photographed as light is unable to penetrate to the angle recess. User definition of the iris plane necessarily uses a straight line to describe a curved plane, leading to inaccuracies in angle width measurements.[15]

In our study, there was no significant difference in mean rotating Scheimpflug camera angle pre and postlaser in all the three groups.

In our study, it was noted that ACV as measured by rotating Scheimpflug camera increased significantly in all the 3 groups postlaser iridotomy ($P = 0.001$). Similar findings were noted in the studies conducted by Antoniazzi *et al*. and Li *et al*. where they concluded that postlaser ACV increased significantly in patients with narrow angles.[16,17]

Post-LPI, the pressure in the posterior chamber equilibrates with the pressure in the anterior chamber resulting in decreased forward bowing of the lens iris diaphragm and consequent increase in the ACV.[18]

CONCLUSION

Rotating Scheimpflug camera is one of the methods for assessment of changes in the anterior chamber parameters such as CACD, ACV before, and after Nd YAG LPI in PAC spectrum. Limitation of our study was that we attempted to study the entire spectrum of angle-closure diseases, i.e., (PACS, PAC, and PACG), and our final subset was skewed toward PACS, with fewer numbers of PAC and PACG. This could have an influence on the outcomes of our study. Long-term follow-up was not done for the patients enrolled in the study.

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Conflicts of interest
There are no conflicts of interest.

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Original Article

Incidence of dry eye in post-operative cataract patient

ABSTRACT

Objective: To estimate the incidence of dry eye in post-operative patient undergoing cataract surgery. **Materials and Methods:** Schirmer's test, tear break-up time (TBUT) test, and lissamine green staining of the cornea and conjunctiva for the evaluation of dry eye preoperatively and again at first and second follow-up examinations at 1 week and 1 month after cataract surgery were performed on 100 patients with senile cataract. **Results:** The patients were 61.25 years old on average, and 71 (71%) of them were men. According to the requirements of our study, none of the patients experienced dry eyes at the time of participation. Schirmer's test results during the first and second follow-ups, respectively, varied from 12-35 mm and 8-24 mm postoperatively. At the first and second follow-ups, the mean TBUT was 13.12 ± 2.44 and 9.61 ± 2.22 seconds, respectively, whereas the lissamine green staining score was 3 in 66 (66%) and 1 in 62 (62%) patients, respectively. At the initial follow-up, grade 2 dry eye was discovered in 89% of the 56 patients who received phacoemulsification (p 0.001) and in 92% of the 66 patients who underwent small-incision cataract surgery (SICS) (p 0.001). At the second follow-up, 83% of patients who had SICS and 93% of those who had phacoemulsification had grade 0 dry eyes, respectively (p 0.001). **Conclusion:** The incidence of dry eye following cataract surgery was significant and largely unrelated to demographic and anthropometric characteristics, surgical technique, length of microscope exposure, and energy input. This dryness was only temporary in character and exhibited a downward trend, with a tendency to return to normal by the end of 1 month.

Keywords: Cataract, dry eye disease, phacoemulsification, Schirmer's test, tear break-up time (TBUT) test

INTRODUCTION

Described as "a malfunction of the tear film due to decreased tear production or excessive tear evaporation, which damages the inter-palpebral ocular surface and is linked with symptoms of ocular pain and/or visual problems," dry eye disease (DED) is a condition that affects the tear film.[1] Pre-corneal tear film instability, ocular irritation, visual distortion, and tear film instability are all symptoms of the multifactorial condition known as dry eye syndrome, which also has the potential to harm the ocular surface.[2,3]

The prolonged use of antibiotic-steroid eye drops; decreased tear film break-up time owing to surface irregularity at the incision site; decreased mucin output from the conjunctiva as a result of incision placement; decreased corneal sensation as a result of surgical site, which disturbs the cornea-lacrimal gland loop resulting in reduced tear efflux; poor tear film production; and stable tear film are factors that contribute to the formation of dry eye after cataract surgeries.[4,5]

In addition to the typical risk factors for dry eye syndrome, it has been demonstrated that several anterior segment surgeries, including photorefractive keratectomy, laser-assisted *in situ* keratomileusis, and cataract surgery, might also result in dry eye syndrome or exacerbate its already-present symptoms. Although the dry eye symptoms may be transient, they have an impact on the patient's life quality. As a result, effective

Alka Ravi, Uma Shankar Singh, Archana Kumari, Pummy Roy

Department of Ophthalmology, JLNMCH Mayaganj, Bhagalpur, Bihar, India

Address for correspondence: Dr. Alka Ravi,
Department of Ophthalmology, JLNMCH Mayaganj, Bhagalpur, Bihar - 812 001, India.
E-mail: alkaravi1995@gmail.com

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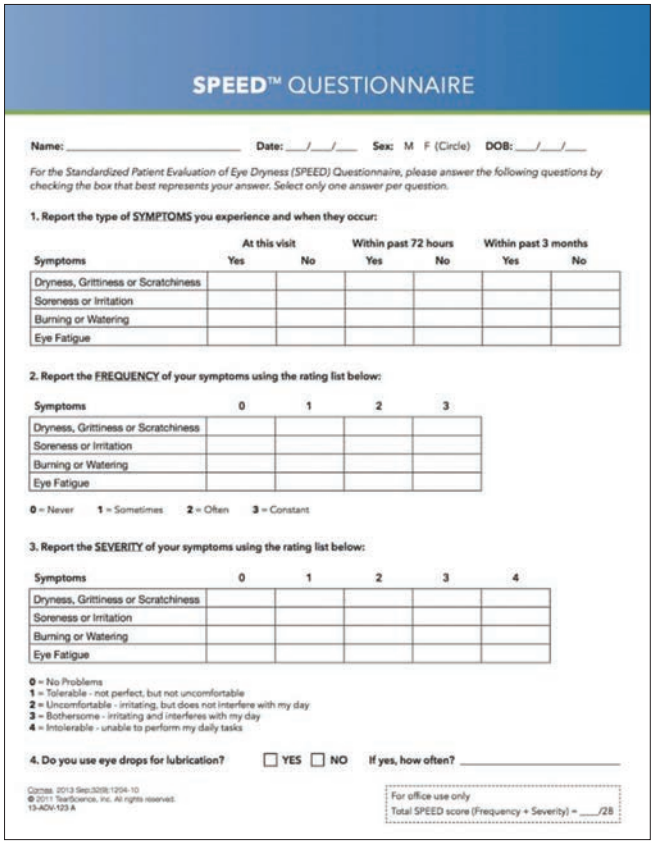
counseling regarding the transient nature of the condition is required.[6,7]

The goals of this research were to determine the incidence of dry eye following cataract surgery and to define the pattern of dry eye following manual small incision cataract surgery and phacoemulsification.

MATERIALS AND METHODS

This hospital-based observational study was carried out in Department of Ophthalmology JLNMCH Mayaganj, Bhagalpur, in North India over a period of 15 months. We enlisted 100 people who had senile cataracts but no history of dry eye disease. Subjects underwent a thorough ophthalmic examination and history, and those who had ocular conditions that could be associated with dry eye, such as lid disorders, Sjögren's syndrome, contact lens wear, rheumatoid arthritis, diabetes mellitus, allergic conjunctivitis, exposure keratitis, contact dermatitis, Bell's palsy, hypertension, thyroid-associated diseases, lupus, scleroderma, vitamin A deficiency, and any previous eye operations.

To assess dry eye, the Schirmer's test, the tear break-up time (TBUT) test, and lissamine green staining of the cornea and conjunctiva were all performed. The following risk factors were taken into account: pre-anesthetic medication, incision type (phacoemulsification or SICS), microscope light exposure, CDE manipulation of ocular surface tissue, and intra- and postoperative drugs. Following surgery, the patients were checked on a week and a month later. On both instances, evaluations of every dry eye parameter were conducted again. Statistical Package for Social Sciences version 21.0 was used to conduct the statistical analysis. The percentages and mean with standard deviation were used to represent the values. Significant *P* values were defined as 0.05 or less, and highly significant *P* values as 0.001.



SPEED™ QUESTIONNAIRE

Name: _____ Date: ___/___/___ Sex: M F (Circle) DOB: ___/___/___

For the Standardized Patient Evaluation of Eye Dryness (SPEED) Questionnaire, please answer the following questions by checking the box that best represents your answer. Select only one answer per question.

1. Report the type of SYMPTOMS you experience and when they occur:

Symptoms	At this visit Yes	At this visit No	Within past 72 hours Yes	Within past 72 hours No	Within past 3 months Yes	Within past 3 months No
Dryness, Grittiness or Scratchiness						
Soreness or Irritation						
Burning or Watering						
Eye Fatigue						

2. Report the FREQUENCY of your symptoms using the rating list below:

Symptoms	0	1	2	3
Dryness, Grittiness or Scratchiness				
Soreness or Irritation				
Burning or Watering				
Eye Fatigue				

0 = Never **1** = Sometimes **2** = Often **3** = Constant

3. Report the SEVERITY of your symptoms using the rating list below:

Symptoms	0	1	2	3	4
Dryness, Grittiness or Scratchiness					
Soreness or Irritation					
Burning or Watering					
Eye Fatigue					

0 = No Problems
1 = Tolerable - not perfect, but not uncomfortable
2 = Uncomfortable - irritating, but does not interfere with my day
3 = Bothersome - irritating and interferes with my day
4 = Intolerable - unable to perform my daily tasks

4. Do you use eye drops for lubrication? ☐ YES ☐ NO **If yes, how often?** _____

Cornea. 2013 Sep;32(9):1204-10.
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Total SPEED score (Frequency + Severity) = ___/28

Figure 1: SPEED Questionnaire for dry eye symptomatology

Schirmer's test was performed using a specific Schirmer's strip made from Whatman filter paper no. 41 measuring 40'5 mm and labeled 0 to 35 mm to measure basal and reflex tear secretion. Schirmer's test results were rated according to how wet the strip was: >10 mm, normal (grade 0); 5-10 mm, mild (grade 1); 3-4 mm, moderate (grade 2); and 0-2 mm, severe (grade 3).[8]

Grading of the TBUT was based on the interval between the last blink and the emergence of a dry spot, which was used to examine the stability of the tear film and meibomian gland abnormality. Less than 10 seconds, however, was considered abnormal and was assessed as follows: >10 s, normal (grade 0); 3.1-6 s, moderate (grade 2); 6.1-10 s, fair (grade 1); and 3 s, poor (grade 3).[8]

To determine whether cells on the ocular surface were dead and devitalized, the ocular surface was stained with lissamine green. A scale from 0 (no dry eye) to 3 (severe dry eye) was used to grade the results.[9,10]

Questionnaire was asked accordingly to SPEED Questionnaire [Figure 1].

Meibography is also one of the finest technique to determine the dry eye incidence but generally not available in the rural areas of North India.

In compliance with international agreements and the Declaration of Helsinki, the study was carried out after receiving ethical permission from the institutional ethics committee, and all subjects participating in the study provided written informed consent.

Table 1: Occupation of Patients

	N %
Homemakers	42
Farmers	33
Skilled workers	11
Teachers	9
Retailers	5

Statistical analysis

Statistical Package for Social Sciences version 21.0 was used to conduct the statistical analysis. The percentages and mean with standard deviation were used to represent the values. Significant *P* values were defined as 0.05 or less, and highly significant *P* values as 0.001.

RESULTS

The patients were 61.25 years old on average, and 71 (71%) of them were men.

Only 16% (n = 16) of the study population were from urban area and 84 patients were from rural regions, which made up the majority of the patient population (n = 84, 84%) [Figure 2].

Homemakers made up the largest occupation group (n = 42, 42%), followed by farmers (n = 33, 33%), skilled workers (n = 11, 11%), teachers (n = 9, 9%), and retailers (n = 5, 5%) [Table 1].

Body mass index (BMI) criteria were used to determine the nutritional health of individuals, of whom 92 (92%) were classified as normal weight (18.5-25.0 kg/m^2) and 8 (8%) as overweight (25.1-30 kg/m^2). None of the individuals that underwent evaluation were obese (>30 kg/m^2) or underweight (18.5 kg/m^2) [Figure 3].

Among the patients, photophobia (56%), itching (51%), burning (47%), watering (46%), eye pain (41%), redness (38%), heavy lids (35%), sensation like a foreign body (28%), and discharge (27%) were the most prevalent ocular symptoms [Figure 4].

Schirmer's test results varied from 15 to 35 mm in the preoperative clinical evaluation of dry eye, with a mean of 27.21 ± 4.36 mm. The average TBUT was 13.55 ± 1.84 (range 10-18 s). The percentage of instances with lissamine green staining was 1 in 74 (74%) and 2 in 40 (40%) [Table 2].

At 1 week and 1 month, the postoperative Schirmer's test values ranged from 12 to 35 mm and 8 to 24 mm, respectively. At 1 week and 1 month of follow-up, the mean TBUT was 13.12 ± 2.44 and 9.61 ± 2.22 s, respectively, and the lissamine green staining score was 3 in 66 (66%) and 1 in 62 (62%) patients.

55% of patients had cataract surgery utilizing the phacoemulsification technique, whereas the other 45% underwent SICS. At 1 week and 1 month, the phacoemulsification group experienced a dry eye incidence of 89.09% and 14.54%, compared to 93.33% and 26.66% in the SICS group at the same time points. Despite the fact that dry eye incidence was higher following SICS than phacoemulsification at it from both points of time, the variations just were not statistically significant (p > 0.05) [Table 3].

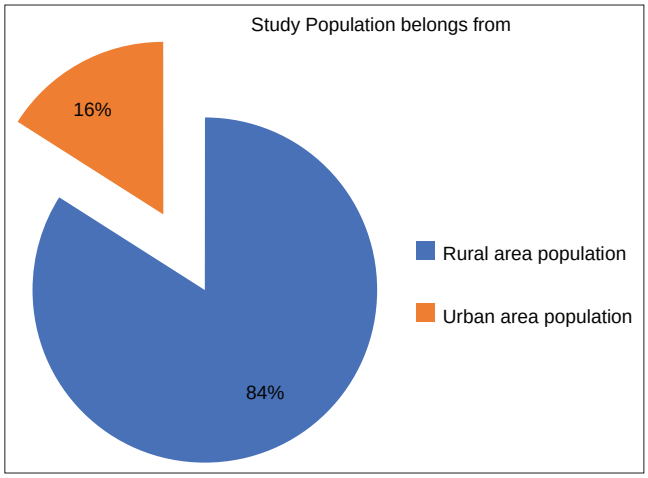


Figure 2: Rural vs Urban distribution of study population

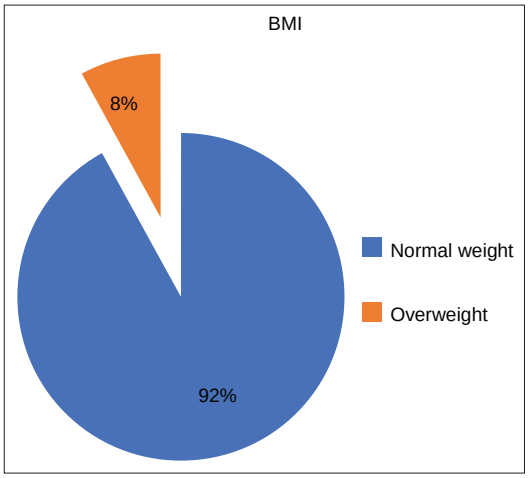


Figure 3: Nutritional status of the study population

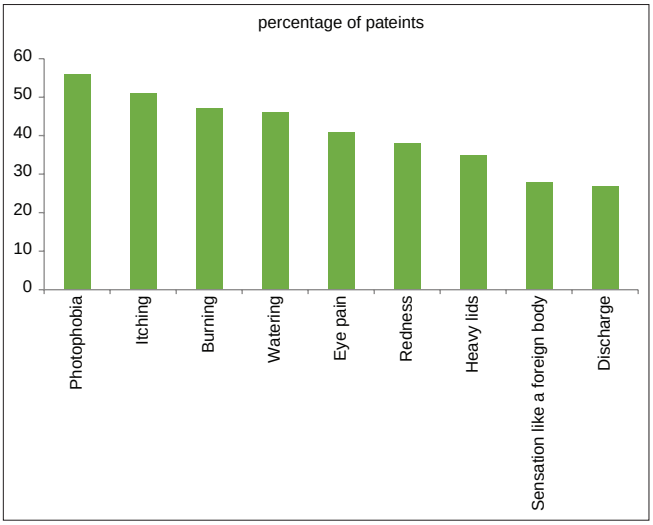


Figure 4: Distribution of symptoms in the study population

The majority (n = 29, 52.72%) of phacoemulsification cases received the surgery with 8.0-11.5% CDE, followed by 11.6-15.5% (n = 19, 34.54%) and 15.6-19.0% CDE (n = 7, 12.74%). The correlation between CDE and the occurrence of dry eyes at 1 week and 1 month was not found to be significant [Table 4].

We noted a statistically significant decline in mean Schirmer's test and TBUT values at 1 week especially in comparison with baseline when examining the pattern of changes in values of various dry eye parameters from baseline at 1 week and 1 month. At 1 month, the change from baseline was not really statically important. The percentage of people with scores of 3 and 4 in LG staining was noticeably higher at 1 week but had returned to baseline by 1 month.

DISCUSSION

One of the most common ocular operations is probably cataract surgery. Nevertheless, it does have certain post-operative consequences, just like any other operation. The four most frequent side effects are cystoid macular edema, a rise in intraocular pressure, and severe post-operative astigmatism. In addition to these issues, the patients also express discomfort from usually disregarded dry eye symptoms as gritty feeling, foreign body impression, and burning sensation.[11] It has been demonstrated that the incidence of dry eye after cataract surgery varies widely, from 9.8 to 96.6.[12-14]

It has been demonstrated that a variety of factors, along with the procedure type (SICS/phacoemulsification), the kind of ophthalmic solution in use, intraoperative and postoperative medications, operating microscope exposure time, CDE during phacoemulsification, coexisting systemic disorders, and the amount of time since surgery, affect the incidence of dry eye in patients having cataract surgery. However, none of these factors has been proven to be solely accountable for the development of dry eye.

In most of the studies, occupation and subject's residence is not taken on account as they are considered as less important but in our analysis, farmers (33%) and homemakers (42%) made up the two most common occupational groupings. We believe that taking into account variations in hygienic environment and conditions location of residence, or occupation might have an impact on the occurrence of dry eyes at the 1-month follow-up, when patients subsequently returned regular routine functions.[15]

In our research, 92% of the participants had BMIs that were within the normal range (18.5-24.9 kg/m^2), whereas the remaining 8% fell into the overweight category (BMI 25-29.9 kg/m^2). Although there have not been any conclusive findings linking DED and BMI in the past, we had included an individual feature in our analysis because BMI has been linked to a number of systemic diseases, which then in turn may play a part in the development of dry eye after cataract surgery.

The vast majority of subjects reported itching (51%) and photophobia (56%) prior to surgery. Each patient had, on average, 3.7 symptoms, including eye pain, a feeling of a foreign substance in the eye, burning sensations, discharge from the eye, itching, heavy lids, redness, and photophobia. Prior research has not evaluated preoperative symptoms in any way. Schirmer's test, TBUT, and lissamine green staining

Table 2: Dry eye test results before and after surgery

	Preoperative *n* (%)	Post-operative 1 week *n* (%)	Post-operative 1 month *n* (%)
Schirmer's test, mean±SD (range	27.21±4.36 mm (15 to 35 mm)	24.63±6.29 m (12 to 35 mm)	12.94±2.96 mm (8 to 24 mm)
≥15 mm, normal	100 (100%)	85 (85%)	9 (9%)
9-14 mm, mild	-	15 (15%)	89 (89%)
4-8 mm, moderate	-	-	2 (2%)
<4mm, severe	-	-	-
TBUT, mean±SD (range)	13.55±1.84 (range 10-18 s)	13.21±2.41 (range 8-18 s)	9.68±2.28 (range 5-16 s)
>10s, normal	100 (100%)	81 (81%)	29 (29%)
6.1-10s, fair	-	19 (19%)	66 (66%)
3.1-6s, moderate	-	-	5 (5%)
<3s, poor	-	-	-
Lissamine green staining of cornea/ conjunctiva score, mean±SD (range)	1.33±0.49 (1-2)	3.17±0.75 (1-4)	1.68±0.72 (1-3)
1	67 (67%)	2 (2%)	58 (58%)
2	33 (33%)	14 (14%)	30 (30%)
3	-	57 (57%)	12 (12%)
4	-	37 (37%)	-

Table 3: Incidence of dry eye in phacoemulsification vs SICS

Surgical Technique	*n* and %	Dry eye at 1 week	Dry eye at 1 month
Phacoemulsification	55 (55%)	49 (89.09%)	8 (14.54%)
SICS	45 (45%)	42 (93.33%)	12 (26.66%)
Significance of difference		χ^2=0.516; *P*=0.470	χ^2=2.254; *P*=0.130

Table 4: Phaco Energy used vs incidence of dry eye

Energy used (%)	Number of eyes	Dry eye at 1 week	Dry eye at 1 month
8.0-11.5	29 (52.72%)	24 (82.75%)	2 (6.89%)
11.6-15.5	19 (34.54%)	19 (100%)	5 (26.31%)
15.6-19.0	7 (12.74%)	6 (85.7%)	2 (28.57%)
Significance of difference		χ^2=3.555; *P*=0.462	χ^2=4.775; *P*=0.095

were used to record and examine these symptoms. It was challenging to determine that whether dry eye incidence recorded in the research was a continuance of previous dry eye condition or a consequence to cataract surgery. It is interesting to note that the majority of studies did not undertake any preoperative assessments for dry eye.

In our research, the effects of the surgery type upon the incidence of dry eye were evaluated by considering both phacoemulsification and SICS operations. In our analysis, phacoemulsification accounted for 55% of the surgeries, whereas SICS accounted for 45%. There are not many studies that have both SICS and phacoemulsification patients.[16]

Each of the results often peaked at 1 week and subsequently started to fall by the end of 1 month when relative to preoperative testing. Even after the 1-month follow-up, none of these variables returned to their initial values. According to these results, the effect of cataract surgery on dry eye peaked within the first week and afterward started to drop.

The results of this study showed that a frequent occurrence of dry eye occurs after cataract surgery. This could be the consequence of corneal nerve transection, which impairs epithelial wound healing, increases permeability, reduces epithelial metabolic activity, and causes the loss of cytoskeletal structures, which in turn causes decreased corneal sensitivity and a consequent reduction in tear production. Another important element in the emergence of dry eye is the increase of the inflammation, which results in the migration of neutrophils and macrophages as well as the formation of free radicals, proteolytic enzymes, and cyclooxygenase. Pre- and postoperative eye drops with preservatives also help to the inflammatory response, as can topical anesthetics.

CONCLUSION

The results of the current study show that the incidence of dry eye following cataract surgery was fairly high, almost completely unaffected by factors like demographic and anthropometric characteristics, surgical technique, length of microscope exposure, and amount of energy expended. The patterns indicated that the dryness was momentary in origin and likely to return to normal after a month. We were unable to determine when all of the patients' conditions reverted to normal because of the short follow-up period of the trial. It is advised to conduct additional research with a longer follow-up period to measure how long it takes to return to normal status. Additionally, research on long-term persistent dry eye after cataract surgery is necessary.

Therefore, despite strong visual recovery, dry eye is observed to be a prevailing post-cataract surgery problem that greatly impacts patients' satisfaction and must be treated. Given the high incidence of dry eye after cataract surgery, we advise using a suitable lubricant during postoperative recovery for two to three months after eye surgery to eliminate dry eye-related issues and give patients therapeutic benefit.

Ethics committee approval

In compliance with international agreements and the Declaration of Helsinki, the study was carried out only after receiving ethical approval from the institutional ethics committee.

Informed consent

Written informed consent was acquired from each person who participated in the study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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Original Article

A comparative analysis to find out the preferred and effective way to identify new Indian currency note by blind individual: A Pilot study

ABSTRACT

Purpose: The purpose of the study was to find out the preferred, accurate, and effective way to identify the new Indian currency note by a blind individual. **Methods:** A cross-sectional study was conducted in two phases among 30 subjects in a school for the blind. In phase 1, comparison was done in terms of accuracy and the time taken to identify the Indian currency between the old and new currency notes by using the tactile method by the blind individuals. In phase 2, comparison was done same as phase 1, with the addition of two more note identification methods, one was by using Mani note identifier application via smart phone and the other was Notex. The accuracy and time were analyzed and compared for all three used methods for both phases. **Results:** Thirty blind individuals were included in the study. The mean age of the subjects was 29.43 years (±10.88 years) and the age range was 18–54 years. The total time taken to identify all the currency notes in each category was recorded in seconds. The average time taken with the help of tactile sense was 75.34 s, but the accuracy here was very poor, even many currencies went unidentified. The average time taken with the help of Notex was 136.54 s. The average time taken with the help of Mani mobile note identifier software was 774.07 s. **Conclusion:** Notex was the most effective method of identifying Indian currency as compared to the other two methods that were used in our study.

Keywords: Blind individual, currency identification, demonetization, low vision, new currency, visually impairment

INTRODUCTION

In India, the money system has been in use for a very long time. In 1861, the Government of India issued its first paper money in the form of ₹10 notes. These were followed by ₹20 notes in 1864, ₹5 notes in 1872, ₹10,000 notes in 1899, ₹100 notes in 1900, ₹50 notes in 1905, ₹500 notes in 1907, and ₹1,000 notes in 1909. The ₹1 and ₹2 and ₹1/2 notes were launched in 1917.[1]

In 1938, the Reserve Bank of India (RBI) began producing notes in the denominations of ₹2, ₹5, ₹10, ₹100, and ₹1,000, while the government continued to issue ₹1 notes.

Previously, before the demonetization there were denominations of ₹1, ₹2, ₹5, ₹10, ₹20, ₹50, ₹100, ₹500, and ₹1,000 in the Indian currency system. All the above denominations are distinct in one way or another. Color, size, and identification markers are examples of such physical features. These characteristics are easy to notice for sighted persons, but not for the visually handicapped. These visually challenged individuals can tell the difference between two different denominations by feeling the size of the notes

Vishal Biswas, Monira Sirajum Choudhury[1], Roshni Majumder[2]

Department of Optometry, School of Allied Health Sciences, Noida International University, Uttar Pradesh, [1]Department of Health Science, Pailan College of Management and Technology, Kolkata, West Bengal, [2]Department of Optometry and Vision Science, Amity University, Gurugram, Haryana, India

Address for correspondence: Mr. Vishal Biswas,
Plot 1, Yamuna Expy, Sector 17A, Lucknow - 203 201,
Uttar Pradesh, India.
E-mail: vishalbiswas45@gmail.com

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through the sense of touch, but the size difference alone is not enough to accurately identify the currency note. The small change in size between successive denominations causes people to be misled and unable to recognize the currency notes from one another.[2]

With the demonetization process, the old 500 and 1,000 currency notes were banned and new 500 and 2,000 currency notes were issued along with new other currency notes. The recently released notes differ from the previous currency notes. The new Indian notes range in size (horizontally) by 10–15 mm, and now there are color differences between two notes of the same denomination, which can help identify them [Figure 1].

In the past, the old currency notes [Figure 2] had horizontal size variances and vertical size differences that were significantly greater between two consecutive values, which used to provide a clue for blind people to recognize the old Indian currency. For people who are blind, it presents major challenges as it is challenging for them to tell the notes apart.[3]

Due to their diminished sense of their surroundings, those who are visually impaired have a lot of difficulty going about their daily lives.

Earlier it was comparatively easy for blind individuals to identify the old notes because they were trained enough in terms of handling the old currency notes, but now with the new currency notes it has become quite a challenging task for them to understand due to the differences encountered by them in terms of size and tactile marks of the new notes.[4]

Like many other tasks, identifying the new currency notes has become quite challenging for them. Differentiation between pairs of notes that are of a nearby denomination value has become an even harder task.

The RBI has also added identification symbols on the new notes, which blind people can use to feel the elevated portion above the insignia on both the left and right side to determine the denomination. However, with frequent use or circulation in multiple locations, such as banks, train stations, bus stops, markets, and so on, those marks may readily be erased.

One recognized method to identify Indian currency notes used by blind people nowadays is a currency identification system that uses color recognition and localization with the aid of MATLAB or a mobile currency identifier.[5]

According to the literature, visually impaired people's brains function differently than those of sighted people in general. The processing of information typically handled by other brain regions, such as touch and hearing, depends heavily on the visual cortex. So, any type of sensory replacement equipment plays a significant role in helping the blind person perceive their environment by transmitting visual information through nonvisual pathways.[6]

A process or an effective way that recognizes the right denominations of cash notes is desperately needed, and this study offers to achieve exactly that by utilizing deep learning.

Finding a quick, precise, and simple method for blind people to identify Indian rupee notes is the main goal of this project. Our aim is to assist these people in understanding the currency system, making it simpler for them to manage money in their daily lives and allowing them to move freely while dealing with financial issues.

RELATED WORK

Many studies have been done in this area, including one where a banknote's identity was determined using color



Figure 1: The dimensions of new Indian currency notes



Figure 2: The dimensions of old Indian currency notes

recognition. This paper feeds the localized regions of the image into the identification module in order to determine the denomination of the currency note. They devised a mechanism for estimating the Indian banknote's value based on its color picture. The shortcoming of this study is that it restricted its research to old banknotes.[2]

Another piece was released Edge Detection Method for Indian Coin Matching and Counting was employed. One of the methods used in this study to recognize Indian currency notes is the Currency Recognition System, which employs MATLAB to aid in color identification and location. Yet, the drawback is that it was carried out using the previous monetary system.[5]

A researcher created a smartphone application that uses a segmentation process to clean up photos of noise. She used a method called "visual bags of words." With pictures taken using a phone, this method works nicely. This method reports 96.7% accuracy when applied to Indian cash using a SIFT description. Yet, it has the drawback of being done with the outdated monetary system.[7]

In a different study,[8,9] the principal features were extracted from data sets of currency notes using a scale-invariant feature SIFT method, which produced more reliable and accurate results with an auditory output feature.

Another project involved developing a smartphone software for cash recognition that can identify Indian currency to help the blind get by every day. For the purpose of note identification detection, they employed the Yolo V3 method here.[10]

SUBJECTS AND METHODS

This study was carried out at a school for the blind and is prospective, cross-sectional, and comparative in nature. After receiving approval from the IRB for the study's ethical review, it was carried out. All participants who met the inclusion requirements voluntarily participated in the study. Thirty participants who were over the age of 18 and used a smartphone regularly and were accustomed to handling money were included in the study.[11,12] Those who did not regularly handle money and those who could not utilize a smartphone were also disqualified from the study. Each participant received brand-new sets of money in the same denominations to preserve consistency among the subjects.

The study was conducted in two phases [Figure 3].

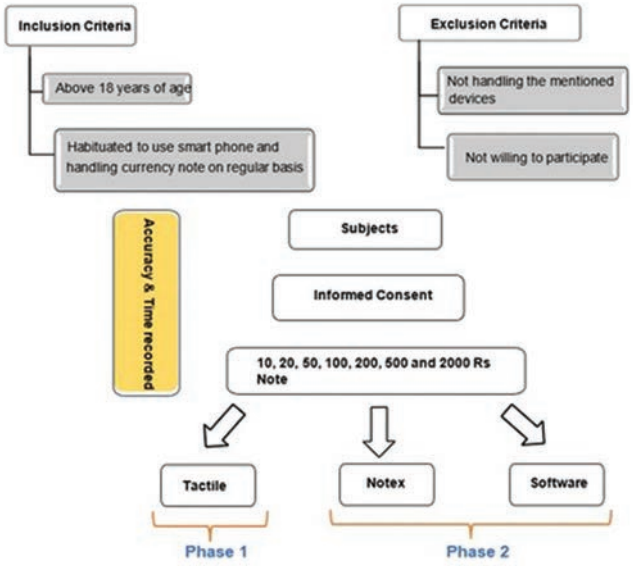


Figure 3: Methodology in the form of a flowchart

Phase 1: For the new monetary system, note identification was carried out with the aid of tactile sense. A double-blinded examiner looked at the individuals' accuracy and response times when identifying the different types of currency. The old currency notes, which are still in use in the currency system, were put through the same procedure after noticing the poor performance using new currency notes.

Phase 2: Phase 1 outcomes with the touch sense were subpar. For a month, the participants received training on how to use the Notex and Mani note identification applications on mobile devices. Following the training, the currency identification procedure was carried out once more using identical techniques. A double-blinded examiner noted accuracy and turnaround time. Finally, phase 2 results were contrasted with phase 1 results.

RESULTS

Phase 1

The mean standard deviation age of the subjects was 29.43 ± 10.88 years, respectively, out of which 12 were female and 18 were male, respectively. Tables 1 and 2 show the accuracy in identifying the new currency notes and old currency notes. The new notes displayed low accuracy, and a few participants were unable to distinguish some notes as being from the wrong currency. Fifteen out of the 30 individuals correctly identified the ₹10 note, representing 50% of the subjects. The lowest amount found was ₹500 because no one could locate it. As seen in Table 1, a small percentage of the individuals were unable to recognize ₹100, ₹200, and ₹500 as an incorrect denomination. While good accuracy was noticed for the old notes, it was discovered to be significantly better than the new notes (paired t test, $P < 0.0015$).

The same individuals from Phase 1 continued in Phase 2. In the intragroup analysis, ₹200 took the longest time to be recognized (25.21 s), and ₹500 took the shortest time (13.40 s). Table 3 displays the speed and accuracy of using Notex demonstrated the highest accuracy (ANOVA, $P < 0.00001$) among all methods when considering both accuracy and time taken to identify the new currency, indicating that the new currency notes were easily recognizable by the subjects.

Using the Mani note identifier (software) on a smartphone, the identification of monetary notes was also completed. The accuracy rate was 100%. The ₹10 note took the longest time (121.55 s), whereas the ₹20 note took the shortest time (95.98 s). Table 4 displays the currency system's identification's accuracy and turnaround time.

P value was found to be statistically significant (ANOVA, $P < 0.00001$) related to accuracy and time effectivity by the procedure where Notex was used.

DISCUSSION

When comparing the two other methods that were utilized in this study for time and accuracy, Notex is shown to be the most efficient approach for identifying the new Indian money. The design of Notex allows participants to identify themselves while learning the precise size of the currency note. No unique causes were found for the difference between the times for the lowest note, a ₹500 note, and the highest note, a ₹200 note, in the intragroup analysis using the Notex, which underlines that it was likely influenced by the subjects' performance.

The lowest time was taken for the ₹10 note, which was 95.98 s, and the most time was taken for the ₹20 note, which was 121.55 s, in the intragroup analysis using Mani note identification (software) application. No precise causes were identified; nevertheless, it may have depended on the subjects' performance.

While both processes are in some way automated, the currency note identification performed with the aid of the Notex and Mani note identifier applications demonstrated the highest degree of accuracy. The software technique took longer to detect the cash notes than Notex because visually impaired persons take longer to use smartphones because they are still very new to the technology.

Phase 1 of the study revealed that there was less accuracy with the new currency notes and that many notes were mistakenly identified as being of the wrong currency using the tactile method, indicating that visually impaired people are still not very accustomed to the new note dimensions and identification marks. It also revealed that the procedure took less time and had poorer accuracy with the new notes, which suggests that human nature is to make quick wild guesses while performing. Even though the tactile markings disappear as the notes age, the respondents were still able to correctly identify the old notes since they were familiar with the sizes of the different denominations of cash.

Phase 2 of the study did not employ the old currency notes for Notex or software because the accuracy level with the new currency notes was 100% when the identification task was carried out with the aid of both techniques. So, after

Table 1: Accuracy for the new notes by the tactile method

Rs/-	10	20	50	100	200	500	2000	NA	Avg Time±std Dev
10	15 (50%)	-	9 (30%)	6 (20%)	-	-	-		10.49+4.59
20	10 (33%)	9 (30%)	11 (36%)						11.57+4.35
50	12 (40%)	-	3 (10%)	9 (30%)	6 (20%)	-	-		10.20+5.25
100	-	-	6 (20%)	6 (20%)	9 (30%)	6 (20%)	-	3 (10%)	11.75+11.95
200	3 (10%)	-	12 (40%)	6 (20%)	3 (10%)	3 (10%)	6 (20%)	3 (10%)	11.71+6.07
500	6 (20%)	-	3 (10%)	3 (10%)	3 (10%)	-	12 (40%)	6 (20%)	8.69+2.06
2000	-	-	3 (10%)	3 (10%)	6 (20%)	6 (20%)	12 (40%)	-	10.93+6.13

Table 2: Accuracy for the old notes by the tactile method

Rs/-	Avg time in Sec	Std dev (+)	SEM	Max time (Sec)	Min time (Sec)	Right Identification	Wrong Identification	Accuracy Rate (%)
10	51.1	8.74	1.59	70.36	36.25			100
20	79.9	13.89	2.53	99.93	47.58	83% (25)	17% (5)	83
50	80.4	24.83	4.53	136	36	93% (28)	7% (2)	93
100	75.8	16.13	2.94	100.21	35.09			100
500	79.2	13.41	2.44	99.67	57			100
1000	81.8	14.74	2.69	98.53	48.58			100

Table 3: Average time taken for the new notes with the Notex

Rs/-	Avg time in Sec	Std dev (+)	SEM	Max time (Sec)	Min time (Sec)
10	14.94	15.68	2.86	44.06	1.45
20	23.57	18.03	3.45	56.97	1.57
50	22.55	17.25	3.15	55.97	1.52
100	22.22	12.02	2.19	43	5.56
200	25.21	18.57	3.39	59.93	2.57
500	13.40	7.21	1.31	28.27	3.24
2000	14.65	12.87	2.35	48.53	1.71

comparing the other two techniques of identifying money notes by taking into account the accuracy and time, we decided that Notex was the best choice after completing both phases.

Limitations

Even so, we felt there were certain restrictions that might have affected the findings. The sample size we used was really small. We can try using a larger sample size to close the gap. Also, we can state that this is the overall impression we have, and on the basis of this, we are unable to advise that only a blind person should use Notex. The last option should be any, depending on how comfortable they are with it, or all, depending on the application. However, this outcome will assist the rehabilitation trainer deliver more condensed instruction on Notex.

Even though this study just provides a broad overview, *RBI and the government* should consider it in terms of either user-friendly identification markers on the money system or alternative smart gadgets.

Also, a more thorough investigation must be done on such crucial everyday living abilities as note identification.

CONCLUSION

According to our study, which took into account the data from two phases, Notex is the most preferred, accurate, and efficient way for blind people to identify the new Indian currency because it takes less time and produces more accurate results than the other two methods, software method and tactile method.

The issue with the Mani mobile note identifier software may be that it evaluates different colors under various lighting conditions and, furthermore, there are numerous types of shades of color on a currency note. This may be a problem with the application on the smartphone, which also has the additional drawback of costing more than Notex and preventing all people with visual impairment from using smartphones on their own.

Table 4: Average time taken for the new notes with Mani note identifier (software)

Rs/-	Avg time in Sec	Std dev (+)	SEM	Max time (Sec)	Min time (Sec)
10	95.98	29.72	5.42	158	44.55
20	121.55	19.55	3.75	159.58	87.35
50	120.55	17.55	3.20	155.97	85.97
100	115.55	21.22	3.87	143	55.66
200	104.48	17.95	3.27	134.13	59.93
500	108.20	14.06	2.56	128	73.37
2000	107.98	14.70	2.68	148.53	7.21

The tactile method is the most popular and time-consuming way to identify currency notes because the raised marks wear off day by day from daily use, especially after numerous rotations. However, the tactile approach did not demonstrate much effectiveness with the new currency system because there is no longer a consistent height and breadth of the notes that are maintained like the old notes; the larger the amount, the longer the note.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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Original Article

Mydriatic efficacy of topical phenylephrine and tropicamide combination vs tropicamide in screening for retinopathy of prematurity (ROP) – An RCT

ABSTRACT

Introduction: Screening for ROP and its severity require optimum pupillary dilatation. Mydriatics that allow good dilatation often have systemic side effects. Topical tropicamide is considered safest but does not dilate pupils optimally. A combination of phenylephrine and tropicamide is a good mydriatic but has adverse effects. The study aims to compare the mydriatic efficacy of phenylephrine (P 2.5%) plus tropicamide (T 0.4%) versus tropicamide (T 1%) alone for ROP screening. **Methods:** Preterm neonates due for ROP screening were randomized to one of the two groups. One drop was instilled in the eye thrice every 15 mins. Pupillary diameter was recorded as a primary outcome measure using the Schirmer's strip at baseline, 15, 30, and 45 minutes after drop instillation. Oxygen saturation, heart rate, and respiratory rate were measured at similar intervals. Adverse effects like apneas, vomiting, and feed intolerance were documented. Ophthalmologist comments on the visibility of different retinal zones were also recorded. Data were analyzed by *t*-test and Chi-square test as appropriate. **Results:** Fifty-four preterm babies were included (27 in each group). The birth weight (1130 ± 300g, 1220 ± 460 g) and gestation (34.40 ± 2.26 and 34.74 ± 3.24) weeks were similar in both groups. The pupillary size after 45 minutes in group 1 (7.56 ± 1.12 mm) was significantly greater ($P < 0.001$) than that of group 2 (5.92 ± 0.90 mm). The visibility of retinal zones was better in group 1 compared to group 2, which was statistically significant ($P < 0.01$). There was no significant difference between the two groups in saturation, heart rate, and respiratory rate at 30 mins and 45 mins. **Conclusion:** A combination of phenylephrine and tropicamide is a more effective mydriatic with no increase in adverse effects.

Keywords: Combination of phenylephrine with tropicamide, mydriasis, retinopathy of prematurity, topical tropicamide

INTRODUCTION

Retinopathy of prematurity (ROP) is emerging as one of the leading causes of preventable childhood blindness. The mandate is to screen all preterm neonates born <34 weeks and/or weighing <1750 gms or any baby with risk factors for ROP. In India, 8.7% of newborns are <2000 grams in weight, implying 2 million newborns are at risk of developing ROP.[1] Maximum mydriasis is the prerequisite for adequate indirect ophthalmoscopy in preterm infants to allow diagnosis and staging of ROP.[2] Screening starts within 4 weeks of birth and continues until the retinal vascularization is complete, ideally involving repeated and frequent screening.[1]

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Topical drugs commonly used for mydriasis are cyclopentolate 0.5%, phenylephrine 2.5%-5%, and tropicamide 0.5-1%. There has been no consensus on the most efficacious mydriatic for preterms, with different studies yielding conflicting results.[2-11] Similarly, varied systemic side effects are reported from various studies attributed to different compounds.

Camina Andrews, Shubashree Karat, Winston Padua, Saudamini V Nesargi[1], Suneetha Nithyanandam, Shalini Butola

Departments of Ophthalmology and [1]Neonatology, St John's Medical College, Bengaluru, Karnataka, India

Address for correspondence: Dr. Shubashree Karat, Department of Ophthalmology, St John's Medical College, Sarjapur Main Road, Koramangala, Bengaluru - 560 034, Karnataka, India.
E-mail: shubashree.karat@gmail.com

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Cardiovascular adverse events have been documented in various case reports.[2,6,7] Gastrointestinal side effects like Necrotizing enterocolitis, gastric residuals, and upper gastrointestinal (GI) hemorrhage have also been reported.[11] There is no consensus on the drug nor the ideal strength of the drug. The UK guidelines for ROP screening recommend phenylephrine 2.5% and cyclopentolate 0.5% (2-3 drops).[12] The National Neonatology Forum (NNF) of India recommends a combination of topical cyclopentolate (0.5%) and phenylephrine (2.5%) drops to be instilled two to three times about 10-15 minutes apart, tropicamide 0.5-1% can be used as an alternative to cyclopentolate.[13] Side effects include apneas, often requiring an increase in respiratory support, vomiting, increase in feed intolerance. These symptoms and signs are all nonspecific mimics of sepsis and hence may lead to over-investigations.

This study was conducted to compare the mydriatic efficacy and systemic side effects of two commonly used mydriatics in preterms for ROP screening, which include a combination of phenylephrine (2.5%) plus tropicamide (0.4%) eye drops and tropicamide (1%) eye drops. These two drugs were chosen as they are commercially available, and reconstitution is simple.

METHODS

This randomized controlled trial (RCT) was done in a tertiary care hospital in southern India from October 2018 to July 2019.

The study was registered with the Clinical Trials Registry of India- [CTRI/2018/10/016148] and Institutional ethics board (IEC) clearance was obtained IEC No. 230/2018, before the study started. Written informed parental consent was taken.

Preterm neonates weighing less than 1.7 kg and/or with a gestational age of ≤34 weeks requiring ROP screening were included in the study. Newborns on invasive ventilation at the time of ROP screening were excluded.

Randomization

Neonates included in the study were randomized into one of two groups: phenylephrine (2.5%) plus tropicamide (0.4%) eye drops and tropicamide (1%) eye drops. A block randomization sequence was generated using online software, with unequal block sizes of 4, 6, and 8. Sequentially numbered opaque sealed envelopes were used for allocation concealment. These envelopes containing the coded randomization sequence were given to the neonatal intensive care unit (NICU) nursing staff in-charge at the beginning of the study. The investigators who were monitoring the parameters, ophthalmologist performing ROP screening, the neonatal team, and the parents were blinded to this allotment. The randomization sequence was revealed only at the end of enrollment and ROP evaluation.

Intervention

Bottle 1 was prepared under aseptic precautions by diluting the mydriatic (1:1 dilution with sterile water) containing phenylephrine 5% with tropicamide 0.8% to obtain the study concentration of P + T (2.5% +0.4%). Bottle 2 was plain T (1%) commercially available and hence did not need dilution. The study eye drops, P + T combination eye drops and T eye drops were prepared and loaded in a 2 ml syringe by the nursing staff and kept by the neonate's bedside as per the randomization sequence. The ophthalmologist, who was blinded, administered the drops three times, a drop every 15 minutes, and monitored the neonates. Necessary sterile precautions and hand hygiene measures were observed before and after handling each baby.

Demographic details of the babies were obtained from the in-patient record. Ocular and systemic parameters were recorded at baseline, 15, 30, and 45 minutes after the start of drops instillation and recorded into the proforma.

Outcome

The primary outcome was pupillary diameter recorded using Schirmer's strip, 35 mm in length. After placing an eye speculum, the pupillary diameter was recorded using the strip. Oxygen saturation, respiratory rate, and heart rate were also recorded in the proforma by the investigator. Oxygen saturation and heart rate were noted from the monitor attached to the baby, while the investigator measured respiratory rate and pupillary diameter manually.

Adverse effects were recorded as a decrease in heart rate to less than 120 beats/min or more than 10 beats/min from baseline, and the O_2 saturation dropped to less than 90% or by 5% from the baseline. Apneas, events requiring increased respiratory support, vomiting, and increased irritability, were also considered adverse events.

The ophthalmologist screening for ROP reported on the ease of fundus examination and the retinal zone visualized. This was recorded as poor, fair, or good visibility. The flowchart of the methodology is given in Diagram 1.

Statistical analysis

It was done using SPSS version 17 and $P < 0.05$ was considered statistically significant. Continuous variables were expressed as mean (+standard deviation), and categorical variables as percentages. Student's *t*-test was done to compare the means

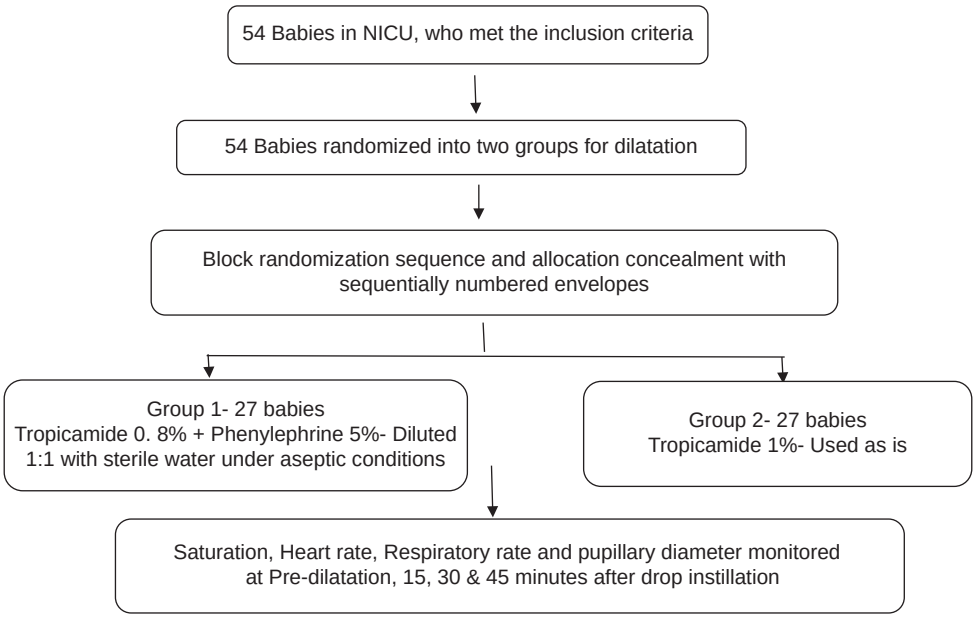


Diagram 1: Flowchart showing participant flow

of the two groups, while Pearson's correlation was used to study the relationship between two continuous variables. The sample size was calculated with n-Master 1, using hypothesis testing for one population mean, with the power of study at 80% and an alpha error of 5% with a two-sided test, and the sample size obtained was 53.

RESULTS

The study included 54 preterms fulfilling the inclusion criteria for ROP screening, 27 in each group [Diagram 1]. The two groups were well matched in baseline characteristics like age in weeks, gender, pupil size before dilatation, heart rate, oxygen saturation, and respiratory rate [Table 1].

Table 2 shows the primary outcome of pupillary size. There was no significant difference at 15 minutes postonset of dilatation; however, at 30 and 45 minutes, the group with the combination of phenylephrine and tropicamide had better-dilated pupils.

Despite better mydriasis, there was no significant increase in vital parameters. [Table 3].

There was a statistically significant difference in the visibility of zones of the retina between the two groups: group 1 was better than group 2 with $P < 0.001$ in both right and left eye [Table 4].

In our cohort, four babies had ROP, three had end zone 2 stage 2 ROP with pre-plus disease, which regressed spontaneously. One baby had zone 2 posterior stage 3 ROP with plus disease in one eye and zone 2 stage 2 ROP with pre-plus disease in the other eye, which required laser ablation to the avascular retina. The plus disease had no effect on the pupillary dilatation in either group in our cohort. The birth weight and age in weeks had no effect on pupillary dilatation in our cohort [Table 5]. Systemic events like heart rate variations and desaturation episodes over a 12-hour period after dilatation were also comparable between the two groups [Table 6].

Table 1: Baseline characteristics of the two groups

Variables	Groups	Mean (±standard deviation)	*t*	*P*
Birth age	1	34.40 (±2.26)	0.43	0.66
	2	34.74 (±3.24)		
Birth weight	1	1.13(+0.30)	0.82	0.41
	2	1.22(+0.46)		
Pupil size	1	2.18 (±0.47)	0.0	1
	2	2.18 (±0.55)		
Heart Rate	1	162.52 (±17.49)	1.27	0.21
	2	156.67 (±16.42)		
Respiratory Rate	1	56.07 (±3.7)	0.174	0.06
	2	58.44 (±5.0)		
Saturation	1	95.33 (±3.07)	0.48	0.06
	2	93.48 (±3.81)		

Variables	Groups	Males	Females	Chi-square value	*P*
Gender	1	18	9	0.55	0.35
	2	20	7		

Variables	Groups	Present	Absent	Chi square value	*p* value
Plus disease	1	8	46	0.33	0.56
	2	6	48		

Both groups were well matched for Age, gender, birth weight, and pupillary size. Baseline characteristics like heart rate, respiratory rate, and saturation were also well matched between both groups

DISCUSSION

As the requirement for ROP screening increases, so does the need for optimum retina visualization. Adequate mydriasis also allows the procedure to be completed quickly, thereby minimizing the pain the neonate perceives.[14] National recommendations suggest using P2.5% and T 0.5 -1% or only tropicamide.[1,13]

Studies have used phenylephrine, tropicamide, and cyclopentolate in varying concentrations and combinations. Our population consists exclusively of babies with dark irides, which react differently to mydriatics than others.[15]

Bruce *et al.*[3] compared phenylephrine 1% and tropicamide 1% with P2.5% and T 1%. Their results were similar to the present study, showing that optimum mydriasis occurred with P2.5% and T1%. Ogut *et al.*[16] in 1996, a combination of P2.5%, C0.5%, and T 0.5% had the best mydriasis than any of them alone or without the cyclopentolate. Lux's paper found that a similar combination as the present study (P2.5% and T0.4%) resulted in maximum mydriasis when compared to T0.5% alone.[9] Chew compared combinations of phenylephrine and cyclopentolate in varying concentrations with a mixture of P and T, finding that they all resulted in adequate mydriasis.[10]

Cyclopentolate is associated with an adverse safety profile for preterm neonates and is not used in our institution. Ogut and Bruce reported higher side effects in the groups who received a combination with cyclopentolate. However, several studies show good mydriasis and fewer adverse effects with cyclopentolate.[2,10,11,14]

Table 2: Showing difference in Pupil size between the Groups at 15, 30, & 45 minutes after instillation of study drops

Time	Group	Mean (±standard deviation) Pupil size in mm	*t*	*P*
15 minutes	1	4.16 (±1.78)	1.71	0.08
	2	3.81 (±0.93)		
30 minutes	1	6.03 (±1.48)	3.35	0.001
	2	5.18 (±1.11)		
45 minutes	1	7.56 (±1.07)	7.74	<0.001
	2	5.92 (±1.04)		

There was statistically significant difference in the mean pupil size between the two groups at 30 and 45 minutes, with *P* value of 0.001 and <0.0001 respectively

Table 3: Visibility of zones of retina during the ROP evaluation between the two Groups

	Groups	Poor dilatation	Fair dilatation	Good dilatation	Chi-square value	*P*
Right eye	1	4	8	13	20.761	<0.001
	2	19	5	1		
Left eye	1	4	6	15	17.218	<0.001
	2	16	7	2		

There was statistically significant difference in the visibility of zones of retina between the two groups, group 1 was better than group 2 with *P*<0.001 in both right and left eye

Table 4: Showing difference in systemic parameters between the Groups at 15, 30, & 45 minutes after instillation of study drops

Systemic parameters	Groups	15 minutes	30 minutes	45 minutes
Mean Heart rate (±standard deviation) beats/min	1	157.9 (±14.91)	153.58 (±19.01)	151.32 (±22.75)
	2	158.9 (±18.39)	158.0 (±19.84)	154.20 (±17.90)
P		0.82	0.41	0.62
Mean Respiratory rate (±standard deviation) breaths/min	1	56.11 (±4.88)	55.46 (±4.25)	56.08 (±4.06)
	2	57.37 (±5.79)	57.11 (±5.30)	56.88 (±5.75)
P		0.39	0.21	0.57
Mean O2 saturation (±standard deviation) %	1	94.74 (±4.09)	95.23 (±3.43)	96.36 (±3.07)
	2	93.33 (±7.57)	93.04 (±9.99)	95.88 (±3.02)
P		0.4	0.29	0.58

There was no statistically significant difference in the systemic parameters studied like heart rate, respiratory rate and Oxygen saturation at 15, 30 & 45 minutes after topical mydriatic application

Table 5: Effect of the presence of plus disease, birth weight, and age on pupillary dilatation

Variable	Statistical test	Pupillary size			
		Baseline	15 min	30 min	45 min
Plus disease	*t*	0.36	0.02	0.84	0.17
	P	0.71	0.98	0.39	0.86
Birth weight	Correlation co-efficient	0.06	0.055	0.074	0.019
	P	0.50	0.57	0.44	0.85
Age in weeks	Correlation co-efficient	0.056	0.078	0.046	0.087
	P	0.56	0.42	0.63	0.39

The plus disease, birth weight, and age in weeks had no effect on the pupillary dilatation in either group in our cohort

Table 6: Occurrence of systemic events within 24hours of topical drops instillation in the two Groups

Variables	Groups	-ve	+ve	Chi-square value	*P*
Canceled ROP evaluation	1	25	2	1.0	0.9
	2	25	2		
Desaturation	1	21	6	0.53	0.38
	2	19	8		
Heart Rate variation	1	7	20	2.03	0.15
	2	12	15		

The occurrence of systemic events like heart rate variations and episodes of desaturation over a 12hour period after dilatation was also comparable between the two groups. (4/54 babies, two in each group)

Our study showed that 14 babies had desaturations and 35 had variations in heart rate. However, this was not different between the two groups and was similar to other studies.[2,16,17] The pain and discomfort induced by the maneuvers during the ROP screening can cause BP fluctuations, apneic events, and tachycardia.[17-21]

CONCLUSION

In conclusion, this study has established that the combination eye drop of phenylephrine 2.5% with tropicamide 0.4% is more efficacious as a mydriatic, while the safety profile is comparable to the plain tropicamide eye drops.

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Nil.

Conflicts of interest
There are no conflicts of interest.

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Original Article

Comparative study of postoperative astigmatism in temporal scleral incision phacoemulsification versus temporal clear corneal incision phacoemulsification

ABSTRACT

Context: Various modifications in cataract surgery have been tried to reduce postoperative astigmatism. Incision length and location are some variable modulations. In this view, we are comparing the astigmatism following scleral incision and clear corneal incision in phacoemulsification surgery with posterior chamber intra-ocular lens implantation. **Aims:** To compare postoperative astigmatism after temporal scleral incision phacoemulsification and temporal clear corneal incision phacoemulsification. **Settings and Design:** Nonrandomized Prospective Interventional Comparative hospital-based study. **Methods and Materials:** In 50 eyes, temporal scleral incision phacoemulsification is performed, and in 50 eyes, temporal clear corneal incision phacoemulsification is performed. The patients were examined on the 1st, 7th, and 30th postoperative days, and surgically induced astigmatism was calculated. **Results:** Mean surgically induced astigmatism in the temporal clear corneal incision phacoemulsification group Mean surgically induced astigmatism is 0.98 ± 0.39 on 1st postoperative day, 0.71 ± 26 after 1st postoperative week, and 0.68 ± 26 after postoperative 1 month. In the temporal scleral incision phacoemulsification group is 0.81 ± 0.24 on 1st postoperative day, 0.610 ± 0.16 after 1st postoperative week, and 0.55 ± 0.16 after postoperative 1 month. **Conclusions:** In this study, at any particular time temporal scleral incision group has less astigmatism compared to temporal clear corneal incision phacoemulsification group. Hence it can be stated that temporal scleral incision induces lesser astigmatism as compared to temporal clear corneal incision phacoemulsification.

Keywords: Phacoemulsification, surgical incision, surgically induced astigmatism

INTRODUCTION

Cataract has been documented to be the most significant cause of bilateral blindness. In India, cataract has been reported to be responsible for 50-80% of bilaterally blind in the country.[1-4] Over the past years, surgical technique has evolved from standard extracapsular to micro incision without suture. Phacoemulsification remains the more advanced and technically superior method of cataract surgery.

Astigmatism plays a major role in postoperative compliance after cataract extraction. It occurs due to alteration in the normal curvature of cornea or lens. It may lead to decreased visual acuity, glare, monocular diplopia, asthenopia, and distortion of image after cataract surgery. The outcome of cataract surgery depends on various factors like incision, approach, type of surgery, and mode of intraocular lens (IOL).[5] Various modifications in cataract surgery have been tried to reduce postoperative astigmatism. Incision length and location are some variable modulations.

It is known that flattening of the cornea occurs ultimately at a direction right angles to the direction of the cataract incision. Also, it has been that the farther the cataract incision from the visual axis, the less likely is the effect on the corneal curvature

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Shivayogi R. Kusagur, Manjunath B. H, Poolan V. Nayak

Department of Ophthalmology, Bapuji Eye Hospital, Davangere, Karnataka, India

Address for correspondence: Dr. Poolan V. Nayak, Bapuji Eye Hospital, Davangere - 577 004, Karnataka, India.
E-mail: poolannayak3@gmail.com

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at the visual axis. A scleral incision is farther from the visual axis and flattening, likely affecting the corneal curvature at the visual axis, thus causing less postoperative astigmatism. But, healing is faster in the cornea compared to sclera. So, early wound stabilization occurs in a clear corneal incision when compared to a scleral incision. In this view, we have endeavored to compare the astigmatism following scleral incision and clear corneal incision in phacoemulsification surgery with posterior chamber intra-ocular lens implantation.

SUBJECTS AND METHODS

A prospective study was conducted on 100 eyes, 50 eyes undergoing temporal scleral incision phacoemulsification (3.2 mm incision 1.5 to 2 mm from limbs), and 50 eyes undergoing temporal clear corneal incision (2.8 mm) between October 2021 and November 2022. After acquiring the approval by the institutional ethics committee, written informed consent was taken from all participants. All patients underwent standard ocular examination protocol. Demographic data: best corrected visual acuity for distance and near vision using Snellen's chart. Keratometry readings were recorded using an auto-keratorefractometer. Slit lamp examination of the anterior segment before and after dilatation of the pupil. Intraocular pressure (IOP) measurement with GoldmannApplanation Tonometer. Slit lamp fundus biomicroscopy examination of the optic disk with a 90D lens through an undilated pupil. The IOL power is calculated by contact A-scan biometry using the Sanders-Retzlaff-Kraff (SRK) formula. The patients are examined on 1st, 7th, and 30th postoperative days. Keratometric data was recorded using an auto-keratorefractometer.

For the simplification of analysis, all astigmatic changes were studied only in vertical or horizontal axis. If readings were oblique, they were considered as 90° or 180°, depending on which is nearest.

Preop and Postop K1, K2, and Axis were entered in the calculator, and it calculated the Surgically Induced Astigmatism (SIA) as below

SIA calculator version 1.1 by Sawhney and Agarwal is used to calculate SIA.

This calculator applies the Holladay method of astigmatic analysis. This method is conceptually based on vector analysis using the Cartesian coordinate-based system such that the Holladay method converts the astigmatic corrections to X and Y vector components according to the equations

$$Xpreop = Cpreop \times \cos(2 \times Apreop)$$

$$Ypreop = Cpreop \times \sin(2 \times Apreop)$$

$$Xpostop = Cpostop \times \cos(2 \times Apostop)$$

$$Ypostop = Cpostop \times \sin(2 \times Apostop)$$

where preop is the before-surgery condition, postop is the after-surgery condition, C is the magnitude of astigmatism, and A is the angle of the steep meridian.

Subsequently, the magnitude of SIA is obtained as in the equation;

$$\text{SIA magnitude} = [(Xpostop - Xpreop)\,2 + (Ypostop - Ypreop)\,2]^{1/2}$$

Finally axis of SIA (ASIA) is determined by using

Xsia and Ysia components as in the equation below

$$\Theta = 0.5 \arctan(Xsia/Ysia)$$

$$ASIA = \Theta; \text{ when } Y \geq 0 \text{ and } X > 0$$

$$ASIA = \Theta + 180; \text{ when } Y < 0 \text{ and } X > 0$$

$$ASIA = \Theta + 90; \text{ when } X < 0$$

$$ASIA = 135; \text{ when } X = 0 \text{ and } Y < 0$$

Where YSIA =Ypreop and XSIA =Xpreop-Xpostop

Inclusion criteria

The study includes:

- Patients with clinically significant uncomplicated cataract
- Patients with clear cornea on slit lamp examination
- Age group between 30 to 80 years of either sex.

Exclusion criteria

The study excludes:

- Patients with astigmatism of more than three dioptres in both meridians.
- Patients with hazy cornea, corneal dystrophies/degeneration or other corneal pathologies.
- Patients with scleral thinning.
- Patients with connective tissue disorder.
- Complicated and pediatric cataracts.
- Patients with posterior segment pathologies.
- Glaucoma.
- Any vision-threatening complications during surgery.

Operative procedure

GROUP A: Phacoemulsification was performed under local anesthesia.

A clear corneal incision was made temporally using 2.8 keratome. The side port performed 2 to 3 clock hours from the main incision. Dye injected and washed. Viscoelastic substance was injected, and continuous curvilinear capsulorrhexis was performed. Hydrodissection was performed, and the nucleus was rotated. Phacoemulsification is performed by either the divide and conquer or the stop and chop method. Epinucleus and cortex removed by irrigation and aspiration probe. Foldable posterior chamber IOL was placed in the bag and dialed. Excess visco washed.

GROUP B: Phacoemulsification was performed under local anesthesia.

Conjunctival peritomy is performed around three o'clock temporally. A 3.2 mm incision was performed, and a sclerocorneal tunnel was performed and entered the anterior chamber. The side port completed 2 to 3 clock hours from the main incision. Dye injected and washed. A viscoelastic substance was injected, and continuous curvilinear capsulorrhexis was conducted. Hydrodissection was performed and nucleus was rotated. Phacoemulsification is performed by either the divide and conquer or the stop and chop method—epinucleus and cortex are removed by irrigation and aspiration probe. Foldable posterior chamber IOL was placed in the bag and dialed. Excess visco washed.

Statistical analysis

SPSS (Statistical Package For Social Sciences) version 20. (IBM SPSS Statistics [IBM Corp. released 2011] was used to perform the statistical analysis

- Data were entered into the Excel spreadsheet.
- Descriptive statistics of the explanatory and outcome variables were calculated by mean and standard deviation for quantitative variables, frequency, and proportions for qualitative variables.
- Inferential statistics like
  - A Chi-square test was applied for qualitative variables.
  - Independent sample *t*-test was applied to compare the quantitative variables (K1, K2, and SIA scores) between the groups at different time intervals.
- The level of significance is set at 5%.

RESULTS

In this study, in the temporal clear corneal phacoemulsification group, the majority of patients were in the age group of 61–70 years (44%), 18% were in the age group of 36 to 50 years, 22% were in 51 to 60 years group, and 8% were in 71 to 80 years group. In the temporal scleral incision phacoemulsification group, the majority were in the 61 to 70 years group (52%), 14% were in the age group of 36 to 50 years, 24% were in the age group of 51 to 60 years, and 10% were in 71 to 80 years group.

In the temporal clear corneal phacoemulsification group, the majority were females (62%), and 38% were males. In the temporal scleral incision phacoemulsification group, both male and female distribution was equal.

In temporal clear corneal phacoemulsification group and the temporal scleral incision phacoemulsification group, the majority were immature cataracts, 82% and 78%, respectively, and Mature cataracts, 18% and 22%, respectively.

Mean preop K1 in temporal clear corneal phacoemulsification was 44.82, and in temporal sclera incision, phacoemulsification was 44.19.

Mean preop K2 in temporal clear corneal phacoemulsification was 45.82, and in temporal scleral incision, phacoemulsification was 45.28 [Table 1 and Figure 1].

Table 1: Comparison of the preop K1 and K2 between the groups using independent sample *t*-test

	Groups	Minimum	Maximum	Mean
Preop K1	TCCIP	42.75	47.25	44.82
	TSIP	41.25	47.00	44.19
Preop K2	TCCIP	43.50	48.50	45.82
	TSIP	42.25	47.50	45.28

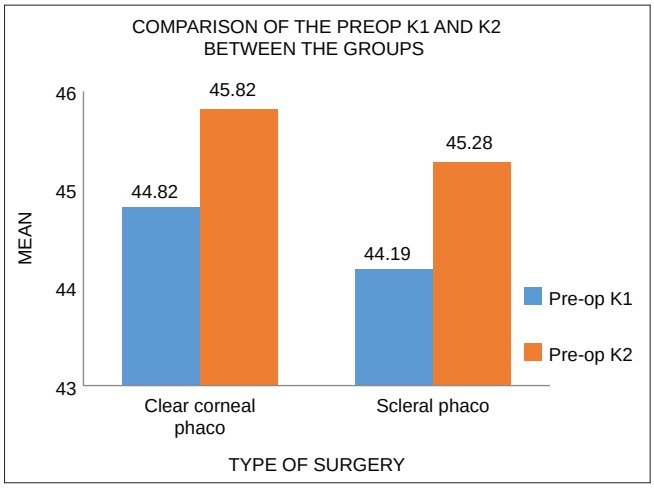


Figure 1: Comparison of the preop K1 and K2 between the groups using independent sample t-test

Mean surgically induced astigmatism in the temporal clear corneal incision phacoemulsification group. Mean surgically induced astigmatism is 0.98 ± 0.39 on 1st postoperative day, 0.71 ± 26 after 1st postoperative week, and 0.68 ± 26 after postoperative 1 month.

In temporal scleral incision, phacoemulsification group is 0.81 ± 0.24 on 1st postoperative day, 0.610 ± 0.16 after 1st postoperative week, and 0.55 ± 0.16 after postoperative 1 month.

The *P* value of 0.01, 0.023, and 0.004 at postoperative day 1, 1 week, and 1 month showed statistically significant differences [Table 2 and Figure 2].

DISCUSSION

Getting accurate postoperative refraction will determine the success of the cataract surgery. SIA is one of the main factors that determines good postoperative refraction. SIA is influenced by many factors like type of cataract surgery, incision type, incision site, and suturing techniques. Nowadays, the two most common types of cataract surgeries are phacoemulsification and MSICS (manual small incision cataract surgery). In general, phacoemulsification surgery produces lower SIA when compared to MSICS. Another factor that affects SIA is the incision site. Gokhale has found that temporal or superotemporal approaches would result in lower SIA when compared to superior approaches.[6] The use of a superior approach results in a larger SIA due to gravitational force and the blinking of the eye at the incision point.

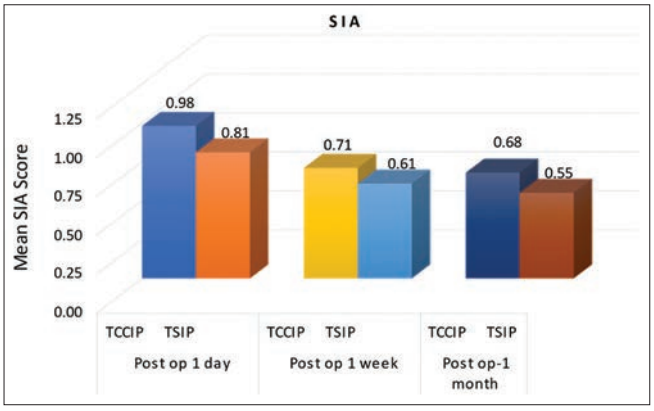


Figure 2: Comparison of SIA scores between two groups at different intervals

In this study, an attempt has been made to analyze the incision type and compare how astigmatism changes in phacoemulsification surgery between temporal clear corneal incision and temporal Scleral incision. It was found that patients in the temporal scleral incision phacoemulsification group had lower gross astigmatism at the end of 1 month compared to the temporal clear corneal incision group. The final surgically induced astigmatism in the temporal clear corneal phacoemulsification group was 0.68 ± 0.260 and in the temporal scleral incision phacoemulsification group was 0.55 ± 16. The *P* value 0.004 shows a significant difference in Mean Surgically induced astigmatism between the two groups.

This study is similar to the study conducted by MR Joshi and S Shakya (2009), which showed that the astigmatism was 1.02 and 0.55 ± 0.31 D in the corneal incision group and the scleral incision group, respectively.

This study is also similar to the study conducted by Latha N V *et al*.[7] in which surgically induced astigmatism was 0.73D in temporal clear corneal phacoemulsification and 0.52D in temporal scleral incision phacoemulsification.

Also, with the study of Huang FC and Tseng SH, the SIA in clear corneal incision was 0.93 D and in scleral incision 0.72D.[8]

This contradicts the study conducted by Bahskar Reddy, Amit Raj, and Virendarpratap Singh in which phacoemulsification with clear corneal incision showed 1.08 ± 0.36 D and scleral pocket 1.23 ± 0.71 D astigmatism.

The present study showed that the mean astigmatism in the temporal clear corneal incision phacoemulsification group Mean Surgically induced astigmatism is 0.98 ± 0.39 on 1st postoperative day, 0.71 ± 0.26 after 1st postoperative week, and 0.68 ± 0.26 after postoperative 1 month.

Table 2: Comparison of SIA scores between two groups at different intervals

Time intervals	Groups	*n*	Minimum	Maximum	Mean	S.D	Mean diff	*t*	*P*
Postop 1 day	TCCIP	50	0.5	2.0	0.98	0.39	0.17	2.64	0.01* S
	TSIP	50	0.5	1.5	0.81	0.24			
Postop 1 week	TCCIP	50	0.5	1.5	0.71	0.26	0.10	2.31	0.023*, S
	TSIP	50	0.5	1.0	0.61	0.16			
Postop-1 month	TCCIP	50	0.5	1.5	0.68	0.26	0.13	2.99	0.004*, S
	TSIP	50	0.25	1.0	0.55	0.16			

Unpaired *t*-test. $P<0.05$ sig

In temporal scleral incision, the phacoemulsification group is 0.81 ± 0.24 on 1st postoperative day, 0.610 ± 0.16 after 1st postoperative week, and 0.55 ± 0.16 after postoperative 1 month.

The *P* value of 0.01, 0.023, and 0.004 at postoperative day 1, 1 week, and 1 month showed a statistically significant difference.

Although a statistically significant difference in postoperative astigmatism is seen between the two groups, the difference amount is only 0.13 ± 0.1 which is clinically less.

In this study, at any particular time, the scleral incision group has less astigmatism compared to the corneal group. Hence, it can be stated that a temporal scleral incision induces lesser astigmatism than a temporal clear corneal incision.

Limitations

Surgeries were not performed by a single surgeon, which might result in a disparity of results.

CONCLUSION

In our study, temporal clear corneal incision phacoemulsification showed greater postoperative astigmatism compared to temporal scleral tunnel phacoemulsification. Although clear corneal incision has a greater advantage in terms that it can be conducted under topical anesthesia and angle structures are not disturbed, so if trabeculectomy is required, it can be planned temporally, but in terms of postoperative astigmatism temporal scleral tunnel phacoemulsification is better than temporal clear corneal phacoemulsification.

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Conflicts of interest

There are no conflicts of interest.

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Original Article

Prevalence of amblyopia among adult population and their various impacts on life: An experience over a period of eight months

ABSTRACT

Background: Amblyopia is due to insufficient development of the visual system in early childhood and affects 1% and 2% population of most developed countries. **Aims and Objective:** (1) Prevalence of amblyopia among adult population attending our hospital. (2) Effect of amblyopia on their academic performance, social life, and on future establishment. (3) Its determinants in a population. **Methods:** This is a prospective, single-center, hospital-based study, where adults between 18 and 60 years were included. A history of ocular trauma, known case of amblyopia, and past ocular surgery were excluded from the study. In this study, amblyopia was defined as best-corrected visual acuity of 20/30 or less or 2-line acuity differences with no pathology. **Results:** Of the total 2880 adults screened, 280 were diagnosed to have amblyopia with a prevalence of 1.75%. Amblyopia was more common among the males (51.1%, N = 143) as compared to females. A maximum number of patients were found in the age group of 20–30. Refractive amblyopia was found to be the most common cause of amblyopia. There was a family history of amblyopia only in 0.7% (N = 2) of cases. **Conclusion:** Awareness of amblyopia among the parents is essential for early detection and treatment of the disease, which will, in turn, reduce the burden of childhood visual impairment.

Keywords: Amblyopia among adults, causes of amblyopia, effects of amblyopia

INTRODUCTION

Amblyopia (sometimes referred to as "lazy eye") is a reduction in visual acuity (VA) that is not directly caused by a structural abnormality. It is a childhood condition that results from suboptimal visual experiences that alter the nerve pathways between the eye and the brain. It is traditionally defined as a difference of 2 or more lines on an acuity chart or less than 20/40 vision (with correction).[1] Amblyopia is mostly unilateral or less commonly bilateral. It affects 1% and 2% population of most developed countries. Amblyopia remains a lifelong problem if treated too late or left untreated.[1] Amblyopia is diagnosed when an amblyogenic factor causes abnormal development of the visual cortex during a critical neural maturation stage resulting in decreased VA.[1] The brain begins to favor the stronger eye over the weaker, resulting in an imbalance between the eyes. 1 It is important to correct amblyopia early in life, while the child's visual brain can still develop better VA.[1] Amblyopia is the most common cause of uniocular visual impairment among children, young, and middle-aged adults and has a prevalence rate of about 1–4%.[2] Anisometropia, high refractive errors, squint, media opacities, or their combinations are the various causes of amblyopia commonly encountered in outpatient departments.[2]

The prognosis of amblyopic patients depends on multiple factors, which include the age of the patient at detection, its cause, severity, the presence of comorbidities, the interval between the

Sujit Das, Sukhdayal S. Shergill[1]

Department of Ophthalmology, AIIMS, Deoghar, Jharkhand, [1]Department of Ophthalmology, Adesh Medical College and Hospital, Shahbad, Haryana, India

Address for correspondence: Dr. Sujit Das, Associate Professor, MS Ophthalmology, Department of Ophthalmology, AIIMS, Deoghar - 814 152, Jharkhand, India.
E-mail: imdrsujitdas@gmail.com

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onset and initiation of treatment, and the patient compliance. Parent education and awareness of the disease also play an important role.[2] Timely correction of the underlying defect is necessary to avoid permanent visual impairment. Amblyopia can lead to permanent loss of vision if timely corrective measures are not taken and so vision testing is recommended for all children around the ages of four to five.[3] Treatment of amblyopia depends on the cause but typically involves forcing the patient to use their weaker eye while correcting the underlying cause of the decreased vision (cataract surgery, glasses, etc.). This "penalization" of the sound eye is typically accomplished using an eye patch or atropine drops.[4] Eye patching is usually done on a part-time schedule of about 4–6 hours a day.[5,6] Treatment is continued as long as vision improves. Deprivation amblyopia is treated by removing the opacity as soon as possible followed by patching or penalizing the good eye to encourage the use of the amblyopic eye.[7] The chance of achieving 20/20 vision is greater if treatment is initiated early.[8,9]

METHODS

It is a prospective, single-center, hospital-based study that has been done over a period of eight months. All patients above 18 years of age who attended our OPD were included in this study. Those who had a history of ocular trauma, history of ocular surgery, and medical illness, which can affect the vision, were excluded from this study. Data had been gathered on patients aged between 18 years and 60 years. The study was conducted after taking written consent and approval from the Ethics Committee. Questionnaires were used to investigate the demographics of participants, which included information on age, gender, religion, study level, occupation, academic performance, effects on jobs, mental peace, and psychosocial effect. Information regarding parent's education and occupation also being taken. The examinations included uncorrected and corrected visual acuity using Snellen chart, cycloplegic and non-cycloplegic refraction, the Hirschberg test, cover-uncover testing, slit-lamp biomicroscopy, and dilated detailed ophthalmoscopy. Intraocular pressure was taken using Goldmann applanation tonometry. In this study, amblyopia was defined as best-corrected visual acuity of 20/30 or less or 2-line acuity differences with no pathology. A total of 2880 adult patients were visited during this study, and out of which, 280 patients were diagnosed as amblyopic. Data were analyzed using SPSS software version 16 for all analyses in this study, and the Chi-square was used as a test of significance to detect association variables.

RESULTS

This study was conducted in over 2880 adult patients attending our OPD over a period of one year, and out of which, 280 patients were diagnosed as amblyopic. Male (51.1%, N = 143) patients were mostly affected and were more prevalent in Hindu (59.3%, N = 166) population in our study. The mostly affected age group was between 21 and 30 years [Table 1]. Most of them resented with complaints of headache 51.1% (N = 143) followed by reduced vision, 28.2% (N = 79), medical eye checkups, 7.1% (N = 48), and routine eye checkups, 3.6% (N = 10). All of them were first time diagnosed and had no history of any ocular trauma, past ocular surgery, and past medical illness. Only 0.7% (N = 2) of cases had a family history of amblyopia. Amblyopia was mostly encountered among students [Table 2]. In our study, most of the parents were found illiterate [Table 3]. The mostly diagnosed underlying cause was found anisometropic amblyopia, 5.71% (N = 240), followed by strabismus (11.07%, N = 31) and cataract (N = 08). One case had severe ptosis. Two cases had bilateral cataract. In all the cases, it was exotropia, found in our study. Mostly encountered anisometropia was mixed astigmatism followed by compound

Table 1: Age distribution

Age group	Frequency	Percent
Valid		
≤20 years	68	24.3
21-30 years	88	31.4
31-40 years	60	21.4
41-50 years	48	17.1
>50 years	16	5.7
Total	280	100

Table 2: Occupation of the indivisual

Occupation	Frequency	Percentage
Valid		
Farmer	16	5.7
Housewife	71	25.4
Job	54	19.3
Student	125	44.6
Unemployed	10	3.6
Others	4	1.4
Total	280	100

Table 3: Parents education

Profile	Illiterate rate	Literacy rate and profile	Total
Mother education			
Illiterate	49	161	210
Literate	8	24	32
Job	0	16	16
Teacher	0	22	22
Father education			
Illiterate	49	161	210
Literate	8	22	30
Job	0	16	16
Teacher	0	12	12

myopic astigmatism [Table 4]. It was right eye mostly affected in our study. Amblyopia had immense social and psychological effect mostly on male (46.9%, N = 131) patients and on the Hindu community (52.14%, N = 146) between the age group of 21–30 years (24.64% N = 69) followed by less than 20 years (22.14%, N = 62). It had an immense effect on job, academic performance, and social life [Table 5]. Most of them were prescribed glasses along with patching. Patching was continued for a maximum of 21 years. Compliance with treatment was good (73.92% N = 207) in our study with a prevalence of adult amblyopia 1.75%. Twelve candidates discontinued patching, and there was not a single case of loss of follow-up.

DISCUSSION

Amblyopia is diagnosed when an amblyogenic factor causes abnormal development of the visual cortex during a critical neural maturation stage resulting in decreased VA. Amblyopia has an impact on the academic performance and psychological development and also has an immense impact on finance and future establishment. The prevalence of amblyopia is quite common among the adult population. Attebo *et al*.[2] found a prevalence of 3.2% among 3654 participants (participant age ≥49 years), while Brown *et al*.[10] found an even lower prevalence of 3.09% among participants aged over 40 years with a mean age of 59 years. Unlike studies conducted in other countries, this research investigated only individuals aged between 18 years and 60 years. In our study, the prevalence was 1.75%. Our study findings agreed with the findings of other studies, where the prevalence of amblyopia was found to range from 1% to 5% in adults.[11,12] In Australia, the prevalence among adults was 3%.[10] A study from Germany showed that the prevalence of amblyopia in older participants whose age ranged from 40 to 44 years was higher than younger participants whose age was 35–39 years.[11] In our study, the prevalence was found higher in the 21–30 years of age group (24.3%, N = 68) followed by less than 20 years of age group. It was 21.4% (N = 60) and 17.1% (N = 48) between 31-40 years and 41-50 years, respectively. In our study, males were mostly affected (51.1%, N = 143) and was mostly in the Hindu community (59.3%, N = 166). Right eye was affected more (65%) in this study. Most of the patients presented to us with complaints of headache (51.1%, N = 143) followed by reducing vision (28.2%, N = 79), medical eye checkups (17.1%, N = 48), and routine eye checkups (3.6%, N = 10). In this study, amblyopia was mostly seen in students (44.6%, N = 125) followed by housewives (25.4%, N = 71), job holders (19.3%, N = 54), and among farmers (5.7%, N = 16).[10-12] While analyzing the literacy status, it was found that 75% (N = 210) of parents were illiterate in our study. While analyzing the job profile, it was found that mother had a job of teaching in 7.6% (N = 22) of cases, whereas father had a job of teaching in 4.2% (N = 12) of cases. Among 5.71% (N = 16) of cases, it was found that both parents were working in different jobs. Hence, it is obvious that ignorance or unawareness of parents plays an important role in detecting amblyopia at home and it cannot be ignored. This is a significant outcome, which came out in our study. In an Iranian study, which was performed among students aged between 9 and 15 years,[13] the study found a prevalence of anisometropic amblyopia 36.36% compared to 22.73% of strabismic amblyopia. In our study, anisometropic amblyopia was 85.71% (N = 240), whereas strabismus was 11.07% (N = 31) and cataract was found in eight cases. Amblyopia due to severe ptosis was found only in one case. Mostly encountered anisometropia in our study was mixed astigmatism (26%, N = 73) followed by compound myopic astigmatism (21.4%, N = 60). Strabismus combined with anisometropia was there in 2.86% (N = 08) of cases. Attebo *et al*.[2] report higher findings, with 46% of their amblyopic study participants having strabismus. In contrast, the frequency of strabismus in the other large Australian study by Brown *et al*.[10] was only 4.7%. In other

Table 4: Distributionof refractive error

Refractive error diagnosed	Frequency	Percentage
Compound myopic astigmatism	60	21.4
Compound hypermetropic astigmatism	48	17.1
Mixed astigmatism	73	26.1
Hypermetropia	12	4.3
Simple myopic astigmatism	47	16.8
Simple astigmatism	8	2.9
Simple hypermetropic astigmatism	24	8.6
Simple hypermetropia	2	0.7
Simple myopia	2	0.7
Nil	4	1.4
Total	280	100

Table 5: Effects of Amblyopia

	Normal	Present
Affect on job		
Nil	57	154
Poor performance	0	8
Rejected for defence, railway	0	61
Affect on mental peace		
Normal	55	53
Shocked & disturbed	2	2
	Frequency	**Present**
Affect on academic performance		
Nil	194	69.3
Poor	86	30.7
Effect of amblyopia on social and psychological issue		
Normal	57	20.4
Present	223	79.6

studies also, anisometropia was found the most common cause of amblyopia.[14]

While analyzing the impact of amblyopia on their carrier establishment, it was found that 21.79% (N = 61) were rejected for a railway and defense job, 30.7% (N = 86) had poor academic performance, and among the 79.6% (N = 223) cases, it had an immense social and psychological impact on their life. This analytical findings was differed from a study conducted by M. Khalaj *et al*.[13] In addition to bias resulting from different study designs, genetic factors may be another reason for the different prevalence of amblyopia in different countries. This is because there is also a confirmed hereditary influence for strabismus and refractive errors, which often cause amblyopia.[15] In fact, there was a lower prevalence of amblyopia (0.8%) among African-American preschool children than among white American or Asian children (both 1.8%).[16,17] In our study, only 0.7% (N = 2) of cases had a family history of amblyopia. For many forms of amblyopia, such as amblyopia resulting from unilateral or bilateral cataract, a treatment that does not begin until the age of nearly three years is much too late to achieve beneficial visual acuity.[16-18] It would be worthwhile to detect amblyopia cases and treated them within the national pediatric screening program so that they can get the benefits, as early treatment for amblyopia has been shown to be effective.[18] In our study, the large majority of patients (55%, N = 156) were prescribed glasses, whereas prescription of glass and patching technique were given in 7.86% (N = 22) of cases up to 21 years of age. Overall, compliance of treatment was good in our study (73.92% N = 207), which was different from other studies.[19,20] In 2008, in Germany [13 article], the Institute for Quality and Efficiency in Health Care (IQWiG, Institut für Qualität und Wirtschaftlichkeit im Gesundheitswesen) found no evidence or indication of a benefit of such preschool screening in a preliminary report assessing the benefit of screening for vision disorders in children before the age of six; this report was much discussed and debated by both ophthalmologists and pediatricians.[21] In contrast, there are reports from Sweden, where multiple eye examinations were performed before the age of three and found that the prevalence of amblyopia in 10-year-olds was substantially lower in Sweden (1.7%) than in Germany.[22] Hence, screening of children around the age group of 6–7 years will definitely have a great impact in lowering the prevalence of amblyopia in the community.

CONCLUSION

Considering the most common type (anisometropic amblyopia) of amblyopia in various studies, screening of students at around six to seven years of age will definitely have a great impact on lowering the incidence of amblyopia. Hence, the government should be pro-active and stricter on school screening programs introducing the prevalence rate. Increasing knowledge about amblyopia is recommended and parents should be focused enough on various causes of amblyopia through various campaigns.

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Conflicts of interest

There are no conflicts of interest.

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Original Article

Ocular manifestation of systemic tuberculosis in children at tertiary pediatric hospital in North India

ABSTRACT

Background: Tubnerculosis is Characterised by the presence of granuloma formation. The mode of spread of pulmonary tuberculosis is via airborne aerosol. This bacteria enters the lungs and leads to latent infection in susceptible hosts. Diagnosis is mostly presumptive in ocular tuberculosis. There is lack of uniform diagnostic criteria. Despite of vast developments in diagnostic tools, evidence of systemic tuberculosis disease along with suggestive clinical ocular findings is considered the major diagnostic criterion for ocular tuberculosis. **Aim:** This study aims to evaluate ocular findings in diagnosed cases of pulmonary and extrapulmonary tuberculosis in children. **Methods:** The study included children with various type of pulmonary and extra pulmonary tuberculosis. All these children referred to ophthalmology department to rule out ocular manifestations were evaluated on the basis of visual acuity, anterior segment and dilated posterior segment examination. **Results:** A total of 90 children were diagnosed with tuberculosis, of whom 30 (33.3%) were male and 60 (66.7%) were female, The mean age of presentation is 4±7 years. 30 (33.7 %) were a diagnosed case of pulmonary kochs, 52 (58.4 %) had tubercular meningitis (TBM), remaining 7 (7.8%) had other extrapulmonary kochs. The most common anterior segment finding was lateral rectus palsy in 14 (15.5%) children, the most common posterior segment finding was papilledema in 20 (22.2%) children. **Conclusion:** Tuberculosis is one of those pandemic in the world that can affect each and every organ of the body. A timely diagnosis of ocular findings can prevent these children from permanent ocular morbidity and blindness.

Keywords: Children, montoux test, papilledema, tuberculosis

INTRODUCTION

Tuberculosis (TB) is a systemic infectious disease caused by the *Mycobacterium tuberculosis* (M. tb) complex. Other species in this complex include *M. bovis* and *M. africanum*. According to the Ministry of Health and Family Welfare (MOHFW), the incidence of TB in India for the year 2021 was 210 per 100,000 population.[1]

There are two types of ocular TB "primary" and "secondary." Primary ocular TB is isolated ocular disease without systemic involvement or when the eye is the initial port of entry for the bacilli. Secondary ocular TB is caused by hematogenous spread to the eye from primary sites such as lungs and lymph nodes or direct invasion from the paranasal sinus or cranial cavity. A characteristic feature of this disease is granuloma formation. *M. tb* is a slow-growing, obligate aerobic, and non-motile, non-spore-forming bacteria. The mode of spread of this disease is via airborne aerosol. This bacteria reaches to the lungs and leads to latent infection in susceptible hosts.

Diagnosis is mostly presumptive in ocular TB. There is a lack of uniform diagnostic criteria. Despite of vast developments in diagnostic tools, evidence of systemic TB disease, along with suggestive clinical ocular findings, is considered the major diagnostic criterion for ocular TB.

Meenakshi Wadhwani, Amit Kumar[1], Dhulika Dhingra[2], Hem Sati

Department of Ophthalmology, Guru Nanak Eye Centre, MAMC, Departments of [1]Ophthalmology, [2]Pediatrics, Chacha Nehru Bal Chikitsalya, [3]Biostatistics, AIIMS, New Delhi, India

Address for correspondence: Dr. Meenakshi Wadhwani, Guru Nanak Eye Centre, New Delhi – 110 031, India.
E-mail: mkgang08@gmail.com

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As ocular TB can lead to permanent blindness in patients, it is important to identify this disease in its early stages. A handful of studies have been reported from India evaluating the ocular tubercular manifestation in children.[2,3] Hence, this study aims to evaluate ocular findings in diagnosed cases of pulmonary and extrapulmonary TB in children.

MATERIALS AND METHODS

It was a hospital-based cross-sectional study. The study was conducted from September 2021 to February 2023 in the Department of Ophthalmology in a tertiary care pediatric hospital in North India. Caregivers (parents or guardians) of children under 14 years of age with systemic TB who agreed who agreed to provide written informed consent were included in this study. The study included children above the age of 2 years who were cooperative for visual acuity assessment with a history of systemic TB. All these children were already diagnosed case of systemic TB by the pediatrician who had examined them following the standard protocol of systemic TB like the Montoux test, three-morning sputum tests for acid-fast bacilli (AFB) staining along with radiological examination in the form of chest X-ray posterior-anterior view. Diagnosis of pulmonary TB was done on the basis of the Montoux test, at least two positive AFB sputum tests and associated chest X-ray findings. Extrapulmonary TB was diagnosed on the basis of other clinical and radiological tests like cytological tests, immunoglobulin M (IgM) QuantiFERON Gold, and serum immunoglobulin for IgM and immunoglobulin G (IgG).

Detailed ophthalmic examination included visual acuity assessment using any of the following criteria: Fixation and following light, ambulatory freely, reaching out to objects, child's ability to recognize parents, Preferential Looking Test (Cardiff acuity cards), Landolt C chart (if the child was cooperative), and Snellen chart.

All children with significant refractive errors after cycloplegic correction were given spectacles as per the American Academy of Ophthalmology guidelines for the prescription of glasses. The children were also examined for extraocular movements using the cover test to rule out motility disorders. Periorbital areas and anterior segment were examined using torchlight and slit lamp biomicroscopic examination to rule out signs of inflammation like anterior chamber reaction, posterior synechiae, iris nodules, and keratic precipitates. Vitreous was examined for cells and flare. Besides this, detailed posterior segment evaluation was done using a direct and indirect ophthalmoscope to rule out choroidal tubercles, subretinal abscess, tuberculoma, endophthalmitis, retinal vasculitis, and optic nerve abnormalities in the form of papilledema was also ruled out. Data was entered in Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) 14.0 software. The frequency of ocular manifestation was evaluated using Chi-square tests.

RESULTS

A total of 90 children were diagnosed with TB; of these, 30 (33.3%) were male, and 60 (66.7%) were female. The mean age of presentation is 4 ± 7 years. Of these, 30 (33.7%) were diagnosed with cases of pulmonary Kochs, 52 (58.4%) had tubercular meningitis (TBM), and the remaining 7 (7.8%) had other extrapulmonary Kochs. Out of 90 patients, 20 (22.2%) had taken anti-tuberculosis treatment (ATT) for <3 months, 6 (6.7%) for 3–6 months, 33 (36.6%) for a period of 6–9 months, and 30 (33.3%) for 9–12 months. Among the 52 children with TBM, 40 reported a history of seizures. Additionally, nearly one-third of children with TBM had raised protein levels. In the ocular examination, presenting visual acuity in the better eye with available correction showed that 14 (15.5%) patients had only light perception, and 20 (22.2%) had moderate to severe visual impairment with visual acuity between 6/60 and 6/18. Fifty-six (62.3%) had 6/12 to 6/6 vision. Out of 90 patients, 14 (15.5%) had lateral rectus palsy, 6 (6.6%) had exotropia, 10 (11.1%) had phlycten, 3 (3.3%) had ptosis, 2 (2.2%) had nystagmus. On evaluating for posterior segment defects, 42 (46.6%) had a normal posterior segment, 8 (8.9%) had disc pallor, 20 (22.2%) had papilledema, 14 (15.5%%) had choroiditis, 5 (5.6%) had optic atrophy [Table 1, Figures 1 and 2].

There was a significant association between the type of TB (pulmonary, systemic, or tubercular meningitis) with gender ($P = 0.012$) and ocular presentation in the anterior and posterior segments ($P < 0.001$). This association was not statistically significant when considering different types of TB with the duration of antitubercular treatment ($P = 0.836$) and visual acuity ($P = 0.301$) [Table 2].

DISCUSSION

There was a significant sex predilection; 60 (66.6%) were females, and 30 (33.3%) were males. This was similar to the findings reported by Sahu e*t al.*,[2] as they also reported female predominance for ocular TB in their study. Bhatta *et al*.[1] reported no gender predominance for the ocular manifestation of TB.

Although, pulmonary TB is more common than extrapulmonary TB, but extrapulmonary TB is more commonly associated ocular manifestations in comparison to pulmonary TB.[4] In the current study, 58.4% of patients with ocular manifestations had TBM, and 8.9% had other kinds of extrapulmonary TB. A similar finding was reported by Bhatta *et al*.,[1]

Table 1: Detailed demographic parameters of children presenting with tuberculosis

Gender	*n* (%)
Male	30 (33.3)
Female	60 (66.7)
Total	90 (100.0)
ATT duration (months)	
< 3	20 (22.2)
3–-6	6 (6.7)
6–9	33 (36.7)
9-12	31 (34.4)
Total	90 (100.0)
Type of TB	
Pulmonary Koch	30 (33.7)
TBM	52 (58.4)
Other extrapulmonary TB	7 (7.9)
Total	89 (100.00)
Visual acuity	
Fixing to torchlight/PL+	14 (15.5)
6 by 60 to 6 by 18	20 (22.2)
6 by 12 to 6 by 6	56 (62.3)
Total	90 (100.0)
Seizure	
Present	40 (44.4)
Absent	50 (55.6)
Total	90 (100.0)
Anterior segment	
Lateral rectus palsy, anterior uveitis	21 (22.4)
Exotropia	6 (6.6)
Phlycten	10 (11.1)
Ptosis	3 (3.3)
Normal	50 (55.6)
Total	90 (100.0)
Fundus	
Disc pallor	8 (8.9)
Disc edema/papilledema	20 (22.2)
Choroiditis	14 (15.5)
Optic atrophy	5 (5.56)
Normal	42 (46.7)
Nodular scleritis	1 (1.1)
Total	90 (100.0)

ATT=anti-tuberculosis treatment, TBM=ubercular meningitis, TB=tuberculosis

Parchand e*t al*.,[3] and Cimino *et al*[4] as they also reported that the majority of patients with ocular manifestation were associated with extrapulmonary TB without any evidence of pulmonary TB.

In the current study, abducens nerve palsy was the most common ocular manifestation 22 (22.4%). Sharma *et al*.[5] also reported sixth cranial nerve involvement as the most common cranial nerve involved in 51 (32.3%) of cases with ocular TB. However Sahu *et al*.[2] reported that only one case out of 55 cases had cranial nerve palsy. The most common reason for abducens nerve affliction is its prolonged course in subarachnoid space. Oculomotor nerve with or without sixth nerve involvement was found in 9 (10.3%) children with ocular TB. The reason for the involvement of the third nerve is basal meningitis due to the long course in the base of the midbrain or tuberculoma in the base of the midbrain.

In the current study, papilledema (22.2%) was the second most common ocular manifestation. Bhatta *et al*.[1] also reported papilledema as the second most common presentation of ocular TB. The occurrence of papilledema in patients with tubercular meningitis is considered to be a poor prognostic factor for tuberculous meningitis.[6] The main reason for papilledema is that basal meningitis can lead to obstruction of basilar cisterns, resulting in obstructive hydrocephalus, further leading to papilledema. Direct involvement of the optic nerve by basal exudates can lead to optic atrophy and blindness in children.

Another important ocular finding that can be an indirect indicator of systemic TB is the presence of choroiditis and phlycten. In the current study, around 14 (15.6%) and 10 (11.1%) of the children suffered from choroiditis and phlycten, respectively. Biswas *et al*.[7] also reported focal choroiditis as one of the most common ocular findings in 50% of the patients. Similarly, Bhatta *et al*.[1] also reported choroiditis as the most common ocular finding in TB. Most of these children with phlycten were referred by ophthalmologists to the pediatrician for detailed investigation to rule out systemic TB on the basis of a raised Montoux test and abnormal chest X-ray, even though they initially presented in the ophthalmology department in view of conjunctival congestion.

Another common manifestation of ocular TB was uveitis, as uveal tissue receives maximum blood supply in the eye.[8] In the study conducted by Sahu *et al*.[2] with a sample size of 55 cases of ocular TB, acute anterior uveitis was the most common finding (21.8%). Direct infection or immune-mediated hypersensitivity response to mycobacterial antigen predisposes to uveitis. Gupta *et al*.,[9] also reported that out of 158 patients with tuberculous uveitis, 36% of cases were having anterior uveitis. Tubercular uveitis can present as granulomatous or non-granulomatous anterior uveitis, neuroretinitis, intermediate uveitis, vitritis, multifocal choroiditis, retinal vasculitis, solitary or multiple choroidal tubercles, choroidal granulomas, subretinal abscess, endophthalmitis, and panophthalmitis.[8,9]

There was one case of nodular scleritis in the current study. Similarly, Sahu *et al*.[2] also reported a 21% incidence of scleritis and a 4% incidence of recurrent episcleritis among 55 cases of ocular TB. A case series from Sri Lanka also reported one case

Table 2: Association of different types of tuberculosis with demographic and ocular parameters

Gender	Pulmonary Kochs	TBM	Other extrapulmonary tuberculosis	Total	*P*
Male	5 (16.7)	20 (66.7)	5 (16.6)	30 (100.0)	0.012
Female	25 (42.7)	32 (54.3)	2 (3.0)	59 (100.0)	
Total	30 (33.7)	52 (58.4)	7 (7.9)	89 (100.0)	
Duration of ATT					
1	20 (34.5)	34 (58.6)	4 (6.9)	58 (100.0)	0.836
2	10 (32.3)	18 (58.0)	3 (9.7)	31 (100.0)	
Total	30 (33.7)	52 (58.4)	7 (7.9)	89 (100.0)	
Visual acuity					
Fixing to torchlight/PL+	4 (28.6)	10 (71.4)	0 (0.00)	14 (100.0)	0.301
6 by 60 to 6 by 18	4 (20.0)	13 (65.0)	3 (15.0)	20 (100.0)	
6 by 12 to 6 by 6	22 (40.0)	29 (52.7)	4 (7.3)	55 (100.0)	
Total	30 (33.7)	52 (58.4)	7 (7.9)	89 (100.0)	
Anterior segment					
Lateral rectus palsy	7 (35.0)	13 (65.0)	0 (0.0)	20 (100.0)	<0.005
phlycten	9 (90.0)	0 (0.0)	1 (10.0)	10 (100.0)	
Ptosis+exotropia	4 (33.3)	6 (50.0)	2 (16.7)	12 (100.0)	
Normal	10 (21.3)	33 (70.2)	4 (8.5)	47 (100.0)	
Total	30 (33.7)	52 (58.4)	7 (7.9)	89 (100.0)	
Fundus					
Disc pallor	0 (0.0)	8 (100.0)	0 (0.0)	8 (100.0)	0.001
Disc edema/papilledema	4 (20.0)	15 (75.0)	1 (5.0)	20 (100.0)	
Choroiditis+optic atrophy	7 (36.8)	11 (57.9)	1 (5.3)	19 (100.0)	
Normal	19 (46.3)	17 (41.5)	5 (12.2)	41 (100.0)	
Scleritis	0 (0.0)	1 (100.0)	0 (0.0)	1 (100.0)	
Total	30 (33.7)	52 (58.4)	7 (7.9)	89 (100.0)	

ATT=anti-tuberculosis treatment, TBM=tubercular meningitis, PL+ = Preferential Looking Test

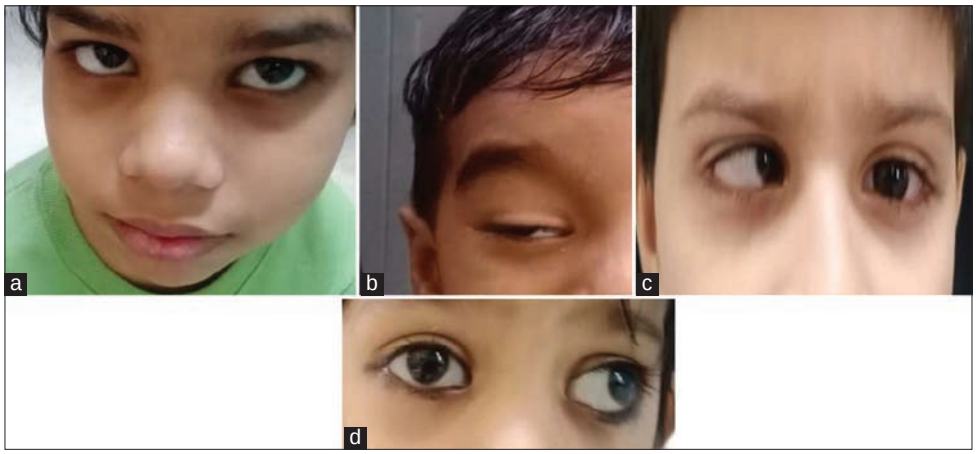


Figure 1: (a) Facial nerve paresis, (b) ptosis in third nerve palsy, (c) esotropia in lateral rectus palsy, (d) exotropia in third nerve palsy

of inflammatory scleral nodule and episcleritis.[10] Scleromalacia can be a subsequent complication from Tuberculous scleritis.[11]

In addition to treating the above cases of ocular TB with systemic steroids in case of posterior segment involvement, all the cases with ocular manifestation were started on full antitubercular therapy with isoniazid, *P* yrazinamide, and ethambutol for a minimum of 12 months in case of extrapulmonary TB. Longer regimens target not only infection and antigenic stimulus that is persistant in retarding the immunity. Treatment regimens are the same as those for pulmonary TB, but they last longer. An oral regimen consisting of H (isoniazid), Z (pyrazinamide), and E (ethambutol) for 12 months without using any injectable agent is preferred as cited by other authors in their study on pediatric sytemic tuberculosis.[12,13]

Besides noticing the ocular manifestation, we also noted the ocular side effects of these antitubercular drugs. In the current study, a 10-year-old female with choroiditis as ocular

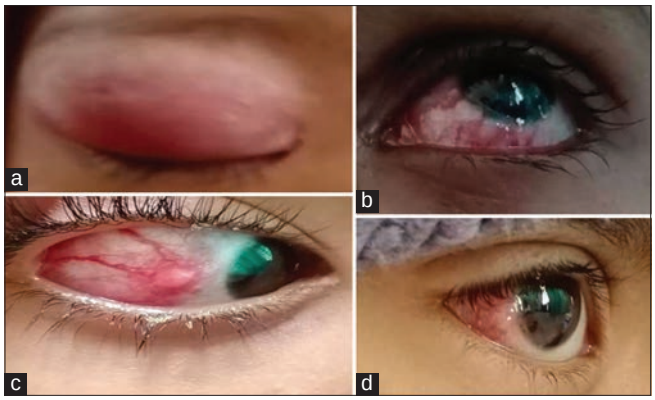


Figure 2: (a) Lid abscess, (b-d) phlycten

presentation reported visual deterioration in the absence of macular involvement, after 5 months of starting antitubercular treatment. On ocular examination, she had 6/36 and 6/12 visual acuity in the right eye (OD) and left eye (OS), respectively, and her color vision was affected for the blue color at the Ishiara chart. The child was treated as a case of ethambutol toxicity and referred to a pediatrician for ATT modification; they replaced ethambutol with linezolid. All of the 90 children on ethambutol were monitored for drug-induced optic neuritis by estimating visual acuity, color vision in the case of children above 5 years, and visual evoked perimetry in uncooperative children and children less than 5 years.

CONCLUSION

TB is one of those pandemics in the world that can affect almost every organ of the body. Newer diagnostic tools such as polymerase chain reaction along with ophthalmic features of TB aid in the diagnosis of ocular TB. Proper coordination between ophthalmologists and infectious disease specialists is essential to prevent blindness in this pediatric age group and reduce disability-adjusted life years by ensuring prompt and appropriate treatment.

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Conflicts of interest

There are no conflicts of interest.

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‘Cancer killing cannon’: The story of radiation therapy for retinoblastoma



Figure 1: Two year old Gordon Isaacs, the first patient successfully treated with external beam radiation using electron beam from linear accelerator for retinoblastoma in 1957, by Dr. Henry Kaplan, at Stanford Medical Centre. Courtesy: Stanford Medical History Center

Retinoblastoma is the first human cancer for which the cancer gene was identified and cloned.[1] In the early days, removal of the eye was the only treatment option available for retinoblastoma. However, the advent of new treatment modalities in ophthalmology, such as laser photocoagulation, cryosurgery, chemotherapy, and radiotherapy, has transformed the lives of thousands of children with retinoblastoma. Once considered a potentially lethal disease, retinoblastoma can now be effectively treated, with the possibility of vision preservation.[2,3]

A landmark event in the treatment of retinoblastoma was the use of external beam radiation for tumor regression. The image [Figure 1] shows Gordon Isaacs, a two-year-old boy who was the first patient to receive linear accelerator radiation therapy using an electron beam in 1957, administered by Dr. Robert Kaplan at Stanford Medical School. Gordon, who was seven months old when his mother, Helen Isaacs, first noticed an “abnormal glow” in his eye in 1955, was subsequently diagnosed with bilateral retinoblastoma. The available options were bilateral enucleation surgeries or an experimental procedure using radio waves. Ms. Helen opted for the latter option and consulted Dr. Henry Seymour Kaplan at Stanford Medical School, making this pioneer event in the history of ophthalmology.

Dr. Henry Kaplan was trained in general radiology at Michael Reese Hospital and completed his fellowship with Leo Rigler at the University of Minnesota. At the age of thirty, he was recruited to be professor and chairman of the Department of Radiology at Stanford University. Although his training and early work focused on general radiology, Dr. Kaplan developed an interest in cancer and radiation therapy, which he attributed to his father’s death from lung cancer. Three years after joining Stanford, he began collaborating with Ed Ginzton, who was developing a new atom smasher known as the linear accelerator. Dr. Kaplan recognized that certain characteristics of this device could make it useful in cancer therapy. With his input, the physics team built the first linear accelerator in the Western Hemisphere specifically designed for radiotherapy [Figure 2]. It was with this machine that Gordon Isaac’s left eye, which had localized retinoblastoma, was treated. Gordone had undergone enucleation of his right eye in 1957 due to advanced cancer; however, thanks to the linear

Sanitha Sathyan
Department of Ophthalmology, Vettam Eye Hospital, Mulanthuruthy, Kerala, India

Address for correspondence: Dr. Sanitha Sathyan, Vettam Eye Hospital, Mulanthuruthy, Ernakulam - 682 314, Kerala, India.
E-mail: dr.sanitha@gmail.com

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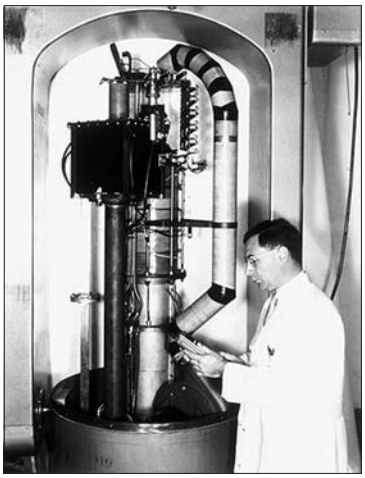


Figure 2: Dr. Henry Kaplan, with an early model of the linear accelerator developed in the 1950s. The protective hood was removed in this picture, revealing the electronic structures inside the six-million-volt machine. Courtesy: Stanford Medical History Center

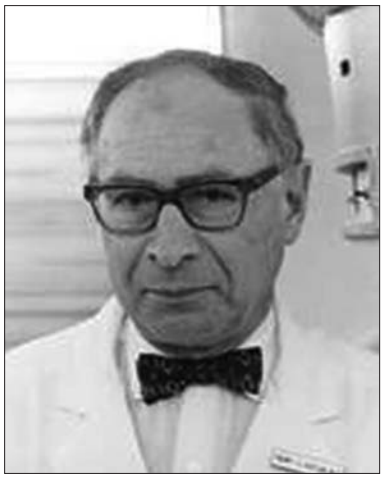


Figure 3: Dr. Henry Kaplan (1918-1984). Courtesy: Stanford Medical History Center

accelerator therapy, he survived into adulthood with his vision preserved in the left eye.

Even today, linear accelerators follow the basic design proposed by Kaplan [Figure 3] and Ginzton throughout the world, and this modality has marked a significant milestone in the history of radiotherapy, saving the lives of millions of people with bilateral retinoblastomas, Hodgkin's lymphoma, and other tumors.

Further researchers has progressively lowered the dose of radiation to the present-day range of 3500 to 4500 cGy. Researchers have also begun using better radiation sources, learned to avoid damaging the anterior segment by delivering focused radiation, and discovered that fractioning doses can achieve higher ocular salvage rates.[4–6]

More than fifty years and millions of patients later, linear accelerators have become the backbone of radiation therapy for cancer. Approximately half of all patients with cancer receive radiation therapy, primarily from the rays generated by linear accelerators.[7]

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Case Report

Sixth nerve palsy post covid treated with course of oral steroids

ABSTRACT

Severe acute respiratory syndrome corona virus (SARS-Cov 2) is known to have neuro-ophthalmological manifestations such as optic neuritis, papillophlebitis, papilledema, visual disturbance associated with posterior reversible encephalopathy syndrome, and vision loss caused by stroke, Miller Fisher syndrome, Adie's pupils, ocular myasthenia gravis, nystagmus eye movement disorders, and cranial neuropathies like third and sixth nerve palsies. Sixth nerve palsy in adults is mostly attributable to microvascular ischemia and trauma. Research suggests that SARS- COV 2 infection can result in inflammatory nerve damage due to aberrant immune response leading to neuropathy. We report a case of a 42-year-old man presenting with a unilateral abducens nerve palsy following Covid-19 infection treated with a course of steroids leading to faster recovery.

Keywords: Covid, Lateral rectus Palsy, Steroids

INTRODUCTION

Severe acute respiratory syndrome corona virus (SARS-Cov 2), a primarily respiratory virus, has affected millions of people. Numerous neuro-ophthalmological manifestations of Covid-19 have been reported, which include optic neuritis, papillophlebitis, papilledema, visual disturbance associated with posterior reversible encephalopathy syndrome, and vision loss caused by stroke, Miller Fisher syndrome, Adie's pupils, ocular myasthenia gravis, nystagmus eye movement disorders, and cranial neuropathies like third and sixth nerve palsies.[1] Sixth nerve palsy in adults is mostly attributable to microvascular ischemia and trauma. Research suggests that SARS-COV 2 infection can result in inflammatory nerve damage due to aberrant immune response leading to neuropathy.[2]

We report a case of a 42-year-old man presenting with a unilateral abducens nerve palsy following Covid-19 infection, which required a course of steroids as treatment.

CASE REPORT

A 42-year-old man presented to us with sudden onset binocular diplopia for the last 20 days. He was diagnosed with Covid 25 days back and was treated with a course of oral antibiotics and vitamin supplements.

He noticed diplopia after 5 days of being diagnosed with Covid-19 infection (RT-PCR confirmed). There was no associated history of headache, nausea, vomiting, or any neurological symptoms like weakness of limbs. He was not a known hypertensive or diabetic.

On examination, the best-corrected visual acuity was (OU) 6/6, N6. He adopted a right-face turn. The cover test revealed 25 prism diopter esotropia for distance and 15–20 prism diopter esotropia for near. Ocular motility examination revealed Grade 2 limitation of abduction in the right eye [Figure 1]. Pupillary reactions were normal in both eyes. Anterior

Divya Upendra Caculo, Sowmya Raveendra Murthy, Ann Willy, Nishant N

Department of Pediatric Ophthalmology, Adult Strabismus and Neuro-Ophthalmology, Sankara Eye Hospital, Bengaluru, Karnataka, India

Address for correspondence: Dr. Sowmya Raveendra Murthy, Sankara Eye Hospital, Main Varthur Road, Kundahalli Gate, Bengaluru, Karnataka, India.
E-mail: drsowmyamurthy@gmail.com

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Figure 1: Nine gaze photograph showing primary gaze right esotropia with limitation of abduction in the right eye

segment and fundus examination were within normal limits in both eyes.

A clinical diagnosis of right sixth nerve palsy probably secondary to Covid-19 was made. Blood investigations and magnetic resonance imaging (MRI) brain and orbits were ordered.

Blood investigations showed normal complete blood count and raised vitamin D levels, raised lactate dehydrogenase (313 U/L), raised serum glutamatic oxaloacetic transaminase (47 U/L), and a borderline rise in serum homocysteine (15.4 mmol/L) and serum ferritin. Random blood sugar was 88 mg%. MRI brain, orbit, and paranasal sinuses with contrast were within normal limits with the incidental finding of bilateral maxillary nasal polyps. Opinion from ENT surgeon was sought. Nasal endoscopy with nasal swab for KOH mount was done, and mucormycosis was ruled out.

He was started on oral steroids in the form of tablet prednisolone 60 mg in tapering doses over 6 weeks along with oral pantoprazole 40 mg, vitamin B12, and folic acid supplements.

One-month follow-up showed a marked improvement with minimal right-face turn. The cover test revealed esotropia of 3–4 PD for distance and orthophoric for near with 12 pd esotropia in right gaze. Ocular movements showed abduction limitation of Grade 1 in the right eye.

Follow-up at 2 months showed complete resolution of a face turn. Cover tests showed orthophoria for distance and near and in right gaze with normal ocular motility [Figure 2].

DISCUSSION

Sixth nerve palsy is the most common isolated cranial nerve palsy attributable to etiologies that include idiopathic, inflammation, ischemia, trauma, space-occupying lesions, and infections – bacterial and viral mainly in adults without comorbidities.[3]

Neuroophthalmological manifestations of Covid-19 are uncommon, and reported cases include those of optic neuritis, papillophlebitis, optic neuritis, Adie's syndrome and isolated abducens palsy, and palsies in relation to Miller Fisher syndrome.[1]

Proposed pathogenic mechanisms include for cranial nerve palsies include

1. Neurotropism
2. Breakdown of blood barrier permeability due to infected leukocytes inciting proinflammatory mediators
3. Direct invasion of the endothelial cells



Figure 2: Nine gaze photograph showing primary orthotropia with normal ocular movements in both eyes

4. Hematological spread by the breakdown of the blood–brain barrier[4]
5. Retrograde transmission to neuronal tissues[5]
6. Due to the raised intracranial pressure that can occur due to the hypercoagulable and proinflammatory condition due to Covid-19 infection.[6]

Occurrence of isolated sixth nerve palsy in a middle-aged adult post Covid-19 infection with no known comorbidities could be attributed as neurological manifestation of Covid-19.[7,8] Here, we report a case of isolated abducens palsy, with sudden onset diplopia, 5 days after Covid-19 infection.

Considering the cause to be an immune-related nerve injury, we started the patient on corticosteroids. The majority of the studies claim it to be self-resolving condition, but in a case study by Zhang *et al*.,[9] two pediatric patients with bilateral abducens palsy were treated with immunomodulators demonstrating slight improvement in symptoms at 5–6 weeks with complete recovery in 12–14 weeks, the average recovery time being 3.6 months.[10]

In our report, the patient showed marked improvement in 4 weeks.

Treatment of neurological manifestations with Covid is usually after ruling out other infectious causes for the same. Symptomatic treatment is recommended, owing to possible inflammatory cause; trial of steroids with monitoring for opportunistic infections and deranged blood sugars has been reported as a possible modality of treatment.[7]

Since Covid-19 is a novel disease, literature regarding ophthalmic manifestations of Covid-19 is still evolving; hence, evaluating each and every clinical finding in a Covid-19/post Covid-19 patient is important.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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Case Report

Immunoglobulin G4-related disease of the ocular adnexa – A case report

ABSTRACT

Immunoglobulin G4-related disease of the ocular adnexa is a systemic fibroinflammatory process of unknown etiology characterized by tissue infiltration by Immunoglobulin G4 plasma cells. In this case report, we present a case of Immunoglobulin G4-related disease involving extraocular muscles and lacrimal gland in a young female with initial and follow-up magnetic resonance imaging findings.

Keywords: Immunoglobulin G4-related disease (IgG-4RD), immunoglobulin G4-related ophthalmic disease (IgG4-ROD), magnetic resonance imaging (MRI)

INTRODUCTION

Immunoglobulin G4-related disease (IgG4-RD) is an inflammatory disorder of unknown etiology that comprises a wide spectrum of presentation, involving nearly all the body systems. Presence of one or more ophthalmic features along with the distinct histopathological appearance is termed as Immunoglobulin G4-related ophthalmic disease (IgG4-ROD). Lacrimal gland is the most common site of involvement followed by extraocular muscles (EOMs). Other less common sites of ophthalmic manifestation include nerves, vitreo-retina, uvea, cornea, sclera, and conjunctiva. In this case report, we present magnetic resonance imaging (MRI) findings at initial presentation and follow-up on treatment in a 20-year-old female in a case of IgG4-ROD.

CASE REPORT

A 20-year-old female, not a known case of major illness presented to ophthalmology outpatient department with gradual onset painless bulging in right eye since 2 months. She was not a known case of hyperthyroidism. On examination, there was proptosis in right eye. Visual acquity in left eye was 6/6 and in right eye was 6/9. No conjunctival chemosis was seen. There was restricted eye mobility in all directions in right eye. Swelling was also noted along supero-lateral margin of right orbit suggestive of right lacrimal gland enlargement. Fundoscopy was within normal limit without disc edema or pallor. Rest of routine blood investigation, thyroid function test, liver function test, renal function test, erythrocyte sedimentation rate, and C-reactive protein were within a normal limit.

MRI of orbit revealed diffuse enlargement of right-sided EOMs with involvement of tendinous insertion. These were hyperintense on STIR, T2W images without associated adjacent fat inflammation in intraconal and extraconal fat space [Figures 1-3]. Moderate homogeneous enhancement was noted on postcontrast T1W images. Subtle restricted diffusion was noted in involved muscles on diffusion weighted images. Also noted was mild enlargement and

Rahul S. Ranjan[1], Namrata[2], Pallavi Prasad[3], Anil K. Singh[4]

Departments of [1]Radiodiagnosis, [2]Ophthalmology, Rama Medical College, Mandhana, Kanpur, [3]Department of Pathology, [4]Department of Radiodiagnosis, SGPGIMS, Lucknow, Uttar Pradesh, India

Address for correspondence: Dr. Rahul S. Ranjan, Department of Radiodiagnosis, Rama Medical College, Mandhana, Kanpur -209 217, Uttar Pradesh, India.
E-mail: rahulranjanradio10@gmail.com

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homogeneous enhancement of bilateral lacrimal gland with STIR hyperintense signal and mild restricted diffusion. MRI brain was within a normal limit.

Based on these findings, differential of low grade benign lymphoproliferative disorder versus IgG4 disease of ocular adnexal tissue was made. Thyroid ophthalmopathy was ruled out due to unilateral involvement, involvement of tendinous insertion, and normal thyroid function test. Possibility of orbital pseudo tumor was ruled out in view of absence of inflammatory changes. Patient underwent biopsy and histopathology of lacrimal gland. It revealed lacrimal gland ducts and acini infiltrated by dense lymphoplasmacytic inflammation forming several reactive lymphoid follicles with prominent germinal center. Moderate amount of periductal fibrosis was seen. Typical storiform fibrosis or obliterative phlebitis was not noted. On immunohistochemistry, IgG4 positive cells to plasma cell ratio were 40%-45% with maximum of 50-60 IgG4 positive plasma cells per high power field [Figure 4]. Based on these findings, possibility of IgG4-related disease of ocular adnexa was made.

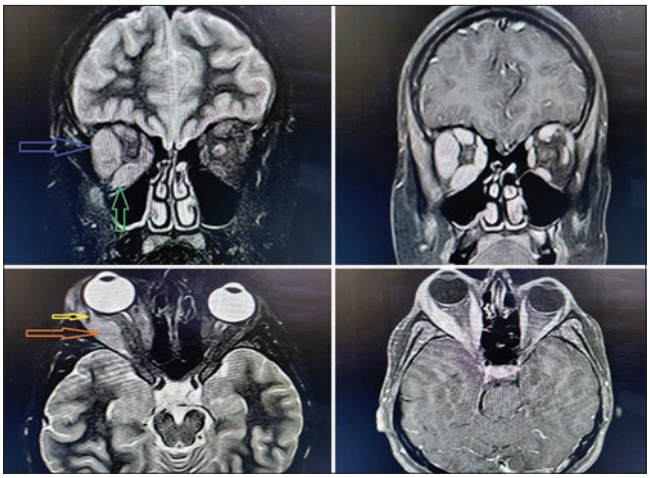


Figure 1: Axial and coronal STIR and post contrast T1W images showing bulky extraocular muscles on right side with STIR hyperintense signal with mild to moderate homogeneous enhancement on postcontrast T1W images. There is predominant involvement of lateral rectus and inferior rectus muscles involving muscle belly (Red Arrow) and tendinous insertion (Yellow Arrow)

Patient was started on high-dose steroid therapy with gradual tapering. At 2 months of follow-up, there was a significant resolution of enlargement of EOMs and lacrimal gland [Figure 5].

DISCUSSION

IgG4–RD is a systemic inflammatory process of unknown etiology, characterized by tissue infiltration by IgG4 plasma cells and sclerosing inflammation. Although initially described in association with autoimmune pancreatitis, manifestation for IgG4-RD now reported in nearly every organ system.[1,2]

Ophthalmic manifestation of IgG4-RD can be orbital and adnexal, corneoscleral, uveal, retinal, or neural.[3] Orbital and adnexal IgG4-ROD involve lacrimal gland and EOMs. Lacrimal gland involvement presents as painless, bilateral (more commonly), or unilateral dacryo adenitis. This may or may not be associated with adjacent bony remodeling. Enlargement of orbital nerves, most commonly infraorbital

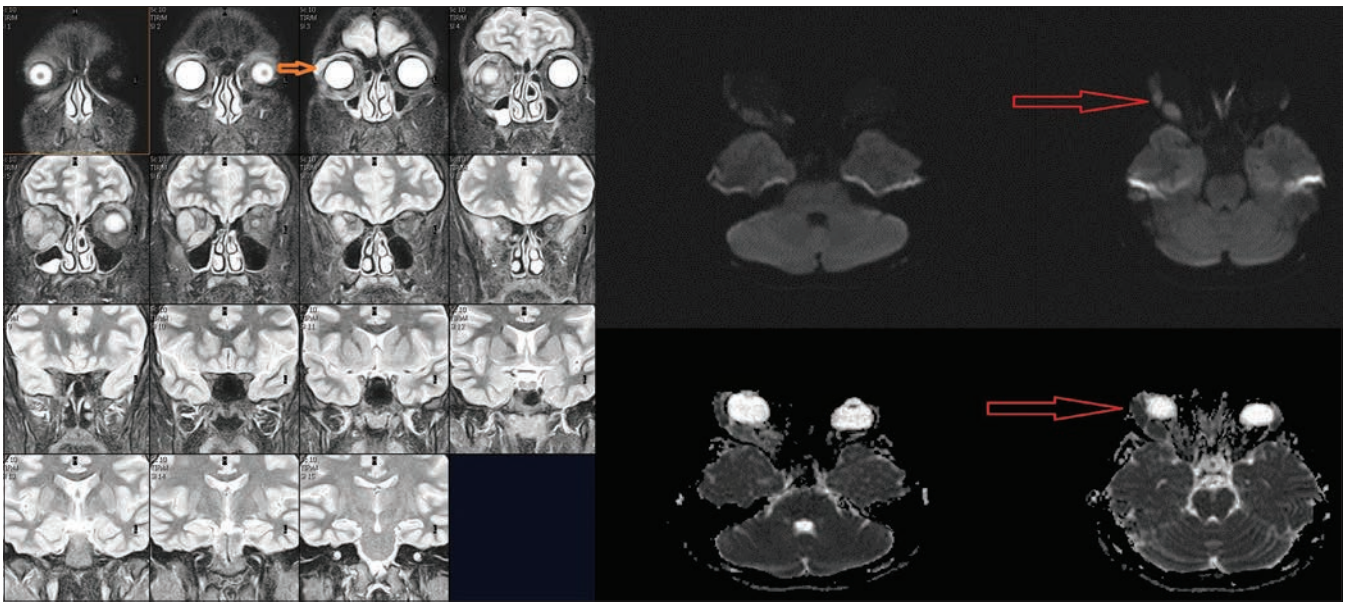


Figure 2: Coronal STIR image showing bulky and hyperintense right lacrimal gland (Red Arrow). Also noted are bulky right-sided extraocular muscles predominantly involving right lateral and inferior rectus muscle. Restricted diffusion noted within the right lacrimal gland and lateral rectus muscle (Red Arrow)

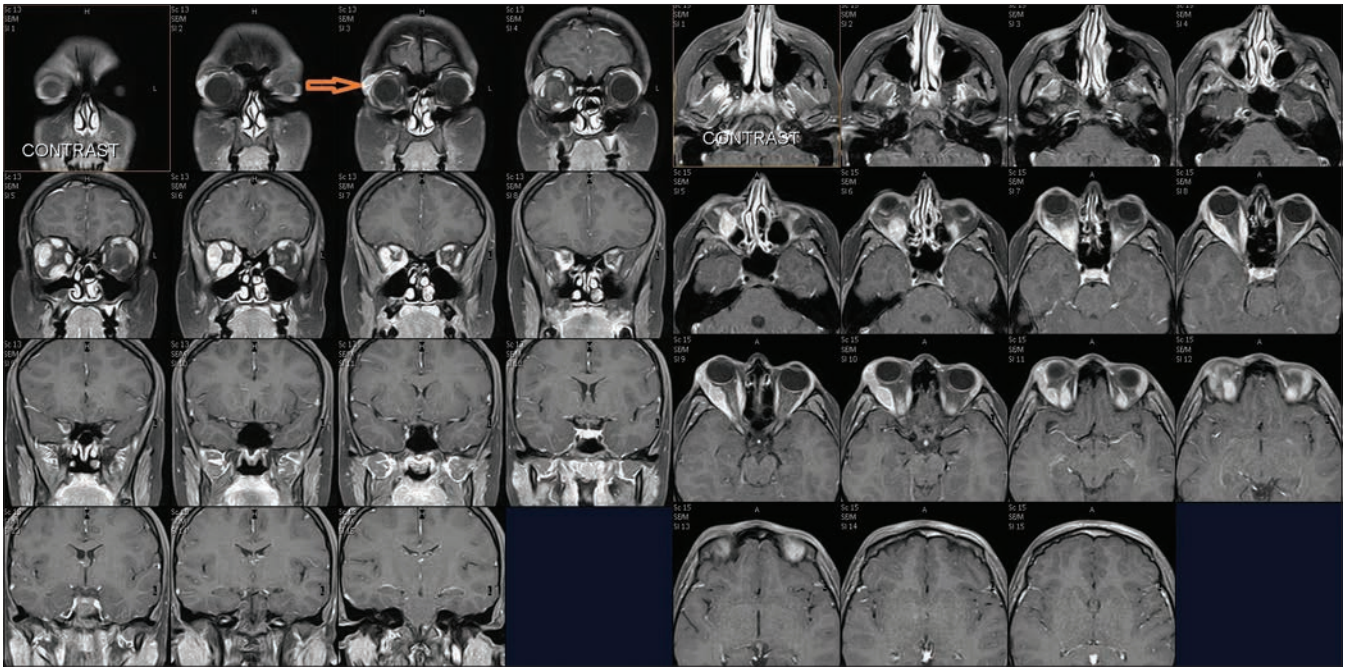


Figure 3: Postcontrast axial and coronal T1W images showing bulky right lacrimal gland showing mild to moderate homogeneous enhancement (Red Arrow)

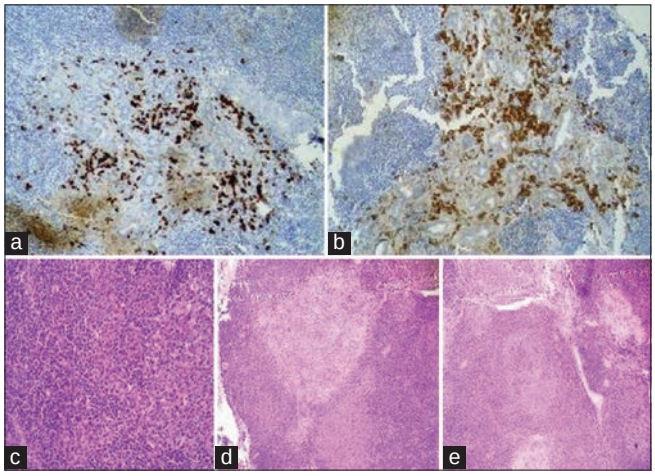


Figure 4: (a-e): (a) The IgG4 staining plasma cells are highlighted by IgG4 (immunohistochemistry × 100. (b) The plasma cells are highlighted by CD138 (immunohistochemistry × 100). (c) Photomicrograph showing lacrimal ducts and glands infiltrated by dense lymphoplasmacytic infiltrate forming reactive lymphoid follicles with prominent germinal centres (H&E stain × 100) . (d) Section showing moderate amount of periductal fibrosis (H&E stain × 200). (e) Higher magnification showing sheets of plasma cells (H&E stain × 400)

nerves followed by frontal nerve are highly suggestive of IgG4-ROD, especially when bilateral. This may or may not be associated with adjacent bony remodeling. Histological perineurium is the primary site of involvement accompanied by absence of fibrosis.

Computed tomography and magnetic resonance imaging findings of lacrimal gland lesions are nonspecific. The lesions show intermediate soft tissue attenuation on computed tomography scan and low signal intensity on T1W images with homogeneous enhancement.[4-6]

The involvement of EOM present as proptosis and ophthalmoplegia. The involved muscles appear isointense on T1W and hyperintense on T2W images with mild restricted diffusion and show homogeneous enhancement on a postcontrast study.[7,8] The imaging findings are nonspecific and nondistinguishable from close differential diagnosis of thyroid eye disease (Graves' disease) and orbital myositis. But it is the pattern of the involvement of EOM that helps in differentiating them.

In Graves' disease, inferior rectus is the earliest and commonest muscles involved followed by medial rectus, superior rectus, and lateral rectus is last to get involved. In contrast, in IgG4-ROD, lateral and inferior rectus is the first, commonest, and most enlarged muscle. One more distinguishing feature is that thyroid eye disease commonly involved muscle belly and spares tendinous insertion, whereas IgG4-ROD equally involves both muscle belly and tendinous insertion.[9-11]

Rarely involvement of orbital fat and bone has been reported with disease in these cases mimicking orbital inflammatory pseudo tumor and orbital lymphomas. However, orbital tumor-like conditions like idiopathic orbital inflammatory syndrome (inflammatory pseudo tumor) and lymphoid hyperplasia are now considered to be part of IgG4-related disease spectrum.

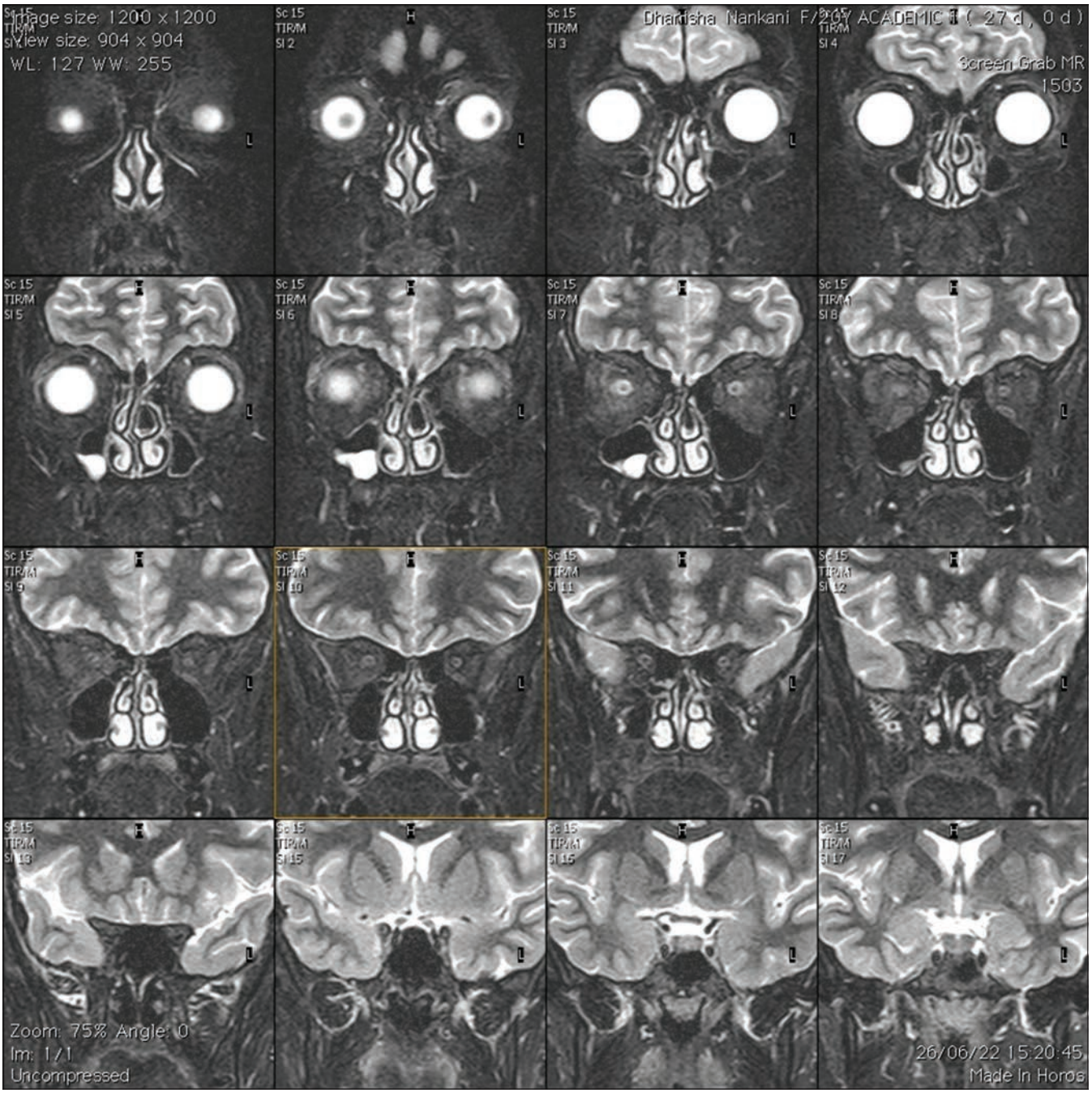


Figure 5: STIR coronal image showing resolution of enlargement of extraocular muscles on right side at follow-up

CONCLUSION

IgG4-ROD should be suspected in cases of proptosis or periorbital swelling with EOM and lacrimal gland enlargement particularly when lateral rectus is predominantly affected.

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the legal guardian has given his consent for images and other clinical information to be reported in the journal. The guardian understands that names and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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Case Report

A rare complication in management of traumatic optic neuropathy

ABSTRACT

Traumatic head injury can cause inappropriately increased Antidiuretic hormone (ADH) secretion, causing water retention and thereby dilutional hyponatremia. Corticosteroids despite controversies, form an important line in the management of traumatic optic neuropathy (TON). Treatment with steroids in patients with undiagnosed Syndrome of Inappropriate ADH Secretion (SIADH) can cause life-threatening hyponatremias. The patient diagnosed with right eye TON was treated with systemic steroids. She developed fatigability, vomiting, and pedal edema. Electrolyte profile and urinary sodium showed hyponatremia and natriuresis following which SIADH was diagnosed. Steroids were stopped; the Patient was started on hypertonic saline, a salt-restricted diet, and Tolvapatan after which sodium levels normalized. Electrolyte workup has a major role in TON management with steroids.

Keywords: Hyponatremia, methylprednisolone, syndrome of inappropriate antidiuretic hormone, traumatic optic neuropathy

INTRODUCTION

Traumatic optic neuritis (TON) is a major complication of a head injury causing visual deprivation. Several controversies surround the proposed treatments for TON. International Optic Nerve Trauma Study (IONTS), showed no significant difference in final visual acuity among the groups treated with surgical decompression, corticosteroid treatment, or simple observation.[1] Surgical techniques for optic canal decompression have no randomization results and are related to potential complications like postoperative CSF leak, infections, and dural exposure.[2] The Corticosteroid Randomization After Significant Head Injury (CRASH) Study, found an increased risk of death within fourteen days in patients with traumatic brain injury (TBI) who were randomized to receive high-dose steroids.[3] National Acute Spinal Cord Injury Study (NASCIS) suggests that steroid treatment initiated more than eight hours after initial injury was associated with significantly poorer neurologic outcomes than placebo.[4] In spite of these side effects, in clinical practice, steroids form a line of management, Sivakumar *et al*.[5] a retrospective study found Optic Neuritis Treatment Trial (ONTT) regimen of IV Methylprednisolone one gram/day for three days followed by oral steroids one milligram/kilogram for two weeks is safe and effective in the management of TON, provided the patient presents within three days of onset of defective vision and presenting visual acuity is better than 6/60 and no major adverse effects encountered with this regimen leading on to interruption of treatment, unlike mega dose steroids. Here we are reporting a rare side effect of the Syndrome of Inappropriate ADH Secretion with steroid treatment in traumatic head injury. A high index of suspicion and appropriate diagnostic workup is required to diagnose traumatic SIADH, which is essential as steroid treatment for these patients can cause life-threatening hyponatremia.

Sushad Prasad, Priya Sivakumar[1]

Department of Ophthalmology, Aravind Eye Hospital, Puducherry, [1]Department of Neuro-Ophthalmology and Low Vision Services, Aravind Eye Care, Puducherry, India

Address for correspondence: Dr. Sushad Prasad, Department of Ophthalmology, Aravind Eye Hospital, Puducherry - 605 007, India.
E-mail: sushad93@gmail.com

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CASE REPORT

A twenty-eight-year-old female presented to our clinic with complaints of a diminution of vision in the right eye for three days. She gives a history of falls following which sustained a lacerated wound on the left forehead which was sutured by the Emergency department of General Hospital. The patient was diagnosed to have right eye traumatic optic neuropathy and was started on intravenous methylprednisolone one gram for three days and referred to our hospital for ophthalmological evaluation and further management. On examination, her best corrected visual acuity (BCVA) was 6/24 in the right eye and 6/6 in the left eye. Central fields and color vision were defective in the right and normal in the left eye. Slit lamp examination showed a normal anterior segment of both eyes except grade three relative afferent pupillary defect in the right eye. Fundus examination was normal in both eyes. No history of loss of consciousness, vomiting, or ear, nose, or throat bleeds. CT and MRI imaging of the brain with orbits was done which was normal. The patient was started with Tab. Prednisolone one milligram/kilogram and tapered over three weeks. After a week of initiation of oral steroids, she developed fatigability along with multiple episodes of vomiting and pedal edema. She was investigated for an electrolyte panel, and showed moderate hyponatremia. Aroused with suspicion of SIADH, urinary sodium level was investigated revealing natriuresis. She was immediately referred for physician attention, put on treatment with hypertonic saline along with salt-restricted diet, followed by Tab. Tolvapatan 60 mg/day was titrated to 15 mg/day based on the improvement in blood sodium levels. Oral steroids were stopped along with the treatment, symptoms were relived after two weeks and sodium levels normalized.

DISCUSSION

An antidiuretic hormone secreted by the posterior pituitary is involved in the maintenance of blood osmolarity and volume, if osmolarity is 290 mOsm/Kg relatively linear rise in ADH secretion. An acute drop in blood pressure sensed by "volume receptors" causes ADH to release causing free water absorption from the kidneys. Acute hyponatremia due to SIADH causes a headache, lethargy, obtundation, and eventually, seizures, coma, and respiratory arrest can occur below 115 to 120 mEq/L. Hyponatremia in SIADH is associated with natriuresis. Though salt restriction, and isotonic saline infusion is recommended treatment for mild and moderate cases, for severe hyponatremias, hypertonic saline, and tolvaptan with or without mineralocorticoids form the mainstay. Misdiagnosing the cause of hyponatremia following head trauma as anterior pituitary insufficiency and treating with steroids or treatment of optic neuropathies associated with hidden traumatic SIADH leads to fatal hyponatremias. The Schwartz and Bartter Clinical Criterion for SIADH includes serum sodium less than135mEq/L, serum osmolality less than 275 mOsm/kg, urine sodium greater than 40 mEq/L, urine osmolality greater than 100 mOsm/kg and the absence of clinical evidence of volume depletion along with the exclusion of other causes of hyponatremia and its correction by fluid restriction.[6,7] Our literature search cautioned the risk of the development of hypothalami-hypophyseal dysfunction leading to post-traumatic diabetes insipidus or SIADH following brain injury which constitutes the most challenging sequelae.[8] Injury to the hypothalamus, posterior pituitary, or stalk transactions can occur. Imaging may show hemorrhage, infarction, increased gland volume, stalk transection- ectopic bright spot, pituitary stalk hematoma, or loss of the bright signal intensity of the pituitary. Sometimes, CT/MRI fails to demonstrate any abnormal finding if occurred due to hypoxic damage or diffuse axonal injury. The neurological signs of hyponatremia should be differentiated from other causes of altered neurological status. If SIADH is left undiagnosed, profound hyponatremia leads to cerebral edema.[9,10] Decision to treat traumatic optic neuropathy with corticosteroids should always be weighed against the risk of fatal hyponatremia.

CONCLUSION

TON can present with underlying hyponatremia due to traumatic brain injury. Steroids in this setting can be fatal. Electrolyte workup plays an important role in TON management particularly when steroids are given to head injury patients.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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Case Report

Oculocardiac reflex during DCR surgery-An unusual presentation

ABSTRACT

Oculocardiac reflex (OCR) is a physiological response of the heart to physical stimulation of the eye or ocular adnexa. It is defined by the appearance of bradycardic arrhythmia during ocular surgery. It is defined as decrease in heart rate from baseline values by atleast 10% to 20%. We report an unusual presentation of oculocardiac reflex during DCR surgery in a 65-year-old female while suturing the muscle layer and which gets resolved as soon as the sutures are removed. OCR during DCR surgery has been rarely reported in the literature and here we present one such case.

Keywords: Bradycardia, DCR surgery, OCR

INTRODUCTION

Oculocardiac reflex (OCR) is a physiological response of the heart to physical stimulation of the eye or ocular adnexa. It is defined by the appearance of bradycardic arrhythmia during ocular surgery.[1] It is defined as decrease in heart rate from baseline values by atleast 10% to 20%.[2-4] Exaggerated OCR may be life threatening. Based on the various published definitions, prevalence of OCR ranges from 14% to 90%.[5] Manipulation of the eye or extraocular muscles during ocular surgery may produce an OCR by stimulating trigeminal nerve branches afferently and by activating the vagus nerve efferently, causing bradycardia or dysrhythmia.[1,6] In addition to DCR surgery, OCR may be encountered during strabismus surgery, phacoemulsification cataract surgery,[7] laser *in situ* keratomileusis surgery,[8] orbital surgery,[9] and craniomaxillofacial surgery. OCR may also lead to asystole. Important complications in DCR or squint surgery are OCR and postoperative nausea and vomiting (PONV), and their management requires special attention. The possible association between OCR and DCR surgery has rarely been reported.

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CASE REPORT

A 65-year-old female presented to an ophthalmology department of HIMS, Barabanki with a complaint of watering and diminution of vision in both the eyes. On examination, her vitals were within normal limit, vision test in both the eyes is finger count 1 feet and detailed slit lamp examination revealed cataract in both the eyes. For watering complaint, we did the syringing of the patient which revealed regurgitation of fluid from opposite punctum on right side and we counseled and planned the patient for right side Dacryocystorhinostomy (DCR) surgery first for which she agreed.

INVESTIGATIONS

The patient was sent for investigations like ECG before the operation which was normal. Other blood investigations (CBC, RBS, viral markers) were in normal range.

Bharat Mittal, Arun Kumar Singh

Department of Ophthalmology, Hind Institute of Medical Sciences, Barabanki, Uttar Pradesh, India

Address for correspondence: Dr. Bharat Mittal, R.No. 223, Kaveri Resident Hostel, Hind Institute of Medical Sciences, Barabanki- 225 003, Uttar Pradesh, India.
E-mail: drbharatmittal93@gmail.com

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SURGERY

Nasal Packing: Few drops of 4% topical lignocaine instilled first in the ipsilateral nostril, then nasal pack inserted in the ipsilateral nostril with the help of nasal packing forceps in the direction of medial palpebral ligament (MPL), insinuated and negotiated as deep as possible.

Local anaesthesia: Done with lignocaine-adrenaline. The preferred site of infiltration is upper inner angle of orbit just medial to medial canthus, where the MPL is situated. At the MPL insertion, the bone is hit with the 26-gauge needle and 2–3 cc injected, then the bevel of the 26-number needle rotated superiorly and 2–3 cc injected and then rotated inferiorly while injecting the remaining 2–3 cc.

Surgical steps: A J-shaped groove was created with back-end of Bard parker (BP) handle medial to the medial canthus. In the groove, created by firm pressure, J-shaped curvilinear incision is taken (skin deep and not bone thick) 3–4 mm from medial canthus.

MPL insertion was reached by blunt dissection of orbicularis fibers with artery forceps in the region of MPL (medial to medial canthus). Lacrimal sac was retracted with periosteum elevator. Periosteum was elevated posteriorly till the lamina papyracea. With a bone punch, the lamina was punctured breaking it outwards and removing the pieces with forceps. The upper punctum was dilated with punctum dilator. Inflate the sac with viscoelastic in a 2-cc syringe with a 26 number cannula. Long vertical top to bottom incision was taken with an 11 number blade and spring scissors on the medial sac wall to create larger anterior and smaller posterior flaps. Vertical long top to bottom incision with an 11 number blade should be made on nasal mucosa such that the posterior flaps can appose well and anterior flap is large. Posterior flaps were sutured so that the posterior sac flap does not block common canalicular ostium in sac. Anterior nasal flap was now opened with an 11 number blade and sutured to the anterior sac flap with minimum two 6-0 vicryls sutures. Orbicularis closure stitches were taken. Skin closure achieved with either interrupted or continuous sub-cuticular sutures. Before closures, conjunctival sac was irrigated to remove any bone pieces.

UNUSUAL PRESENTATION

While suturing orbicularis muscle layer, the patient went into apnea and bradycardia. Patient was stimulated within one minute and airway was secured. Atropine, dopamine, and adrelaine were given immediately. Sutures were removed following which bradycardia improved and ADR infusion followed by isoprenaline infusion was given and patient shifted to ICU.

DISCUSSION

This case demonstrates an oculocardiac reflex during DCR surgery due to orbicularis muscle suturing. The patient underwent bradycardia that appeared vagally mediated on EKG. In addition, the bradycardia resolved with a removal of sutures from the muscle.

In the early 20th century, Aschner found that bradycardia occurred in the setting of ocular and orbital manipulations. Since then, OCR has been a major concern as a cause of death during ocular surgery. The higher tonicity of the vagus nerve may be one explanation for the higher chance of this reflex in patients. In other words, the probability of OCR is reduced with age because of central nervous system maturation. In the literature, controversy surrounds the relation between OCR and type of ocular surgeries. In some published studies, a strong relationship has been reported between the operated muscle and the occurrence of OCR, while in some others it has not.

The majority of the incidences of OCR responded to cessation of operative manipulation. Treatment with atropine was only given to patients who had persistent OCR.

Because of the possibility of catastrophic consequences of OCR such as cardiac arrest, this matter requires special attention.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

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Case Series

Usefulness of spectral domain optical coherence tomography in assessing the clinical course of idiopathic intracranial hypertension: A case series

ABSTRACT

To assess the clinical corelation of optical coherence tomography and the clinical course of idiopathic intracranial hypertension with a case series of 4 patients diagnosed with IIH and presented to a tertiary eye care centre over a 1 year period (2020-2021). Ethics committee approval taken on 12th Oct 2020. A detailed history and complete ophthalmic examination including best corrected visual acuity (BCVA), color vision, pupils, dilated fundus examination, visual fields, and OCT were done on all visits. OCT PP RNFL thickness was found to correlate with an increase and decrease in disk edema; however, in the presence of optic atrophy, mGCL was found to be a better predictor of ongoing axonal damage. A valid relationship was found between the patient's clinical course, visual field changes as well as the RNFL and GCL parameters in OCT. Serial OCTs have a useful role in predicting the course and prognosis of the disease and can aid in altering treatment modalities.

Keywords: Idiopathic intracranial hypertension (IIH), Intracranial pressure (ICP), Macular ganglion cell layer (mGCL), Optic nerve head (ONH), Peripapillary retinal nerve fiber layer (PP RNFL), Spectral domain optical coherence tomography (SD-OCT)

INTRODUCTION

Idiopathic intracranial hypertension (IIH), or pseudotumor cerebri, formerly called benign intracranial hypertension, is a challenging condition with raised intracranial pressure (ICP) in the absence of an identifiable cause.[1] In most patients, IIH manifests with severe headache, visual disturbances, and bilateral papilledema.[2-5] Visual loss can occur anytime along the course of the disease but is often insidious and as central vision is spared until late in the course of the illness and the visual loss is often asymptomatic until profound. Fulminant IIH is a subtype of IIH that results in severe, rapidly progressive vision loss within a month of its onset and requires prompt diagnosis and treatment to prevent permanent vision loss.[1] It is often the ophthalmologist, who diagnoses the condition, and reviews the patient in conjunction with the neurologist, who in turn relies on the reduction of papilledema in deciding the further course of treatment. Often the diagnosis is delayed as the general knowledge of IIH is limited, and doctors from multiple specialties are consulted. Optical coherence tomography (OCT) is a non-invasive, non-contact transpupillary imaging technology providing high-resolution, cross-sectional images of ocular and biological structures to visualize and measure anatomic layers of the retina. It is a useful investigation to diagnose and monitor cases of

Vrinda Viswanath, Neena R

Department of Paediatric Ophthalmology, Strabismus and Neuro-Ophthalmology, Giridhar Eye Institute, Kadavanthara, Kochi, Kerala, India

Address for correspondence: Dr. Vrinda Viswanath, Giridhar Eye Institute, Kadavanthara, Kochi - 682 020, Kerala, India.
E-mail: vijayamandiram123@gmail.com

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papilledema.[6] RNFL thickness is an important parameter in OCT for the detection and monitoring of papilledema and is a non-invasive tool compared to lumbar puncture.[7] RNFL thickness increases in patients with IIH which is attributed to axoplasmic flow stasis and has been noted to reduce with time with the help of anti-edema measures. A reduction in peripapillary RNFL thickness can cause a diagnostic dilemma as it can be a result of the improvement in papilledema *per se* or due to worsening axonal loss from disease progression. Here comes the role of macular GCL thickness in OCT. Preserved GCL with reduced peripapillary RNFL offers reassurance that the optic nerve is not losing axons at an abnormal rate.[8]

Herein we report four cases who were diagnosed with IIH according to modified Dandy's criteria who presented to us with variable clinical course and how serial OCTs helped in assessing the clinical course and modifying the treatment modalities.

CASE SERIES

Case 1

Thirty-five-year-old lady was presented with the headache of 4 months duration. BCVA was 6/6, N6 in both eyes (BE). She was diagnosed to have IIH from elsewhere and was on oral acetazolamide 250 milligram (mg) twice daily for the last one month.

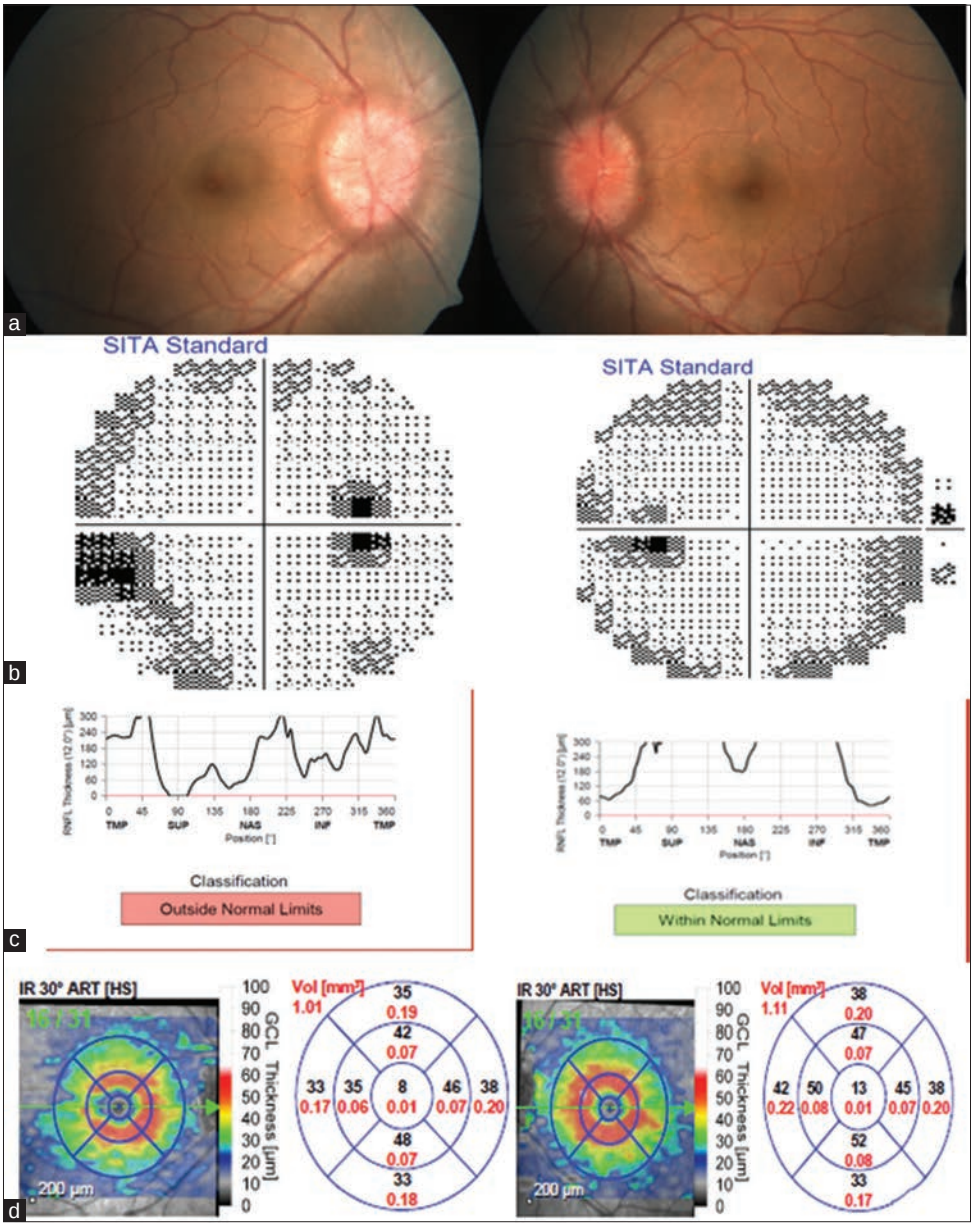


Figure 1: (a) Fundus picture showing bilateral papilledema (b) Visual fields showing peripheral constriction with enlarged blind spot in both eyes (c) Optical coherence tomography showing increased RNFL thickness in both eyes (d) Optical coherence tomography showing preserved macular GCL in both eyes

Fundus examination showed bilateral papilledema [Figure 1a]. Visual fields showed peripheral constriction with enlarged blind spot BE [Figure 1b]. OCT showed increased RNFL thickness in BE [Figure 1c] with preservation of macular GCL [Figure 1d]. The dose of oral Acetazolamide 250mg was hiked to thrice daily in view of persistent papilledema.

On her follow-up after 3 months, there was a significant reduction in headache and resolution of papilledema [Figure 2a]. Visual fields showed clearing peripheral defects in both eyes [Figure 2b]. OCT findings of reduced RNFL thickness [Figure 2c] in BE and preserved macular GCL [Figure 2d] in BE correlated well with her clinical improvement.

Case 2

Twenty-five-year-old lady with headache and blurry vision (left > right) was presented. Patient was diagnosed with IIH and was on oral Acetazolamide 250 mg 4 times daily since last six months. Her BCVA was 6/6, N6 right eye (RE), and 6/9, N6 left eye (LE).

Clinical examination showed asymmetric papilledema [Figure 3a]. LE showed enlarged blind spot with central scotoma in visual field evaluation [Figure 3b]. There was increased RNFL thickening [Figure 3c] with macular GCL thinning [Figure 3d] in OCT in the LE. On her review after three weeks, she had worsening symptoms. Visual acuity was the status quo.

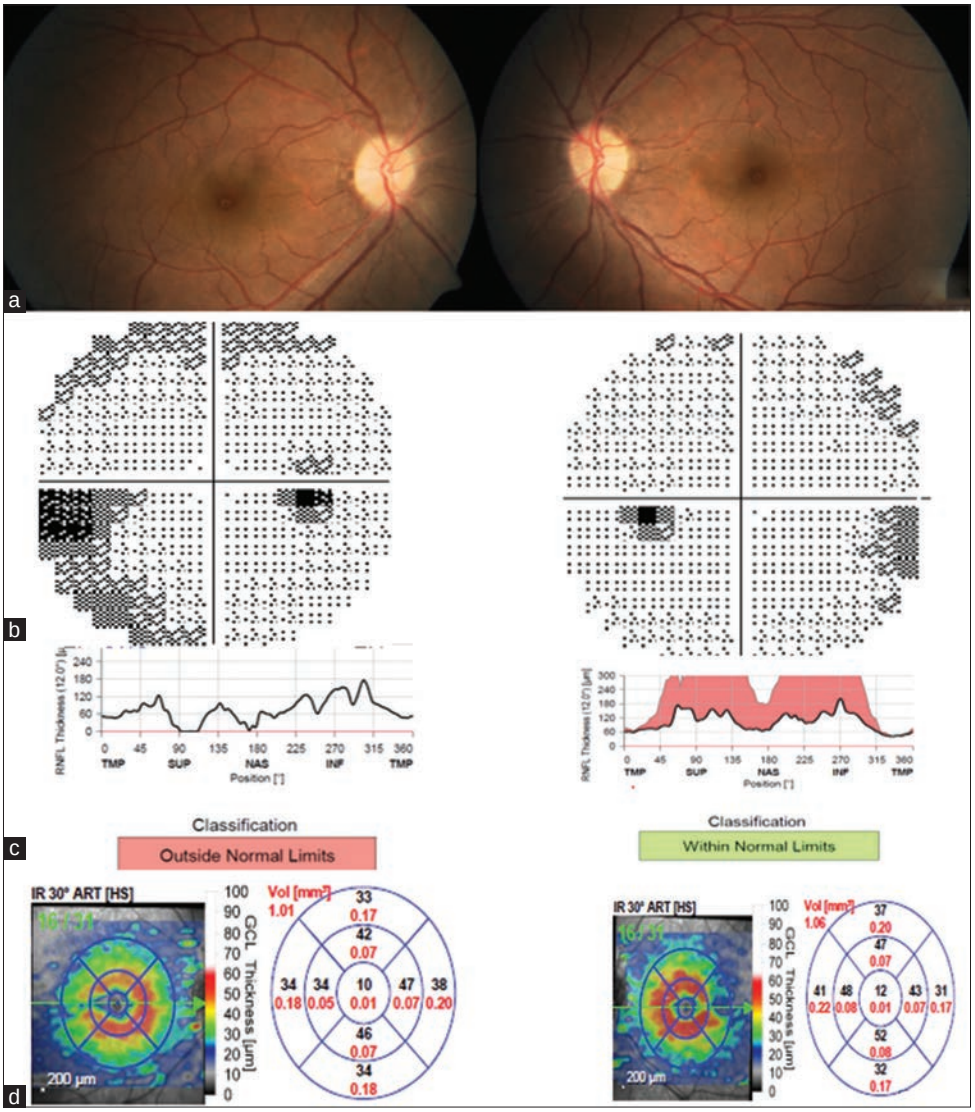


Figure 2: (a) Fundus picture showing resolved papilledema (b) Visual fields showing resolving peripheral defects in both eyes (c) Optical coherence tomography showing reduced RNFL thickness in both eyes compared to initial visit (d) Optical coherence tomography showing preserved macular GCL in both eyes

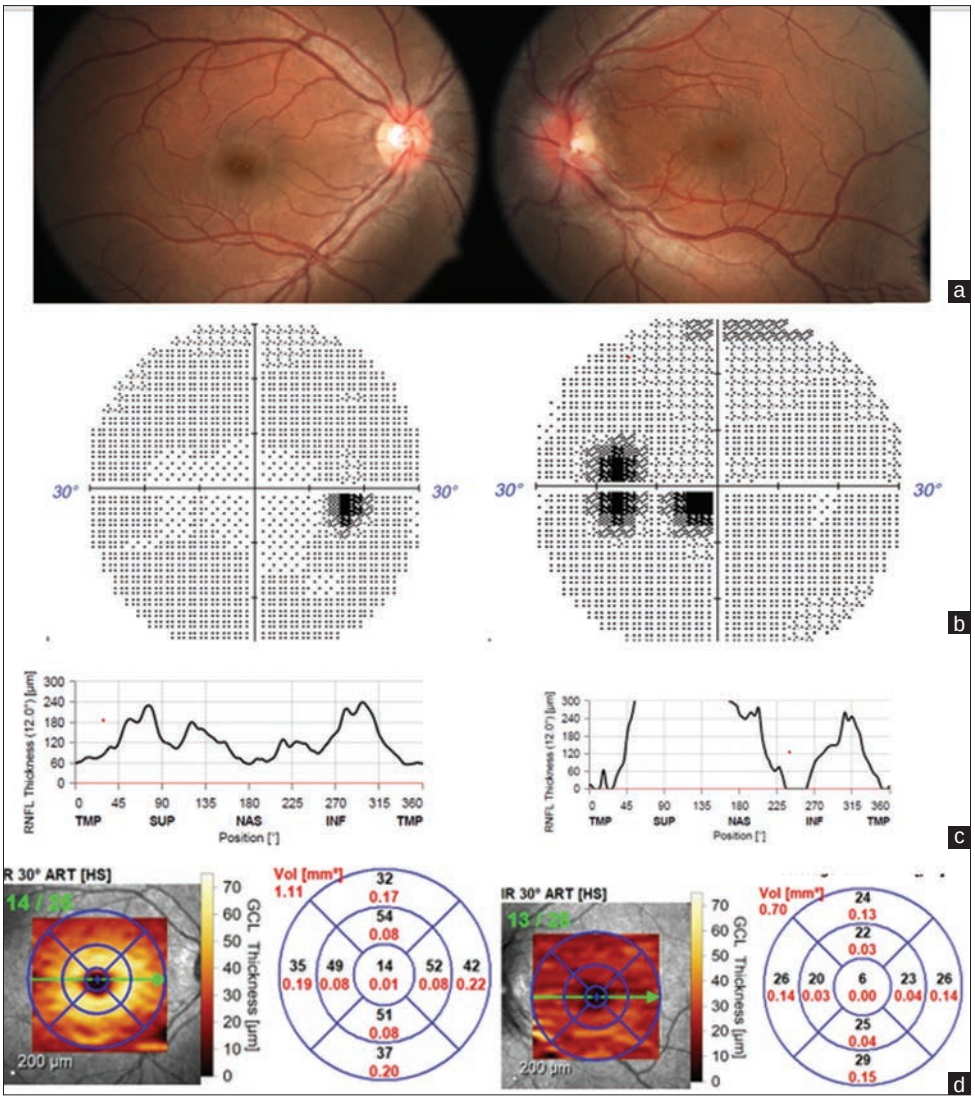


Figure 3: (a) Fundus picture showing asymmetric papilledema (left>right) (b) Visual fields showing normal field right eye and enlarged blind spot with central scotoma left eye (c) Optical coherence tomography showing increased RNFL thickness (left>right). (d) Optical coherence tomography showing macular GCL thinning in the left eye

On follow-up after 1 month, papilledema [Figure 4a] and central scotoma in the left eye [Figure 4b] were found to be persisting. OCT revealed increased RNFL thickening [Figure 4c] in the LE with progressive thinning of GCL [Figure 4d]. Patient was referred for Optic Nerve Sheath Fenestration left eye in view of fulminant IIH.

Case 3

Thirty-year-old lady, diagnosed with IIH, with complaints of headache who was on oral Acetazolamide 250 mg three times daily has been advised from elsewhere to undergo a shunt procedure in view of non-resolving papilledema. On examination her best corrected visual acuity was 6/6, N6.

Fundus examination did not reveal any papilledema [Figure 5a]. Visual fields were also normal [Figure 5b]. OCT RNFL [Figure 5c] and macular GCL [Figure 5d] were also within normal limits. The patient was asked to taper the dose of Acetazolamide 250 mg BD, and surgery was deferred.

On review after 3 months, fundus examination revealed no papilledema [Figure 6a]. There were no field defects [Figure 6b] and OCT-RNFL [Figure 6c], and macular GCL [Figure 6d] were also normal. Patient was continued on medical therapy.

Case 4

Twenty-nine-year-old doctor, known case of fulminant IIH, status post theco-peritoneal shunt came with c/o transient blurring of vision and persistent headache. On examination, her best corrected visual acuity in the right eye was 6/6, N6 and left eye was 6/9, N6 with relative afferent pupillary defect in the LE.

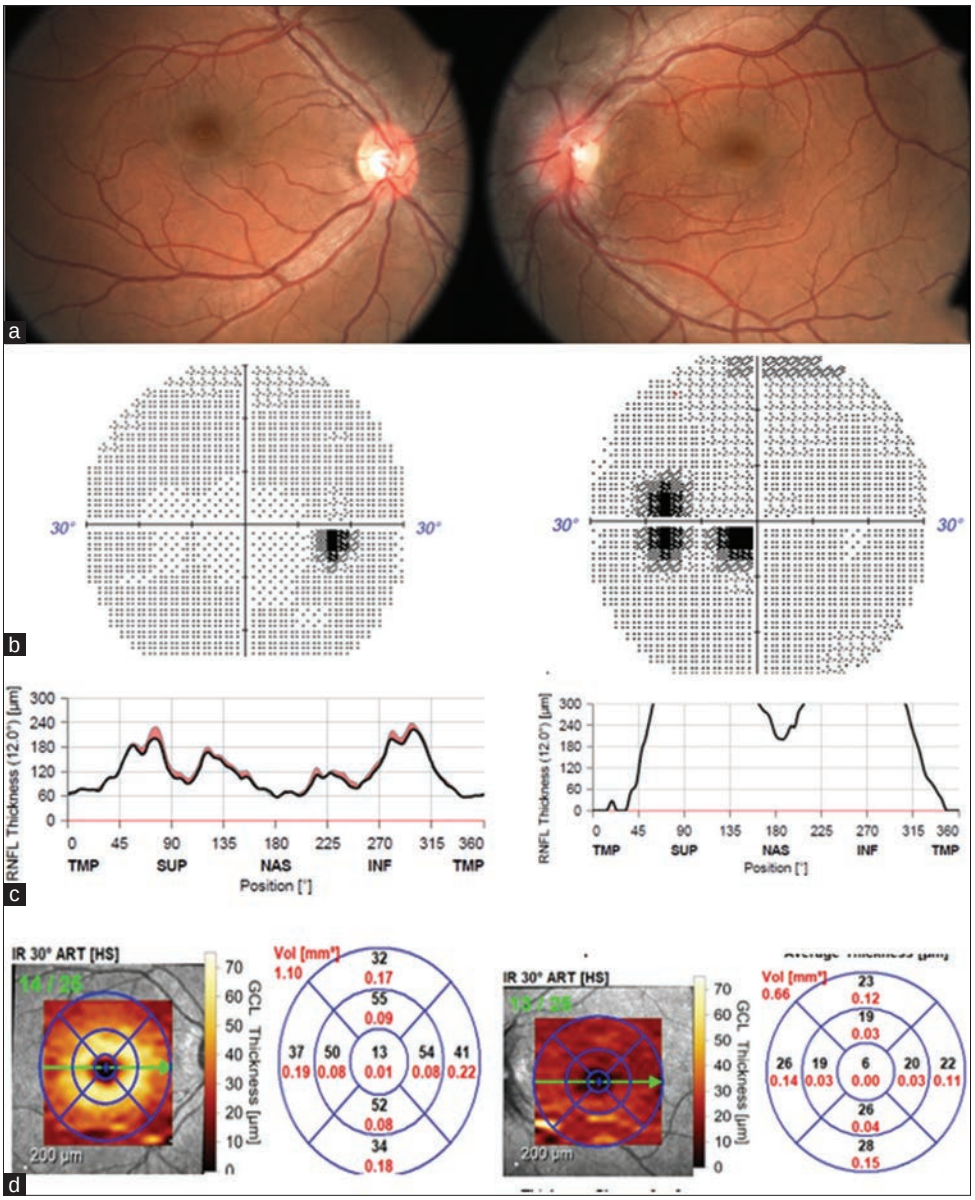


Figure 4: (a) Fundus picture showing asymmetric papilledema persisting (L>R). (b) Visual fields remain status quo with enlarged blind spot and central scotoma in the left eye (c) Optical coherence tomography showing further increased RNFL thickness in the left eye (d) Optical coherence tomography showing macular GCL thinning left eye

Both eyes showed pale disks [Figure 7a] with inferior field defect in LE [Figure 7b]. There was increased RNFL thickening [Figure 7c] in OCT with macular GCL showing superior thinning mainly in the LE [Figure 7d]. Patient was referred to a neurologist for repeat lumbar puncture which showed elevated cerebrospinal fluid (CSF) opening pressure, and a mal-positioned shunt was noted on neuroimaging. Patient underwent a re-shunt procedure.

On review after 1 month, the patient was symptomatically better but disks remained pale [Figure 8a]. Visual field defects showed clearing in the RE, and LE showed mild reduction in the superior defects and persistence of inferior altitudinal defect [Figure 8b]. There was a reduction in RNFL thickness [Figure 8c] and macular GCL thinning in both eyes [Figure 8d], suggestive of optic atrophy.

DISCUSSION

Idiopathic intracranial hypertension (IIH) is a syndrome characterized by elevated intracranial pressure (ICP) that usually occurs in obese women in the childbearing years.[9,10] Various degrees of visual impairment are present in up to 90% of patients with IIH at the time of diagnosis.[11] Patients require regular ophthalmology follow-up visits to know the clinical course of the disease and step up or taper the dose

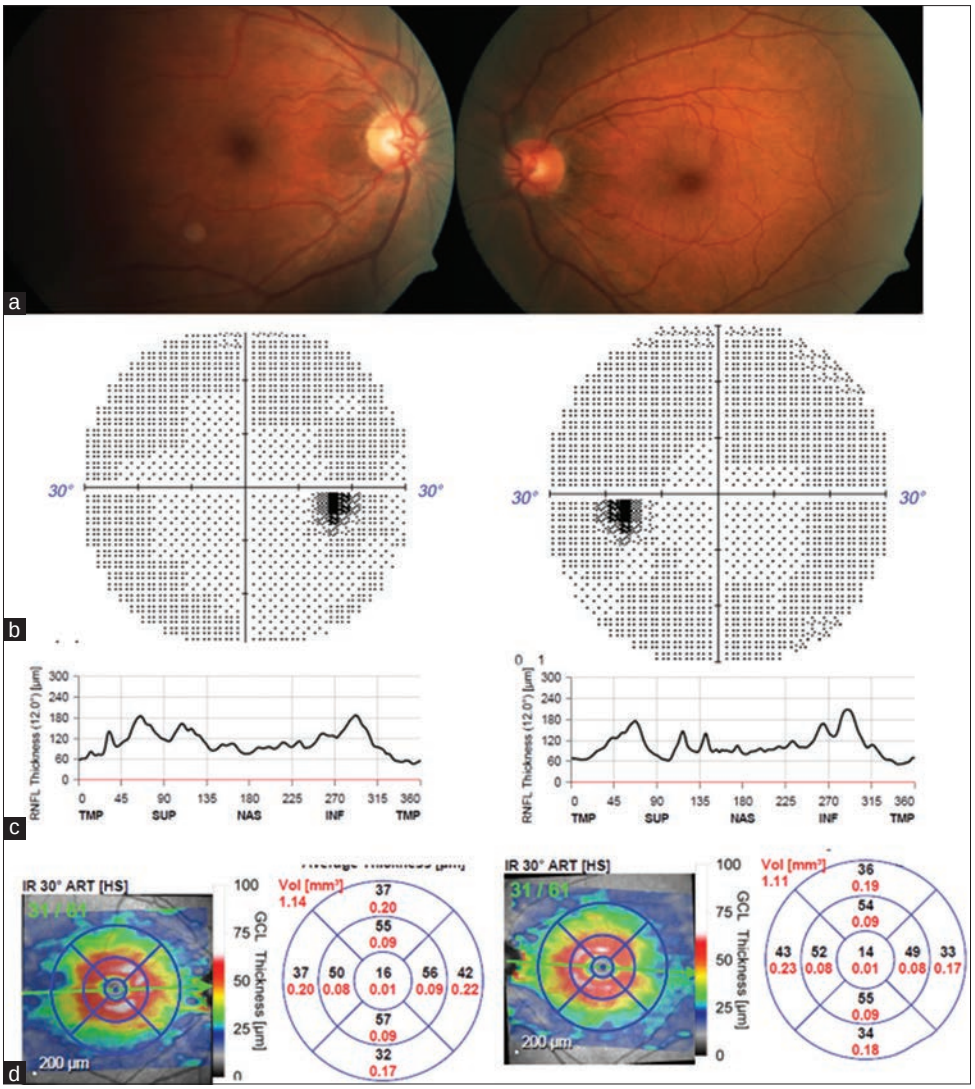


Figure 5: (a) Fundus picture showing normal fundus with no evidence of papilledema (b) Visual fields showing normal fields in both eyes (c) Optical coherence tomography showing normal RNFL thickness in both eyes (d) Optical coherence tomography showing normal macular GCL thickness in both eyes

of medications and also to monitor if the patient is going in for any optic atrophy which can be picked up easily from serial OCT monitoring. The accepted objective method for evaluating papilledema and monitoring the alterations in the optic nerve head (ONH) is the Frisén scale [Figure 9], a non-continuous ordinal grading based on specific features described in fundus photographs or on ophthalmoscopy. The scale has been clinically useful but lacks sensitivity to small changes in the degree of disk edema and variability among observers.[12]

OCT is emerging as an important diagnostic tool in neuro-ophthalmic disorders due to its ability for excellent imaging of each layer of the retina and optic disk.[9] It also helps in assessing the improvement of papilledema, seen as a reduction in pp RNFL edema in response to various treatment modalities employed.[13] However, assessing the pp RNFL alone can cause a diagnostic dilemma because the reduction in pp RNFL can be due to an improvement in papilledema or due to optic atrophy. Preservation of macular GCL in the presence of reduced RNFL thickness in response to anti-edema measures provides a reassurance that the papilledema is reducing with axonal preservation.[7] The OCT parameters also provide a good clinical correlation with subjective tests like visual fields and thus also help in assessing the functional status of the patient. Being non-invasive, it is preferred by the neurologist as well as by the patient over repeated lumbar punctures for follow-up of papilledema.

The cases highlighted here showcase the importance of serial OCTs in monitoring the clinical course as well as altering the treatment modalities. Case 1 showed a patient diagnosed with IIH who was followed up with OCT-RNFL and macular

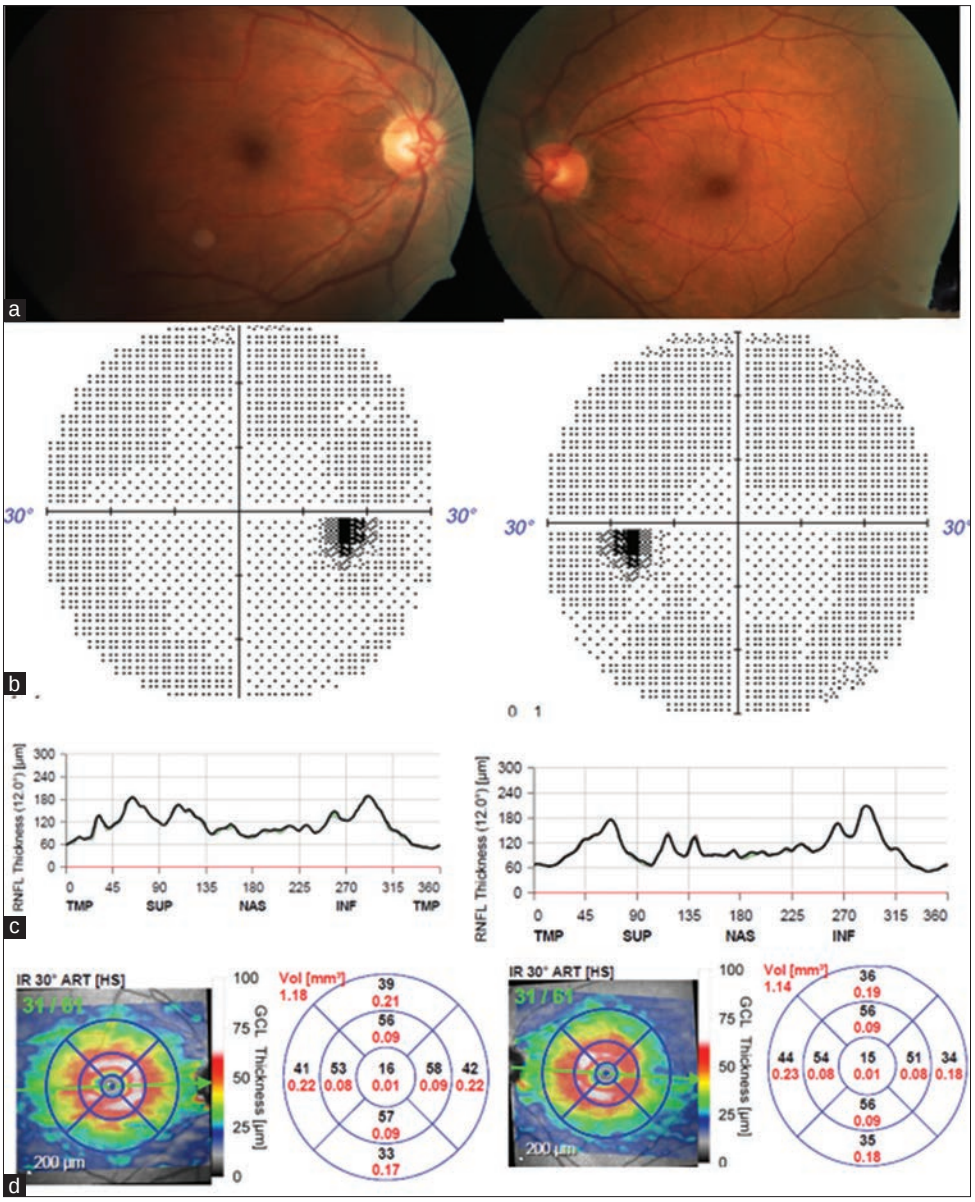


Figure 6: (a) Fundus picture showing normal fundus in both eyes (b) Visual fields were normal in both eyes (c) Optical coherence tomography showing normal RNFL thickness in both eyes (d) Optical coherence tomography showing preserved macular GCL in both eyes

GCL and clinical reduction in papilledema correlated well with a reduction in RNFL thickness and a maintained GCL confirmed optic nerve integrity. Patient also improved symptomatically with medical therapy.

Case 2 in contrast revealed asymmetric papilledema (L>R) despite being on maximum medical therapy with acetazolamide. OCT RNFL revealed thickening in the LE, and there was macular GCL thinning in LE. On review, there was progressive GCL thinning, so the patient was promptly referred for surgical management in view of asymmetrical fulminant IIH.

Case 3 was a referred patient, who was advised shunt procedure due to presumed failure of medical therapy. Clinical examination did not reveal papilledema. OCT RNFL and macular GCL were within normal limits. Patient was maintained on medical therapy and showed symptomatic improvement.

Case 4 was a case of bilateral fulminant IIH who was presented with transient obscuration of vision and headache despite having undergone theco-peritoneal shunt. Despite the disk pallor (L>R), there was increased RNFL thickening in both eyes with GCL loss mainly in the superior quadrant in the LE and a predominant inferior field defect, which was highly suggestive of persistent papilledema producing axonal damage. Patient was referred to the neurologist and repeat lumbar puncture done

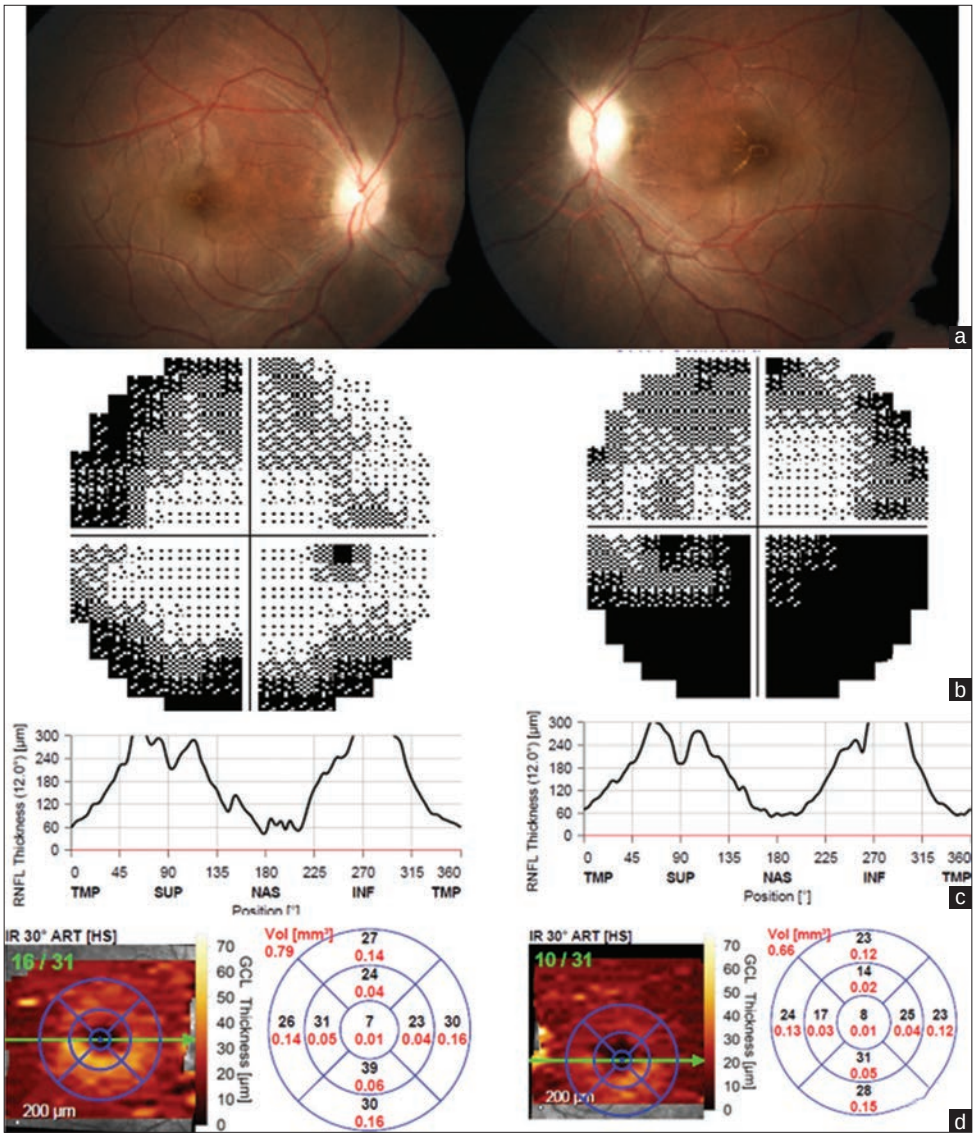


Figure 7: (a) Fundus picture showing pale disks in both eyes. (b) Visual fields showing peripheral field constriction in the RE and an inferior altitudinal defect in the LE (c) Optical coherence tomography shows increased RNFL thickness in both eyes (d) Optical coherence tomography shows thinning of macular GCL in both eyes (L>R)

showed raised ICP. Shunt mal-positioning was noted on neuro-imaging, and a re-shunt procedure was performed. Patient had symptomatic improvement of visual fields in the RE, but the field defects in the LE persisted. There was the reduction in RNFL thickening, but GCL thinning suggested evidence of optic atrophy probably due to the long-standing disk edema.

In a prospective study conducted by Maren Skau on "OCT for optic disc evaluation in IIH" in 2010, promising findings were presented in support for the use of OCT to quantify retinal layer thickening in papilledema objectively and may improve the identification of subtle disk swellings.[14] In an article published in 2020 by David Moreno-Ajona *et al*.[3] on Updates of imaging in IIH, it was stated that rapidly improving the quality of OCT imaging may offer a possibility to reduce the number of lumbar puncture for diagnostic follow-up as they could provide reliable markers that could be used in indirectly assessing ICP. Our case series also confirms the above.

CONCLUSION

OCT serves as an important diagnostic and prognostic imaging modality which may pick up early ONH changes before and after treatment of IIH. Macular GCL may aid in the detection of optic nerve injury earlier than RNFL changes and correlates better with subjective tests like visual field changes than PPRNFL. It also has a role in predicting the course and prognosis of the disease which paves a way for

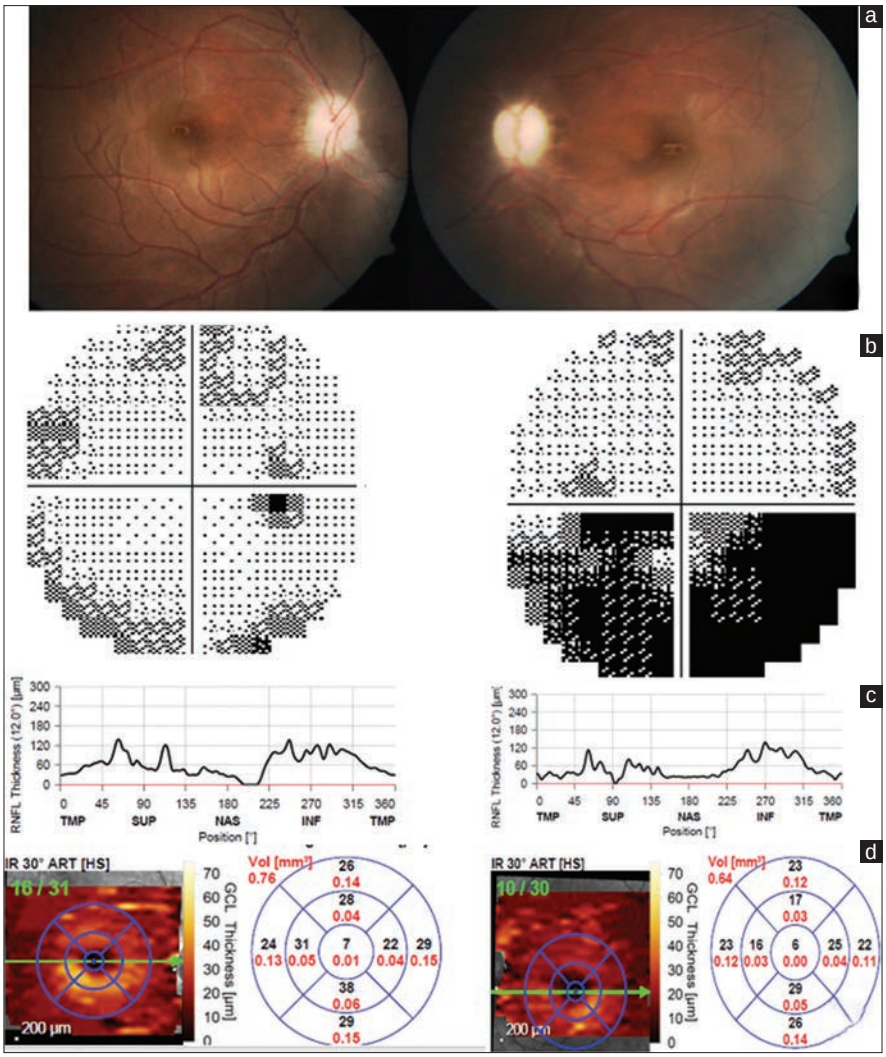


Figure 8: (a) Fundus picture showing pale disk in both eyes (b) Visual fields showing clearing of peripheral defects in the right eye with reduction in the density of inferior altitudinal defect left eye (c) Optical coherence tomography showing reduced RNFL thickening (d) Optical coherence tomography showing thinning of macular GCL in both eyes

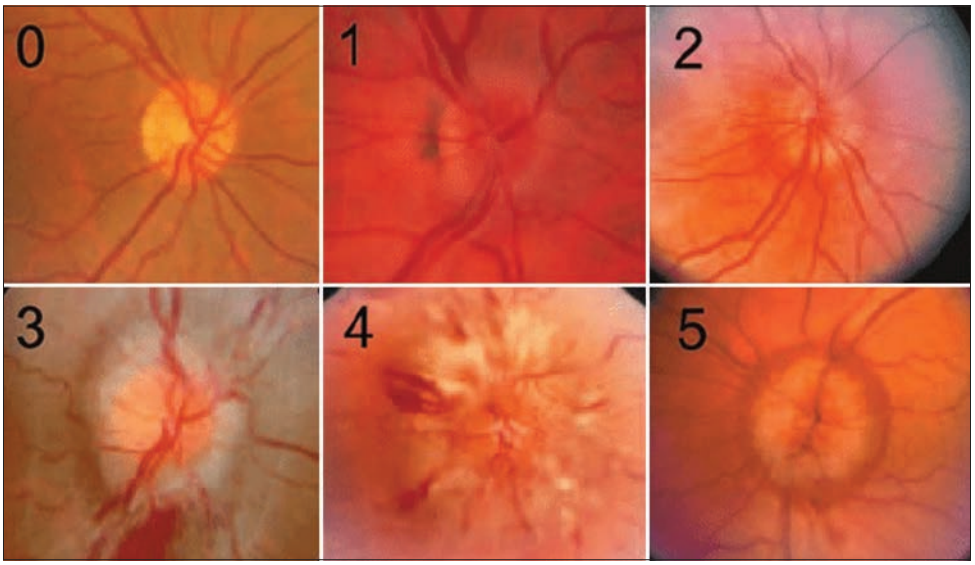


Figure 9: Frisen grading of papilledema. (Pic courtesy: Schiffman, Jade and Scherokman, Barbara and Tang, Rosa and Dorotheo, Edgardo Ulysses and Prieto, Pilar and Varon, Joseph. (2006). Evaluation and treatment of papilledema in pregnancy. Comprehensive ophthalmology update. 7. 187-202.)

deciding the treatment modalities. Although it is unlikely to replace the diagnostic lumbar puncture, in the coming few years, we can hope to reduce the number of invasive lumbar punctures as the OCT parameters can serve as a reliable marker in assessing papilledema and thus indirectly assessing the ICP.

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Conflicts of interest

There are no conflicts of interest.

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Retinal revelations: Seeing beyond the eye with artificial intelligence

ABSTRACT

Artificial intelligence (AI) has revolutionized ophthalmology by aiding in the diagnosis, prognosis, and treatment planning of various eye diseases. However, AI's potential extends beyond ocular conditions. By analyzing eye-related biomarkers, AI can utilize the eye as a window into the body's systemic health. This field, known as oculomics, leverages AI and deep learning algorithms to process vast amounts of data from imaging techniques such as fundus photography, optical coherence tomography (OCT), OCT angiography, infrared iris imaging, slit-lamp photography, and external eye photography. AI-powered analysis of these images can predict systemic diseases such as Alzheimer's, Parkinson's, cardiovascular disease, cerebrovascular disease, chronic kidney disease, and liver disease. Retinal changes —including alterations in the retinal nerve fiber layer, ganglion cell layer, and retinal vessels —serve as valuable indicators of these conditions. Additionally, AI can estimate age, sex, body composition, and other health parameters from eye images. While the potential of AI in oculomics is promising, challenges such as access to ophthalmic imaging, data quality, and the need for rigorous validation must be addressed to ensure its widespread adoption and clinical utility. Nevertheless, AI holds the potential to transform healthcare by enabling early detection, noninvasive screening, and personalized treatment for a wide range of systemic diseases.

Keywords: Age, alzheimers, artificial intelligence, cardiovascular disease, cerebrovascular disease, cognitive impairment, diabetes, gender, kidney disease, liver disease, machine learning, OCT, parkinsons, systemic diseases

INTRODUCTION

Artificial Intelligence (AI) has various applications in Ophthalmology,[1] including diagnosing, prognosticating, and planning treatment for various eye diseases, as well as performing intra ocular lens power calculations and predicting refractive error.

However, the power of AI extends beyond what can be observed with the naked eye. With sufficient data, AI can use the eye as a window into the body's systemic health. Here, we explore the different ways in which this technology can be applied to diagnose and predict systemic conditions and diseases through eye examination [Figure 1].

Oculomics

Oculomics utilizes cutting-edge imaging techniques, genetic data, and analytical tools to explore systemic diseases and conditions by studying eye-related biomarkers. The term "oculomics" is derived from "oculo," meaning eye, and "-omics," which signifies the comprehensive analysis of biological molecules.[2,3] Analyzing such vast amounts of big data is best accomplished using AI and deep learning (DL) algorithms.[4]

Systemic disease forecasting

AI and DL applied to ocular imaging, such as color fundus photographs (CFP), optical coherence tomography (OCT) and OCT angiography can potentially aid in prognosticating

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John Davis Akkara[1,2]

[1]Department of Glaucoma, Cataract and Refractive Surgery, Westend Eye Hospital, Kerala, [2]Department of Glaucoma, Cataract and Refractive Surgery, Chaithanya Eye Institute, Kochi, Kerala, India

Address for correspondence: Dr. John Davis Akkara, Department of Ophthalmology, Westend Eye Hospital, Chittoor Road, Kacheripady, Kochi - 682 018, Kerala, India.
E-mail: JohnDavisAkkara@gmail.com

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various systemic diseases.[5] In addition, some studies have used external eye photos, palpebral conjunctiva images, infrared iris images, and slit-lamp images to predict various systemic diseases and health parameters.

RETFound, a foundation model for retinal images, was trained on 1.6 million unlabeled retinal images and used CFP and OCT to predict myocardial infarction, ischemic stroke, heart failure, and Parkinsons disease.[6] DL algorithms have proven effective in detecting retinal image features linked to cognitive decline, dementia, Parkinson's disease (PD), kidney disease, and cardiovascular risk factors. Additionally, longitudinal prediction models using retinal images show promise for ongoing disease risk evaluation and early detection. AI-driven retinal biomarkers offer a noninvasive, accurate, and efficient method for disease prediction and personalized healthcare.

Mild cognitive impairment

OCT changes are observed in patients with mild cognitive impairment.[7] These changes are evident in both the retinal nerve fibre layer (RNFL) and ganglion cell layer and may later progress to Alzheimers disease and other types of dementia.

Alzheimer's disease (AD)

AD is the most common type of neurodegenerative dementia, and there is a need for affordable screening tests to enable early detection. Early detection may facilitate the discovery of new treatments that can stop this dangerous disease. Compared to positron emission tomography imaging, cerebro spinal fluid markers, blood markers, retinal imaging, and OCT are the least invasive and most cost-effective methods for screening AD.[8]

Drusen in age-related macular degeneration (AMD) contain amyloid-beta (Aβ) and iron, while retinal ganglion cells (RGCs) in glaucoma contain Aβ and p-tau, suggesting an overlapping pathophysiology with AD.[9] Visual symptoms sometimes appear in AD before cognitive decline, possibly due to visual cortex degeneration, RGC loss, or AMD-associated retinal degeneration. Studies have shown that peripapillary RNFL and macular thickness[10] are reduced in mild cognitive impairment and AD. The detection of apoptotic retinal cells may allow early identification of RGC pathology.[11] Animal studies have demonstrated that Aβ plaques in AD can be detected in the retina earlier than in the brain, supporting the idea that the retina is a promising target for AD screening.[12]



Figure 1: AI-generated image by Gemini. The prompt was, "Create an image of an eye, through which icons representing various body systems or diseases are visible." Note that this has no relation to the pseudoscience of iridology

Parkinson's disease (PD)

Individuals with PD have been found to exhibit reduced retinal vessel and perfusion densities, increased total choroidal `area and choroid luminal area, and a decreased choroidal vascularity index on OCT imaging.[13] They also show decreased thickness of the ganglion cell-inner plexiform layer and inner nuclear layer years before the clinical presentation of PD. The retinal age gap, derived from a deep learning algorithm, has shown potential in predicting the risk of developing PD.[14]

Cardiovascular diseases (CVDs)

Retinal vascular parameters such as vessel caliber, tortuosity, and branching patterns have been identified as key biomarkers of CVD in retinal imaging.[2] Early detection and management of CVDs are vital for reducing related morbidity and mortality rates.

Cerebrovascular disease (CeVD)

Studies have shown that retinal vascular changes can predict CeVD.[15] Retinal vasculometry with AI analysis has been identified as a predictive biomarker for vascular health, circulatory mortality, stroke, and myocardial infarction. Signs of hypertensive retinopathy have been consistently linked to both clinical and subclinical CeVD subtypes, including subclinical large artery infarction, lacunar infarction, and white matter lesions. Additionally, certain retinal conditions, such as diabetic retinopathy, retinal arterial and venous occlusion, and transient monocular vision loss, are regularly associated with clinical CeVD. The risk of recurrent stroke is notably higher immediately following retinal artery occlusion (RAO).[16]

Chronic kidney disease (CKD)

Zhang *et al.*[17] used a DL based model to assess the risk of progression to kidney failure. The retinal age gap is a significant biomarker for aging and mortality.[18] It is defined as the difference between the AI-predicted age from retinal imaging and the actual chronological age, and it can predict the risk of end-stage renal disease. Additionally, the risk

of CKD, estimated glomerular filtration rate, and serum creatinine levels can also be predicted.[19]

Liver disease

Various studies have predicted total and direct bilirubin levels, liver cancer, cirrhosis, chronic viral hepatitis, nonalcoholic fatty liver disease, cholelithiasis, and hepatic cysts.[20,21]

Age and gender prediction

Multiple studies[22-24] have predicted age and sex from CFPs and iris patterns.[25] The factors used by humans in these predictions include optic disc ovality ratio, artery trajectory, and supratemporal retinal artery angle.

Other systemic diseases and parameters

Alcohol use[21] and smoking status[26] have been predicted from CFPs in some studies.

Other research[21,27,28] has shown that body mass index, muscle mass, height, weight, relative fat mass, and waist-hip ratio can also be predicted.

Hemoglobin concentration, anemia, red blood cell count, and hematocrit levels were predicted by studies using external eye images as well as CFPs.[21,28,29]

Some studies have used CFPs and iris images[30] to predict diabetes, blood glucose levels, HbA1c, triglycerides, and peripheral neuropathy.[21,31-33] Dysglycemia is associated with increased retinal age gaps.

An artificial neural network was applied to OCT RNFL data to diagnose individuals with multiple sclerosis.[34]

CONCLUSION

Alhough there is significant potential for low-cost screening using AI and DL on CFP and OCT images, we must be aware of the medicolegal implications of missed and false diagnosis. Several challenges must be addressed to make this technology accessible, accurate, and affordable for all. Difficulties in accessing ophthalmic imaging should be resolved with a focus on providing good-quality yet affordable imaging. Predictions are only as reliable as the training data; thus, adequate representation of all populations is essential. Finally, ground truth should be verified with appropriate confirmatory tests before further treatment and management.

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Conflicts of interest

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Bilateral subconjunctival hemorrhage in a young adult following excessive coughing

A 34-year-old man presented with sudden-onset redness in both eyes two weeks ago following an episode of vigorous coughing. He had been suffering from an upper respiratory tract infection (URTI) for one month with excessive coughing. His best-corrected visual acuity was 20/20 in both eyes with normal intraocular pressure. On slit-lamp examination, there was subconjunctival hemorrhage (SCH) in both eyes [Figure 1]. The anterior and posterior segments were normal. There was no sign of ocular infections such as conjunctival follicles and discharges. His systemic examinations were normal. The results of routine investigations such as a complete blood count, coagulation profile, and chest X-ray were also within normal limits, with a normal blood pressure of 122/80 mmHg. A bilateral SCH is a rare condition reportedly associated with vigorous coughing,[1] straining during micturition,[2] sneezing,[2] postpartum,[3] etc., The pathogenesis behind the SCH is due to high venous pressure developed in the head and the eye secondary to high intrathoracic and intraabdominal pressure following coughing, and straining during micturition leads to rupture of the conjunctival blood vessels.[2,3] SCH is a benign condition that usually resolves in 2 weeks[3] and requires no treatment, but recurrent SCH requires thorough systemic evaluation to look for any other uncommon underlying causes.

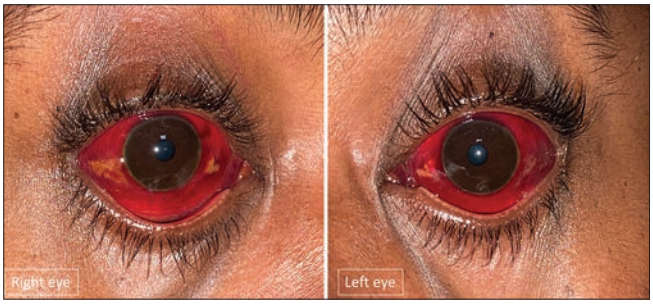


Figure 1: Bilateral subconjunctival hemorrhage in a young patient during excessive cough

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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Balamurugan R., Adimulam G. Ravindra[1]
Department of Ophthalmology and [1]Pulmonology, All India Institute of Medical Sciences, Mangalagiri, Andhra Pradesh, India

Address for correspondence: Dr. Balamurugan R., Department of Ophthalmology, All India Institute of Medical Sciences, Mangalagiri - 522 503, Andhra Pradesh, India.
E-mail: bala16690@yahoo.co.in

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Implantation iris cyst

Implantation iris cysts are seen after trauma or anterior segment surgery. They occur due to the invasion of corneal or conjunctival epithelial cells into the anterior chamber.[1]

Reporting the case of a 15-year-old boy, who came to eye OPD with blurring of the vision in the right eye. The patient had a history of repaired corneal perforation and traumatic cataract surgery with IOL implantation in the right eye 5 years back. Now, the patient came with a complaint of diminution in vision in his right eye, which has been progressive from the last 6 months to level 6/60 in the right eye, with the restriction of field on the nasal side. Intraocular pressure in the right eye was 28 mmHg.

Ophthalmological examination revealed a healed corneal scar, a large bi-lobed, fluid-filled cyst in the anterior chamber occupying almost half of it, with significant corneal touch and also partially obscuring the visual axis. [Figure 1] The IOL was visible in the pupillary area. Fundus examination of the right eye was normal with a cup-disc ratio of 0.5:1.

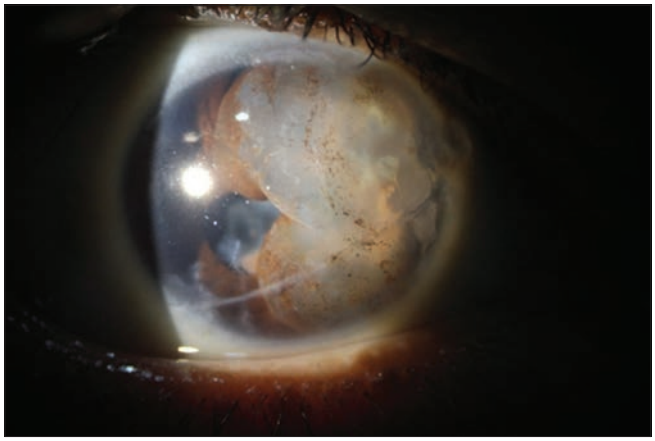


Figure 1: Slit-lamp image showing healed corneal scar and a large bi-lobed, fluid-filled cyst in the anterior chamber

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Considering the age of the patient, visual discomfort, risk of endothelial decompensation, and elevated intra-ocular pressure, the patient was managed surgically. The cyst was aspirated using a 26G needle, followed by surgical removal of the cyst wall. Post-operatively, the patient was given topical eye drops containing antibiotics + steroids at a gradually tapering dose, and timolol eye drops twice a day for 1 month.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCE

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Madhu Sharma, Navjot Chugh[1]
Department of Ophthalmology, SGHS Sohana Hospital, Mohali, Punjab, [1]Department of Ophthalmology, Chugh Eye Surgery Centre, Ludhiana, Punjab, India

Address for correspondence: Dr. Madhu Sharma, 689/1, Sector 40-A, Chandigarh, India.
E-mail: mdsrma@gmail.com

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How to write an introduction and literature review for your research?

ABSTRACT

Writing an engaging Introduction and Literature Review is essential for any research paper. These segments lay the foundation for your research, offering context, pinpointing deficiencies, and substantiating the necessity of your study.

Keywords: Introduction, literature review, research article

INTRODUCTION

The introduction serves as the guiding map for your research paper. It ought to captivate the reader, succinctly articulate the issue, and highlight the significance of your work. A literature review constitutes an essential element of any scholarly research paper. It offers an extensive examination of the current body of knowledge pertaining to a specific subject, thereby assisting researchers in recognizing deficiencies, establishing contextual relevance, and substantiating their own research assertions.

Salient points[1]

Introduction

a. **Opening with Context:** Begin with a comprehensive overview of the topic to furnish readers with the essential background. Concentrate on clarifying why the research domain holds significance. This may encompass real-world challenges or knowledge gaps that necessitate further exploration.
b. **Narrowing down into a Specific Problem:** Once you have established the wider context, gradually focus on the precise issue that your research intends to tackle. Present the primary research question or hypothesis that your study is centered around.
c. **Justification and Rationale:** Articulate the necessity of your study and how it fills a void in the existing body of literature.
d. **Aims and Objectives:** Clearly articulate your research aim and objectives. This allows readers to grasp the specific results you aim to achieve.

Review of literature

a. **Identify Relevant Studies:** Engage in a thorough search of academic databases to uncover the most significant and current research findings.
b. **Overview of Key Research:** Initiate the discourse by addressing the most pertinent studies associated with your subject matter. Categorize the research according to thematic elements while emphasizing the main findings of each study.
c. **Identify Gaps and Limitations:** Following your analysis of existing literature, identify areas that have not been sufficiently investigated. This will identify the deficiencies that your research intends to rectify.
d. **Establish the Theoretical Framework:** Elucidate any theoretical models, frameworks, or hypotheses pertinent to your inquiry.

Common mistakes/pitfalls

- Introduction being too broad and vague

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Sruthi MV
Department of Community Medicine, Amala Institute of Medical Sciences, Thrissur, Kerala, India

Address for correspondence: Dr. Sruthi MV, Haritha, Cherumuuku Temple Road, Chembukkavu, Thrissur - 680 020, Kerala, India.
E-mail: drsruthimv@amalaims.org

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- Weak justification of the research question and objectives
- Poor structure and coherence in the review of literature
- Listing studies in the review of literature without critically evaluating them.

Take home messages

- **Clarity and Focus:** Avoid using too much jargon and stay focused on your research problem. The introduction should be short, and the literature review should synthesize rather than summarize.
- **Citing Credible Sources:** Use original, peer-reviewed publications from reputable journals. Cite contemporary studies to demonstrate that you are participating in the current academic discussion.
- **Logical flow** ensures smooth transitions between sections. In the introduction, move from broad to specialized. To improve the flow of the literature review, categorize studies thematically or chronologically.
- **Be Critical, Not Descriptive:** The literature review should critically examine previous research, highlighting its merits and limitations to support your study's contribution.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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Curated article summaries

CLINICAL PROFILE AND MANAGEMENT OF OCULAR SUPERGLUE INJURIES: CASE SERIES AND REVIEW OF LITERATURE

Malepati N, Sharma S, Kate A, Basu S, Shanbhag SS. Clinical profile and management of ocular superglue injuries: Case series and review of literature. Indian Journal of Ophthalmology. 2024 Apr; 72(4):587.

Summary

Eye injuries represent a significant cause of visual impairment globally, ranging from mild abrasions to severe trauma that can result in permanent vision loss. Chemical eye injuries pose unique challenges, often leading to immediate irritation, inflammation, and potentially lasting damage if not treated promptly. Among these, exposure to household chemicals, particularly adhesives like cyanoacrylate glue (superglue), is an uncommon but notable cause of ocular injuries. Superglue is a highly adhesive, fast-acting material widely used in domestic, craft, and industrial applications due to its ability to bond effectively to surfaces such as plastic, glass, and ceramic. However, its easy availability and affordability, packaging often resembling eye drop bottles increase the risk of accidental application into the eye, particularly for children, the elderly, and individuals with visual impairments.

This retrospective study examined the clinical profile and management of 58 patients with ocular superglue injuries (OSI) from January 2016 to December 2020, comparing pediatric (24 patients) and adult (34 patients) cases. The majority of pediatric OSIs (92%) occurred due to unsupervised handling of superglue, while in adults, 91% of injuries resulted from improper handling. The spectrum of ocular injuries caused by superglue includes dermatitis, loss of eyelashes, chemical ankyloblepharon, severe ocular pain, and various corneal abrasions. The most common presentation involves the sticking of eyelids and eyelashes, as superglue bonds with dry surfaces like eyelid margins, leading to severe inflammation and conditions like chemical conjunctivitis and keratitis.

The study emphasizes two key management principles for OSI: reversing chemically induced tarsorrhaphy for evaluation and removing retained glue while assessing ocular surface damage with fluorescein staining. Although immediate irrigation can reduce injury severity, only a minority of patients received it in time, leading to more severe cases. Treatment typically included lubricants, antibiotics, and steroids. Preventive strategies, such as safer child-proof packaging, stronger warnings, and public awareness of superglue risks, particularly for children, are crucial for reducing OSI.

Why this article?

This article was selected due to its detailed exploration of a rare yet important ocular injury-superglue–related eye trauma, providing crucial insights for clinicians. It addresses the unique clinical profile and management challenges of such injuries in both children and adults. The study emphasizes the need for prompt medical intervention, such as irrigation and careful removal of polymerized glue, to prevent severe complications and long-term visual impairment.

Moreover, the article discusses preventive strategies, including improved product packaging, child-proofing, and public awareness campaigns, which can significantly reduce the incidence of these injuries. Its focus on practical management protocols, such as the use of lubricants, topical antibiotics, and steroids, offers clinicians a structured approach to treatment. This study's relevance lies not only in its clinical guidance but also in its advocacy for preventive measures, making it a valuable resource for both ophthalmologists and public health professionals.

SIDEWAYS SCULPTING: A NOVEL TECHNIQUE IN EYES WITH POSTERIOR POLAR CATARACTS

Patwardhan SD, Patwardhan NS, Sangle A. Sideways sculpting: A novel technique in eyes with posterior polar cataracts. Indian Journal of Ophthalmology. 2024 Apr; 72 (4):596.

Video Link: https://drive.google.com/file/d/17ukCjdr9DlEggu Cgfh0DPAPYxCCEzirq/view?usp=sharing.

Summary

Posterior polar cataracts (PPCs) present a significant challenge for cataract surgeons due to the high risk of posterior capsule rupture during surgery. The central posterior opacity in PPC is often adhered to the posterior capsule, increasing the likelihood of complications such as capsular fractures

and vitreous loss. This condition is typically congenital and can be inherited in an autosomal dominant pattern, although isolated cases are also common. PPCs may remain asymptomatic for years, but as patients enter adulthood, they can experience visual disturbances like glare, particularly while driving at night.

Surgical management of PPC requires careful planning and specific techniques to minimize stress on the fragile posterior capsule. Techniques like limited hydrodissection, hydrodelineation, nuclear suction within the epinuclear shell, and gentle viscodissection have been developed to reduce complications. Despite these advancements, posterior capsule rupture rates remain significant, with studies reporting rates as high as 26% to 36% after surgical intervention.

This retrospective study evaluates the efficacy and safety of the sideways sculpting technique for managing posterior polar cataracts (PPCs), aiming to reduce complications and improve surgical outcomes. This unique technique avoids nucleus rotation and is performed with low bottle height, helping to maintain a stable anterior chamber throughout the procedure. It effectively removes dense nuclei without disrupting the epinucleus or affecting the posterior capsular plaque reducing the risk of complications associated with posterior capsule rupture.

This technique describes an innovative method for managing denser nuclei in posterior polar cataracts (PPCs) using sideways sculpting phacoemulsification. The process begins by creating a central trench in the nucleus, followed by a perpendicular trench to form a plus sign. The phacotip is moved sideways without rotating the nucleus, allowing precise quadrant separation and emulsification.

Why this article?

This article was selected because even in expert hands, phacoemulsification in posterior polar cataracts (PPC) is highly challenging due to the increased risk of posterior capsular rupture. The simple yet innovative sideways sculpting technique described offers a practical approach to managing PPCs, minimizing the risk of rupture and associated complications. By avoiding nucleus rotation and maintaining anterior chamber stability, this technique can help surgeons achieve better outcomes in PPC cases, making it a valuable addition to current cataract management strategies.

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Conflicts of interest

There are no conflicts of interest.

Remya Edachery

Consultant in Pediatric Ophthalmology and Strabismus, Co operative Hospital, Payyanur, Kerala, India

Address for correspondence: Dr. Remya Edachery, "Navani", Kokkanissery, Payyanur - 670 307, Kerala, India.
E-mail: remyae2003@gmail.com

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Charting your career graph post residency

ABSTRACT

Overview on the opportunities available for an ophthalmology resident.Included are the options for those who want to start working immediately after PG and for those who want to do fellowships (both long term and short term.) both in India and abroad.

Keywords: Career, fellowships, post residency

"It is in your moments of decision that your destiny is shaped," stated Tony Robbins. It is imperative to open oneself to the myriad spheres of ophthalmology [Figure 1] before making a career decision.[1]

Residents seeking further training in specific sub-specialties can enhance their expertise through long-term or short-term fellowship programs, both nationally and internationally.

CAREER OPPORTUNITIES ABROAD

Ophthalmology is a highly sought-after field in numerous countries globally. Listed below are several nations that provide ophthalmic education and fellowship opportunities.

1. **United Kingdom (UK):** Opportunities for clinical training, research programs, Ph.D. (Doctor of Philosophy), and MD programs are available. To obtain registration with the General Medical Council (GMC), candidates must pass the Professional and Linguistic Assessment Board (PLAB) exam, a prerequisite within the UK medical system. However, those who have successfully completed the MRCS (Membership of the Royal College of Surgeons.), FRCS (Fellowship of the Royal College of Surgeons.), or IELTS (International English Language Testing System) exams may be exempt from the PLAB and can apply directly to the GMC for various positions.[2]
2. **United States of America (USA)** – The United States is a highly sought-after destination for ophthalmology education due to its premier institutions that offer strong academic frameworks, innovative research opportunities, and exceptional mentorship. Available fellowships include short-term, long-term, basic science, clinical, clinical + research, and collaborative options. Notably, California and Pennsylvania are two states that allow overseas candidates to bypass the USMLE (United States Medical Licensing Examination), enabling them to start working directly. Research experience and publications are highly valued when applying for positions in the U.S.[3,4]
3. **Dubai**- To practice in Dubai, candidates must pass the Dubai Health Authority (DHA) exams. Preference is often given to candidates who have completed their FRCS training in the United Kingdom. Additionally, Indian candidates holding an FRCS qualification typically receive enhanced compensation opportunities.[5]
4. **Australia**- In Australia, candidates must pass the Australian Medical Council (AMC) examinations—Part 1 and Part 2—to apply for medical positions. Part 1, a multiple-choice

Monisha Mohan, Mini Mathew[1]

Department of Paediatric Ophthalmology and Strabismus, Ahalia Foundation Eye Hospital, Palakkad, [1]Department of Ophthalmology, Regional Institute of Ophthalmology, Trivandrum, Kerala, India

Address for correspondence: Dr. Mini Mathew, Thamarasseril House, 43-Thoppil Nagar, Kumarapuram, Medical College P.O., Thiruvanathapuram - 695 011, Kerala, India.
E-mail: miniacherian@gmail.com

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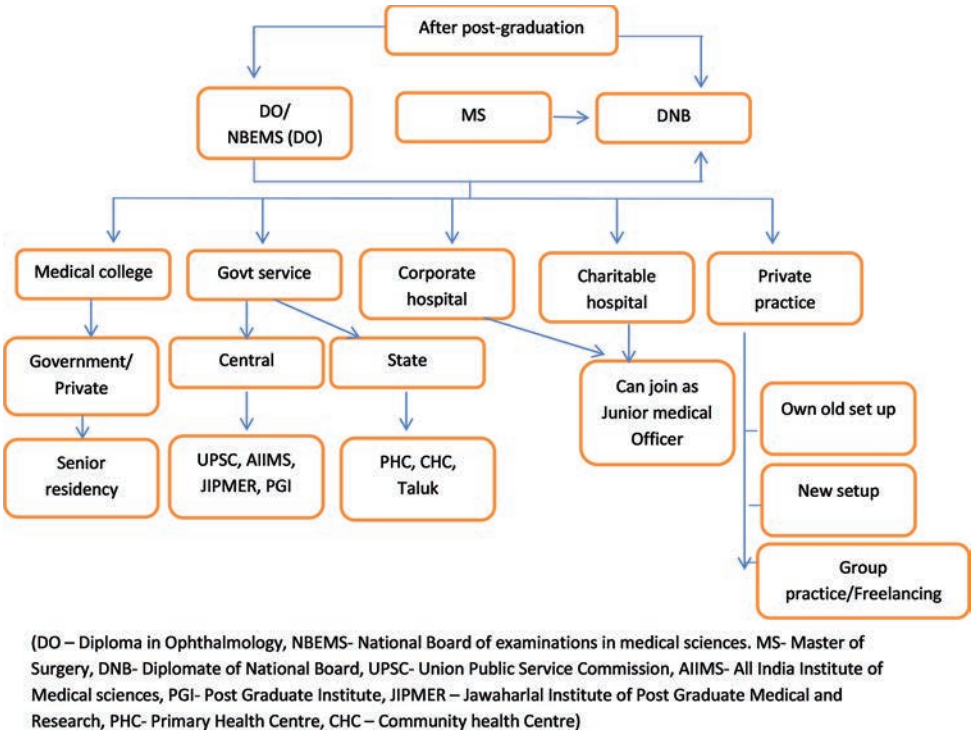


Figure 1: Career guidance algorithm outlining options in the workforce after residency

questionnaire (MCQ), can be taken after completing postgraduate studies in India. However, Part 2 requires candidates to be physically present in Australia for a face-to-face examination. Additionally, having publications is highly beneficial when seeking job opportunities.[6]

Long-term fellowships are offered by major eye institutes both within and outside Kerala.[7-17]

Long-term fellowships typically last 2–3 years, providing comprehensive and sub-speciality training, while international fellowships usually range from 1 to 2 years, offering exposure to global practices [Figure 2].

LVPEI (LV Prasad Eye Institute) offers a three-year fellowship with structured rotations.[18]

- **First 9 months:** Advanced induction module with a focus on cataract training.
- **12 months:** Management at a secondary center.
- **15 months:** Advanced subspecialty training.

Specializations available include cataract and refractive surgery, glaucoma, cornea and anterior segment, retina and vitreous, pediatric ophthalmology and strabismus, oculoplasty and ocular oncology, uveitis, and medical retina. Admission requires an entrance exam and interview. The stipend is Rs 30,000 for the first year and Rs 35,000 for the second and third years.

Ahalia Foundation Eye Hospital offers a one-year fellowship in phacoemulsification, a 1.5-year fellowship in phacoemulsification and glaucoma, and a Fellowship in National Board (FNB) program in vitreo-retina.[19]

Short term fellowships

Short-term fellowships focus on enhancing surgical skills, particularly in cataract surgery techniques such as small incision cataract surgery (SICS) and phacoemulsification. These fellowships may also include brief observerships lasting 1–3 months in areas like medical retina, glaucoma, pediatric ophthalmology, strabismus, and oculoplasty with facial aesthetics [Figure 3].

Further, short term fellowships are available at Aravind Eye Hospital, LV Prasad Eye Institute, and Sankara Eye Hospital, with durations of 1–3 months in subspecialities such as glaucoma, oculoplasty, paediatric ophthalmology and strabismus, and neuro-ophthalmology.

The Government of India provides training to doctors in government service under the National Programme of Blindness Control and Visual Impairment programme. Details of the fellowships offered and the zone-wise distribution of institutes are provided at this link https://npcbvi.mohfw.gov.in

Name of the Institute	AEH	CEH	CHRI	CFS	TEF-C	GEI	LF	MMJ	NN	SCEH	SN - C	SEH
Mode of entrance (Entrance exam – E Interview –Int)	Int	Int	Int	Int	Int	E+ Int	Int	Int	Int	Int	E+ Int	E+ Int
Comprehensive	✓ (18 m)	-	✓ (18 m)	✓ (2 y)	✓ (18 m)	✓ (2 y)	✓ (2 y)	-	-	✓ (2 y)	✓ (18 m)	✓ (2 y)
Phaco/ IOL	✓ (18 m)	-	-	✓ (2 y)	✓ (18 m)	✓ (1 y)	-	✓ (2 y)	✓ (2 y)	-	-	-
Cornea and Anterior Segment	✓ (18 m)	-	-	-	✓ (18 m)	✓ (15m)	✓ (2 y)	✓ (2 y)	✓ (2 y)	✓ (2 y)	✓ (2 y)	✓ (2 y)
Glaucoma	✓ (18m)	✓ (18m)	✓ (18 m)	✓ (2 y)	-	-	✓ (2 y)	✓ (18 m)	✓ (2 y)	✓ (18 m)	✓ (18 m)	✓ (2 y)
Long Term Medical Retina	✓ (18m)	-	✓ (18 m)	-	-		✓ (2 y)	-	-	-	✓ (1 y)	✓ (2 y)
Long Term Surgical Retina	✓ (2 y)	✓ (2y)	✓ (18 m)	✓ (2y)	✓ (2y)	✓ (2y)	✓ (2y)	✓ (2.5y)	✓ (2 y)	✓ (18 m)	Clinical – 2 y Clinical + researc h – 2.5 y	✓ (2 y)

Name of the Institute	AEH	CEH	CHRI	CFS	TEF-C	GEI	LF	MMJ	NN	SCEH	SN - C	SEH
Uvea and Medical retina	✓ (18m)	✓ (6m)	-	-	-	-	-	-	✓ 18 m (uvea-15 m, medical retina – 3 m	-	✓ 2 years (1st y – Uvea, 2nd y– Retina)	-
Paediatric ophthalmology	✓ (18 m)	✓ (18m)	✓ (18m)	-	-	✓ (15m)	✓ (2 y)	✓ (18 m)	✓ (2 y)	✓ (18m)	✓ (18m)	✓ (2 y)
Oculoplasty and Orbit	✓ (18 m)	-	-	-	-	✓ (15m)	✓ (2 y)	-	✓ (2 y)	✓ (18 m)	✓ (2 y)	✓ (2 y)
Neuro-ophthalmology	✓ (3m)	-	-	-	-	-	-	-	✓ (2 y)	-	✓ (18 m)	-
Clinical PHD Programme	-	-	-	-	-	-	-	-	✓ (3-5 y)	-	-	-
Stipend	1st year - Rs 40K 2nd year- Rs 50K	Rs 55K	Rs 40K	1ST Yr- Rs 30K 2nd Yr- Rs 40K	Rs 35K	Rs 30K For retina - Rs 40K	Rs 55K	Rs 30K	Rs 56K	Rs 25K	Rs 30K	Rs30K

(AEH – Aravind Eye Hospital; CEH – Comtrust Eye Hospital, Calicut; CEHRI – Chaithanya Eye Hospital and Research Institute; CFS : Center for Sight, Delhi; TEF-C : The Eye Foundation, Coimbatore; GEI – Giridhar Eye Institute, Kochi, LF – Little Flower Eye Hospital, Angamaly, MMJ – MM Joshi Eye Institute, Hubli, NN- Narayana Nethralaya, Bangalore; SCEH – Dr Shroff Charity Eye Hospital, Delhi, SN-C: Sankara Nethralaya, Chennai, SEH – Sankara Eye Hospitals)

Figures 2: Comprehensive list of long term fellowships

Name of the Institute	AEH	LVPEI	MMJ	SCEH	CFS	SEH	CEHRI	SN	GEI
SICS	✓ 1m Rs 25K	✓ 1-3 m	✓ 1 m Rs 60K	✓ 1 m Rs 80K	-	-	-	-	-
Phacoemulsification	✓ 1m Rs 40K	✓ 1-3m	✓ 1m Rs 90K	✓ 1m Rs 50K	✓ 3m Rs 50K	✓ 1m	-	-	-
Medical retina	✓ 2m Rs 20K	✓ 1-3m	-	✓ 3m Rs 80K	✓ 4m Rs 50K	-	✓ 3m	✓ 1m	✓ 2m Rs 40K

(SICS- Small Incision cataract Surgery, AEH – Aravind Eye Hospital; LVPEI -LV Prasad Eye Institute; MMJ – MM Joshi Eye Institute, Hubli; SCEH – Dr Shroff Charity Eye Hospital, Delhi; CFS - Center for Sight, Delhi; CEHRI – Chaithanya Eye Hospital and Research Institute; SN- Sankara Nethralaya, Chennai; GEI – Giridhar Eye Institute, Kochi)

Figure 3: Short-term fellowships

Answer to previous issue mcq

Which of the following immunosuppressants is a selective T-cell costimulation modulator used in the treatment of noninfectious paediatric uveitis? D) Abatacept.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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Taming posterior polar cataract – My way of small incision cataract surgery

ABSTRACT

Posterior polar cataracts (PPCs) present a challenging situation for surgeons due to the high likelihood of intraoperative issues such as posterior capsular rupture and aphakia. It is widely recognized that patients with PPC typically have a thin posterior capsule, which is densely attached to the cataract, making it fragile. Although various surgical techniques have been suggested for addressing this specific type of cataract, achieving successful outcomes without complications remains a significant challenge for many surgeons. In developing countries, aspiring surgeons may not have extensive experience with phacoemulsification. This study explores the safe application of small incision cataract surgery in such cases.

Keywords: Hydrodelineation, posterior polar cataract, small incision cataract surgery

Video Available on: https://drive.google.com/file/d/1Ld0RHdNSg8wxwEaQKJxTFeDf5QtTh3JI/view?usp=drive_link

FOCUS POINTS

- An adequate size of the capsulorhexis should be created.[1,2]
- Carefully inject viscoadaptive (sodium hyaluronate 2.3%) OVD.[3]
- Use gentle hydrodelineation or a Simcoe cannula to separate the epinucleus from the nucleus.
- Avoid rotating the lens in the bag.
- Perform cortex wash in a manner similar to reverse blooming of a flower petal; then aspirate.
- Carefully place the IOL inside the bag.
- Ensure the wound is properly secured.

CONCLUSION

With this method, we can achieve excellent results and have good postoperative vision. The chance of posterior capsular rupture is also reduced.

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Soumya P P
Consultant Glaucoma and Phaco Refractive Surgeon, Trinity Super Speciality Eye Hospital, Palakkad, Kerala, India

Address for correspondence: Dr. Soumya P P,
Trinity Superspeciality Eye Hospital, Palakkad, Kerala, India.
E-mail: soumyaputhuvel@gmail.com

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Comments on the case report of "fleeting diplopia and wobbly feet: Miller-Fisher syndrome presenting as bilateral abducent nerve palsy"

Dear Editor,

We write this letter to express our views regarding a care report published in the Kerala Journal of Ophthalmology (Volume 35, Issue 3) (September–December 2023) titled "Fleeting Diplopia and Wobbly Feet: Miller-Fisher Syndrome Presenting as Bilateral Abducent Nerve Palsy" by Namitha VG and Neena R.[1] We want to congratulate the authors for publishing this rare case. While the report provides valuable insights into the clinical presentation, diagnosis, and management of Miller-Fisher syndrome (MFS), we would like to offer some constructive feedback on certain aspects that could enhance the clarity and completeness of the report.

Firstly, the case report appropriately details the patient's clinical history, examination findings, and subsequent diagnostic and therapeutic interventions. However, a more explicit discussion of the limitations encountered during the evaluation and treatment of the patient would have been beneficial. Acknowledging the limitations, such as the absence of certain diagnostic tests or challenges faced during the therapeutic process, would contribute to a more comprehensive understanding for readers and clinicians.[2]

Furthermore, the report lacks information on the long-term follow-up of the patient. Given the relatively rapid recovery post-intravenous immunoglobulin therapy, insights into the patient's progress over an extended period would be invaluable. A discussion on any residual symptoms, recurrence, or need for additional interventions during follow-up could enhance the report's clinical relevance.

Additionally, it would be beneficial to include a section addressing the potential variations in the presentation of MFS. Recognizing that clinical manifestations may differ among individuals could aid clinicians in diagnosing cases with atypical features. This discussion could also explore any existing literature on variant presentations of MFS to provide a more comprehensive context for the readers.

While the report appropriately emphasizes the importance of a thorough neurological evaluation in cases of abducens nerve palsy, it would be helpful to underscore the challenges that ophthalmologists may face in identifying such neurological conditions, particularly those that may not be familiar to them. Providing guidance on collaboration between ophthalmologists and neurologists or the potential need for additional training could be valuable for the readership.

In conclusion, the case report on MFS is a commendable contribution to the literature. Addressing the mentioned aspects could further enhance its educational value and applicability to clinicians encountering similar cases. We appreciate the opportunity to share these suggestions and look forward to future insightful contributions to your journal.

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Conflicts of interest

There are no conflicts of interest.

Suraj Kumar Chaurasiya[1,2], Mahendra Singh[1], Pradeep Agarwal[3]

Departments of [1]Optometry and Vision Science, [2]Contact Lens and Anterior Segment and [3]Ophthalmology, Pediatric and Neuro-Ophthalmology, CL Gupta Eye Institute, Moradabad, Uttar Pradesh, India

Address for correspondence: Mr. Suraj Kumar Chaurasiya, CL Gupta Eye Institute, Ram Ganga Vihar Phase II (Extn.), Moradabad - 244 001, Uttar Pradesh, India.
E-mail: csurajk414@gmail.com

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