EMERGENCY APPROACHES
IN OCULAR EMERGENCIES

Editor
LEYLA HAZAR
MINE KARAHAN

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Content

Foreword

Emergencies involving the eye are uniquely challenging: they demand swift clinical judgment, precise intervention, and a deep understanding of both ocular anatomy and systemic associations. The ability to promptly recognize and manage ophthalmic emergencies is a critical skill not only for ophthalmologists, but also for emergency physicians, primary care providers, and all clinicians on the front lines of acute care.

Ophthalmic Emergency Medicine: Principles and Practice was conceived to serve as a comprehensive, practical, and accessible reference for healthcare professionals dealing with urgent ocular conditions. The book is structured to reflect the real-world approach to emergency ophthalmology, beginning with general principles, then focusing on anterior segment disorders, sight-threatening posterior segment and neuro-ophthalmic emergencies, and concluding with special situations—such as trauma, pediatric cases, and emergencies in systemic diseases.

Each chapter has been crafted by experts in the field, combining evidence-based knowledge with clinical experience. Special attention has been given to diagnostic strategies, decision-making pathways, and timely intervention—all essential in preserving vision and preventing irreversible damage.

This book aims not only to inform but also to inspire a deeper awareness of the critical importance of ophthalmic emergencies in overall patient care. It is our hope that this work will guide residents, specialists, and emergency clinicians in providing optimal care, ultimately improving outcomes for patients in crisis.

I extend my sincere gratitude to all contributors for their dedication and scholarship, and to the readers for their commitment to excellence in ophthalmic emergency medicine.

Assoc. Prof. Dr. Leyla Hazar

Editor

Ophthalmic Emergency Medicine: Principles and Practice

Assoc. Prof. Dr. Leyla Hazar[1]

Assoc. Prof. Dr. Mine Karahan[2]

[1] Dicle University, Faculty of Medicine, Department of Ophthalmology, Diyarbakır, Turkiye

[2] Dicle University, Faculty of Medicine, Department of Ophthalmology, Diyarbakır, Turkiye

GENERAL APPROACHES AND FUNDAMENTAL PRINCIPLES IN OPHTHALMIC EMERGENCIES

ALİ HAKİM REYHAN[1]

Introduction

Ophthalmic emergencies are urgent situations that require prompt medical assistance to avoid permanent vision loss or other issues. These emergencies include various eye problems, such as injuries, retinal detachments, and acute glaucoma, which can severely affect the patient's life. Prompt treatment of these issues is essential since many can lead to severe complications if not addressed. For example, using point-of-care ultrasound to detect endophthalmitis has exhibited the potential to speed up treatment for patients who were wrongly diagnosed with orbital cellulitis, highlighting the need for rapid and precise diagnostic methods (Shinde & Birru, 2024). Furthermore, a systematic approach in emergency rooms can help with referrals and increase care efficiency, since studies have shown that many emergency visits are not necessary due to poor referral details from general practitioners

[1] Assistant Professor, Harran University, Faculty of Medicine, Department of Ophthalmology, Şanlıurfa/Turkey, ORCID: 0000-0001-8402-0954

(Maria, 2024). Being skilled and trained to handle these emergencies can greatly improve patient outcomes.

A methodical method for handling eye emergencies is very important for reducing problems and improving patient outcomes. First, it is very important to correctly assess the urgency, because misclassification can cause delays in treatment and poor visual results. Research shows that many eye-related cases in emergency rooms are not urgent, which shows the need for good screening methods (Rossi et al., 2007). Good referrals and clear record-keeping are key to ensuring that patients receive care that is timely and suitable. Using ocular point-of-care ultrasound (POCUS) has been helpful in quickly diagnosing issues such endophthalmitis and providing quick information that helps with urgent treatment, especially in places without eye care specialists. In addition, ongoing education and training for emergency doctors on how to handle common eye emergencies can boost their confidence and improve service quality, thus helping to avoid serious long-term vision problems (Maria, 2024). In conclusion, understanding these concepts is crucial for good emergency eye care.

In the field of ocular emergencies, it is very important to have a clear classification system for proper diagnosis and treatment. These emergencies can be categorized in different ways, including the type of injury, how urgent it is, and the underlying cause. For example, we may broadly divide them into traumatic and non-traumatic types. Traumatic conditions include phenomena like foreign objects in the eye and scratches on the cornea. Non-traumatic cases may encompass infections such as endophthalmitis and acute glaucoma (Shinde & Birru, 2024). This classification helps emergency medical workers decide what to treat first. Recent research shows that a worrying 80.9% of emergency referrals are not urgent, suggesting a possible waste of resources (Hammed et al., 2023). The effective classification of ocular conditions not only improves patient results but also makes healthcare delivery more efficient by easing unnecessary strains on emergency services. Highlighting the need for classification ensures that medical professionals are ready to tackle these varying clinical situations, and will help to maintaining vision and enhancing care quality.

1. Emergency Ophthalmologic Assessment

Ocular emergencies pose a significant challenge in clinical practice, requiring both rapid intervention and precise diagnostic expertise. Ocular complaints represent up to 3% of all emergency department visits, emphasizing the importance of adopting accurate and efficient examination techniques in high-stakes environments. The systematic evaluation of acute ophthalmologic conditions necessitates a structured and hierarchical approach that seamlessly integrates initial emergency assessment with advanced specialist care. This comprehensive protocol may be divided into two interconnected phases: the critical first-line evaluation and the subsequent specialized ophthalmologic assessment. The initial emergency phase focuses on establishing fundamental parameters through vital history-taking, basic examination techniques, and essential diagnostic tests, representing the foundation of urgent ophthalmic care. Building on this, the advanced specialist evaluation incorporates sophisticated imaging modalities, detailed structural analyses, and complex therapeutic decision-making processes. By integrating these sequential levels of assessment, this approach ensures optimal patient outcomes, balancing the urgency of the situation with the need for thorough diagnostic evaluation. This systematic framework not only facilitates accurate diagnosis and timely treatment, but also ensures a seamless transition between emergency care and specialized ophthalmologic management, ultimately enhancing visual outcomes in acute ocular emergencies (Evans et al., 2023)(Shahetet al., 2020).

1.1.Initial Emergency Assessment (First-Line Evaluation)

1.1.1.Vital History Taking

- Onset and duration of symptoms
- Pain characteristics
- Visual changes
- Trauma history if applicable
- Systemic conditions

1.1.2.Basic Examination Steps

- Visual acuity measurement
- Basic pupillary light reflex
- Gross external examination
- Confrontation visual fields
- Basic penlight examination

1.1.3.Essential Initial Tests

- IOP measurement with tonometry
- Basic fluorescein staining
- Simple red reflex test
- Direct ophthalmoscopy
- Basic slit-lamp examination

1.1.4.Initial Documentation

- Basic visual acuity records
- Primary findings
- Initial treatment decisions
- Referral requirement assessment
- Advanced Ophthalmologist's Specialized Emergency Assessment
- Comprehensive Specialist Evaluation

1.2.Advanced Diagnostic Techniques

- Goldmann applanation tonometry
- Dynamic gonioscopy
- Detailed slit-lamp biomicroscopy
- Indirect ophthalmoscopy with scleral depression

1.2.1.Specialized imaging

- AS-OCT for anterior segment analysis
- Posterior segment OCT
- B-scan ultrasonography

1.2.2.Detailed pupillary assessment

- Quantitative RAPD evaluation
- Pharmacological testing

1.2.3.Specialized Staining Techniques

- Rose Bengal

- Lissamine green
- Corneal sensitivity testing
- Formal visual field assessment

1.2.4.Complex Decision Making and Surgical Intervention Assessment

- Timing determination
- Approach selection
- Risk stratification

1.2.5.Advanced Medical Management

- Medication interactions
- Dosing modifications
- Treatment sequencing

1.2.6.Specialized Documentation

- Digital imaging documentation
- Medical-legal consideration documentation

1.2.7.Advanced Management Planning

- Emergency surgical planning if needed
- Complex medical therapy protocols
- Interdisciplinary consultation coordination
- Long-term management strategy development

Table1. Diagnostic Technique Use Analysis

Technique	Description	Common Uses
Slit Lamp Examination	Direct visualization of anterior segment	Corneal injuries, anterior chamber assessment
Ophthalmoscopy, Retinoscopy, Fundoscopy	Examination of anterior and posterior segments	Retinal detachment, hemorrhage detection
Tonometry	Measurement of intraocular pressure	Glaucoma assessment, acute pressure changes
Gonioscopy	Examination of anterior chamber angle	Angle closure assessment
OCT	High-resolution imaging of retinal layers	Macular edema, retinal thickness measurement
B-scan Ultrasound	Posterior segment imaging through opaque media	Retinal detachment when view obscured
OCTA	Retinal metrics: vessel density, perfusion density, FAZ, fractal dimension	Diabetic retinopathy: staging, ischemia, FAZ enlargement, treatment monitoring, AMD: CNV detection/typing, therapy response
AS-OCT	Examination of anterior segment	Angle-Closure Glaucoma, corneal Emergencies

OCT; Optical coherence tomography, AS-OCT; Anterior segment optical coherence tomography

2. Diagnostic Methods and Imaging Techniques

Understanding eye emergencies is very important for a quick and effective clinical response. Rapid recognition and handling of these cases can greatly improve patient results, since quick treatment often reduces complications that can derive from issues like blunt trauma, retinal detachment, or acute glaucoma. Doctors use different diagnostic tools, including advanced imaging methods, to evaluate and diagnose these emergencies correctly (Table1). For example, eye imaging techniques, such as optical coherence tomography and fluorescein angiography, improve the detection of retinal problems and blood flow changes, which are particularly important in cases of diabetic retinopathy (Mahendradas et al., 2024). Additionally, combining thorough clinical evaluations with imaging yields a better view of the eye's structure and problems, setting the stage for effective treatments. A unified approach that blends diagnostic skills with clinical knowledge is therefore crucial in dealing with eye emergencies, highlighting their importance in the clinical setting (Cristescu et al., 2019)

2.1. Slit Lamp Examination

The slit lamp biomicroscope is a vital diagnostic instrument in ophthalmology, providing stereoscopic magnified views of the eye's anterior segment structures, including the cornea, anterior chamber, iris, and lens. Using a high-intensity light source focused into a thin slit, it enables detailed visualization through various illumination techniques such as direct focal, indirect, and retroillumination. This versatility allows clinicians to systematically evaluate each layer of the cornea and anterior chamber, making it indispensable for both routine assessments and emergency care. In cases of corneal injuries, the slit lamp excels in detecting and characterizing epithelial defects, stromal infiltrates, and foreign bodies, with fluorescein staining enhancing the visibility of abrasions and ulcerations. In traumatic cases, it is particularly valuable in examining the anterior chamber, revealing the presence of cells, flare, or hyphema, which indicate inflammation or hemorrhage. Additionally, the Van Herick technique performed at slit lamp examination facilitates the assessment of the anterior chamber angle, which is critical for evaluating the risk of angle-closure glaucoma. Its ability to provide both qualitative and semi-quantitative measurements of anterior segment pathology ensures its role as an essential tool for diagnosis, treatment planning, and monitoring therapeutic responses in corneal and anterior segment disorders (Shu, Wang J, & Hu, 2019).

2.2. Ophthalmoscopy, Retinoscopy, Fundoscopy

2.2.1. Ophthalmoscope

The ophthalmoscope is a cornerstone diagnostic tool in emergency ophthalmology, enabling direct visualization of the posterior segment of the eye. This handheld device employs a focused beam of light and a series of lenses to illuminate and examine the retina, optic disc, and posterior pole structures. In emergency scenarios, the ophthalmoscope is indispensable for identifying sight-threatening conditions such as papilledema, which may signal increased intracranial pressure, retinal detachment requiring urgent surgical intervention, or central retinal artery occlusion necessitating immediate treatment. With approximately 15x magnification and a 5-degree field of view, the direct ophthalmoscope allows detailed examination of the optic nerve head for signs of edema, hemorrhage, or pallor. Emergency physicians rely on this instrument for rapid assessments in cases of acute vision loss, severe headaches with visual symptoms, or ocular trauma, in which timely diagnosis is critical for preserving vision (Keeler, C. R).

2.2.2 Retinoscopy

While traditionally associated with routine refractive error evaluation, the retinoscope occupies a distinct place in emergency ophthalmology. This specialized instrument projects a streak or spot of light into the eye, analyzing the movement of the reflected light from the retina (retinal reflex). In emergencies, the retinoscope is particularly valuable for detecting media opacities such as traumatic cataracts, vitreous hemorrhage, or corneal edema, which may obstruct clear visualization of the fundus. Its ability to assess the quality and characteristics of the red reflex makes it especially useful in pediatric emergencies, including suspected retinoblastoma or congenital cataracts. Furthermore, in situations in which conventional visual acuity testing is challenging due to patient cooperation or communication barriers, retinoscopy provides objective insights into the optical status of the eye (Corboy, 2024).

2.2.3.Fundoscopy

Fundoscopy, encompassing both direct and indirect examination techniques, represents a critical diagnostic approach in emergency ophthalmology. Unlike the direct ophthalmoscope, indirect fundoscopy employs a head-mounted binocular device paired with a condensing lens, providing a stereoscopic view of the retina with a significantly wider field of view (approximately 30 degrees). This broader perspective is essential in emergency settings for identifying peripheral retinal pathologies such as retinal tears, hemorrhages, or signs of infectious retinitis. The stereoscopic capability of indirect fundoscopy enhances the evaluation of elevated lesions, making it particularly effective for assessing conditions including choroidal melanomas or retinal detachments. In acute scenarios, its ability to examine the peripheral retina through small pupils and media opacities renders it indispensable for comprehensive evaluations of trauma cases, suspected endophthalmitis, or acute retinal vascular events (Driban, 2024).

2.3.Tonometry

Tonometry is a vital tool in eye care, one used to measure intraocular pressure, which is essential for maintaining the health and function of the eye. This measurement is particularly important in diagnosing and managing glaucoma, a condition in which elevated eye pressure can lead to optic nerve damage and vision loss if left untreated. The most widely used method, Goldmann applanation tonometry, gently flattens a small area of the cornea to determine the pressure inside the eye, providing accurate and reliable results. Modern advances, such as non-contact and rebound tonometry, have made the process quicker and more comfortable, especially for children or patients who may be anxious about the procedure. In addition to routine check-ups, tonometry plays a critical role in emergency situations, such as detecting acute pressure spikes in angle-closure glaucoma, which require immediate intervention to prevent permanent vision loss. By offering a simple, painless, and effective means of monitoring eye pressure, tonometry helps protect vision and permits the provision of timely treatment for a range of ocular conditions (Cook et al., 2012).

2.4.Gonioscopy

Gonioscopy is a crucial diagnostic technique in ophthalmic emergencies, particularly for assessing the status of the anterior chamber angle. As the reference standard for evaluating angle closure risk, it plays a pivotal role in managing acute angle-closure glaucoma, an ocular emergency marked by a rapid rise in intraocular pressure. By enabling direct visualization of the anterior chamber angle structures, gonioscopy allows clinicians to identify anatomical variations, angle abnormalities, and potential obstructions to aqueous outflow that may trigger acute angle closure. In emergency scenarios, prompt gonioscopic examination can detect peripheral anterior synechiae, appositional angle closure, or other pathological changes that require immediate intervention. Its capacity for real-time, dynamic assessment of angle configuration is invaluable in determining the need for urgent therapeutic measures, such as laser peripheral iridotomy or medical management, to prevent irreversible optic nerve damage and vision loss (Nolan, 2022).

2.5. Optical coherence tomography

Optical coherence tomography (OCT) is a noninvasive imaging technology primarily used in ophthalmology to produce high-resolution, three-dimensional cross-sectional images of the eye. It enables detailed visualization of the retina, where healthy tissue exhibits smooth, regular layers. Deviations from this structure, such as irregularities, elevations, or depressions, may indicate pathological conditions.

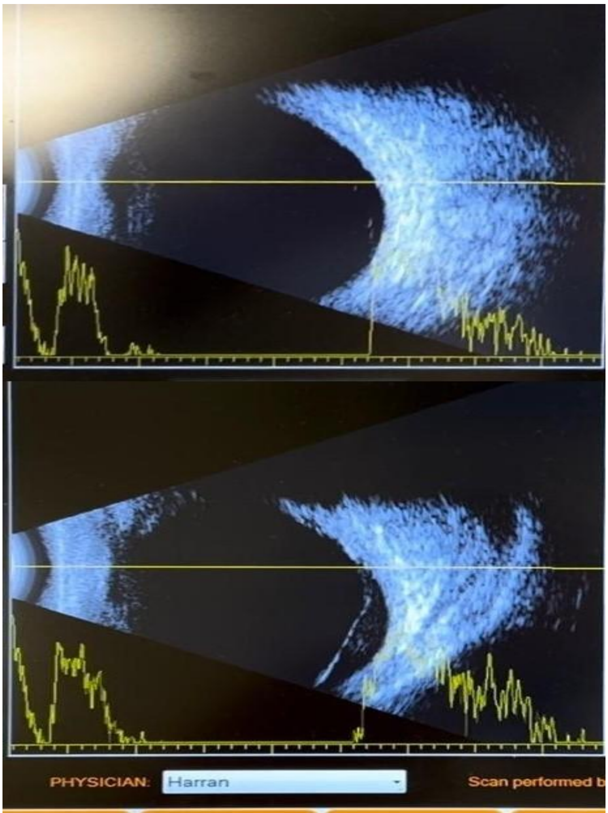
Quick and correct diagnosis in eye emergencies is very important in order to avoid serious vision loss. Important diagnostic tools include OCT, fluorescein angiography, and ultrasonography, each conferring special benefits for the rapid checking of eye issues. For instance, OCT yields clear images of the retina and optic nerve, helping doctors to see small changes that may indicate serious problems. On the other hand, fluorescein angiography helps check blood flow problems, such as diabetic retinopathy or retinal detachment, by showing how blood moves and leaks in the retinal vessels. Recent studies show that early diagnosis and treatment of eye issues can help prevent lasting vision loss (Saleh et al., 2022).

Optical coherence tomography is a critically important diagnostic tool in emergency settings, particularly for identifying pathologies associated with acute vision loss. It is highly effective in detecting conditions such as retinal detachment, optic nerve edema, retinal vascular occlusions, and macular problems, all of which can lead to sudden vision impairment. OCT's advantages include its ability to be used with light-sensitive patients due to its near-infrared light source, rapid imaging capabilities essential for urgent interventions, and its non-invasive nature, which ensures patient comfort. Specific applications include detailed examination of retinal layers, early detection of macular edema and retinal detachment, and evaluation of retinal and choroidal structures in cases of blurred vision. Additionally, OCT is instrumental in diagnosing vitreous detachment and retinal tears in patients reporting light flashes or floaters. By enabling the swift identification of conditions requiring surgical or medical intervention, OCT plays a pivotal role in guiding treatment plans and determining whether vision loss is reversible. This technology provides maximum diagnostic information with minimal patient discomfort, making it indispensable in acute ophthalmic care (Lains et al., 2021).

2.6. B-scan Ultrasound

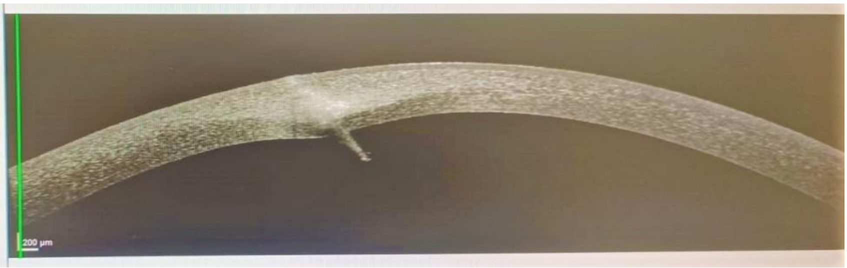
B-scan ultrasound is a diagnostic imaging technique that uses high-frequency sound waves to create two-dimensional cross-sectional images of the eye and orbit. It operates by emitting sound waves from a transducer. These penetrate ocular tissues and reflect back to the device based on the density and structure of the tissues encountered. These reflected waves are then processed to generate detailed images, making B-scan ultrasound invaluable for visualizing posterior segment structures obscured by media opacities such as dense cataracts or vitreous hemorrhage. Its significance in ophthalmology lies in its ability to detect and evaluate retinal detachments, intraocular tumors, vitreous opacities, and choroidal abnormalities (Figure 1). In emergency settings, B-scan ultrasound is particularly useful for assessing acute vision loss and ocular trauma. For instance, it can rapidly identify retinal detachments, vitreous hemorrhages, or foreign bodies in cases of trauma, guiding immediate clinical decisions. Additionally, it is a critical tool for diagnosing globe rupture or intraocular hemorrhage in patients with severe eye injuries. By providing real-time, non-invasive imaging, B-scan ultrasound plays a pivotal role in both routine ophthalmic evaluations and urgent care scenarios, ensuring timely and accurate diagnosis (figure 1) (Silverman et al, 2023).

Figure 1: Top: Normal posterior segment architecture with appropriate vitreoretinal interface. Bottom: Pathological separation of the posterior hyaloid membrane, diagnostic posterior vitreous detachment



Source: Department of Ophthalmology Archives, Harran University School of Medicine, Türkiye

Figure 2: Anterior Segment Optical Coherence Tomography (AS-OCT) image of a hyper-reflective foreign body extending into the anterior chamber



Source: Department of Ophthalmology Archives, Harran University School of Medicine, Türkiye

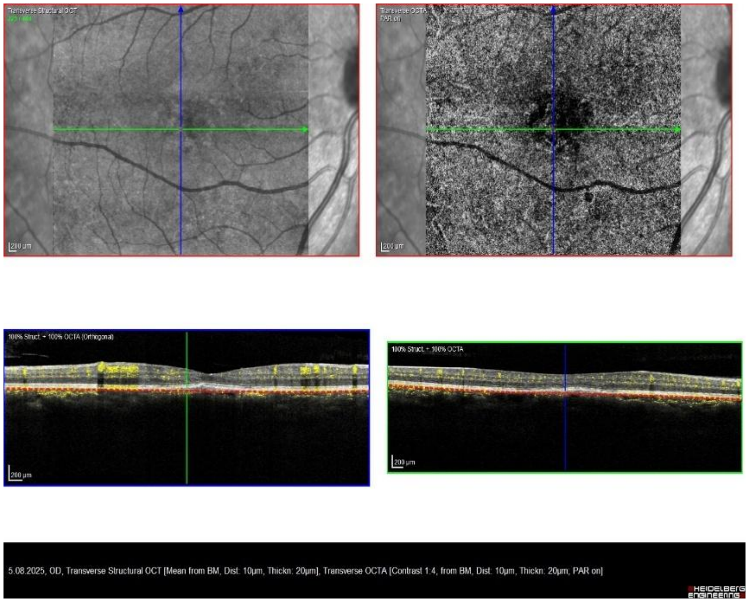
2.7. Anterior segment optical coherence tomography

Anterior segment optical coherence tomography (AS-OCT) is a transformative diagnostic tool in emergency ophthalmology, providing rapid, non-contact, and high-resolution imaging of anterior chamber structures. In acute scenarios, AS-OCT provides critical diagnostic insights through real-time, cross-sectional visualization of the cornea, anterior chamber angle, iris, and anterior lens surface. Its primary applications in emergencies include the evaluation of acute angle-closure glaucoma, where immediate assessment of angle configuration informs urgent intervention strategies; trauma cases, where it enables detailed imaging of structural damage without requiring direct contact; and corneal emergencies, permitting precise measurements of corneal thickness, foreign body depth, and the extent of infections (Figure 2). The non-contact nature of AS-OCT, combined with its ability to generate quantitative measurements, makes it particularly advantageous in situations in which traditional examination methods are hindered by patient discomfort or corneal opacity. The integration of AS-OCT into emergency protocols has significantly enhanced diagnostic accuracy and treatment planning, providing emergency physicians with a reliable method for documenting and monitoring acute anterior segment pathologies. This technology facilitates evidence-based clinical decision-making, ensuring timely and effective management of urgent ophthalmic conditions (figure 2) (Asam et al., 2019).

2.8. Optical Coherence Tomography Angiography

Optical Coherence Tomography Angiography (OCTA) is a modern, noninvasive scan that maps the tiny blood vessels in the retina and choroid without needing dye. It can look at different layers of the eye—like the superficial and deep capillary plexuses, the outer retina, and the choriocapillaris—and measure things such as vessel density, perfusion, and the size of the foveal avascular zone. In the clinic, this helps doctors spot early, layer-specific changes in conditions like diabetic retinopathy, age-related macular degeneration, retinal vein occlusions, and glaucoma. OCTA isn't perfect: movement during the scan, projection artifacts, and segmentation errors can affect images, the field of view is limited, and it doesn't show leakage the way fluorescein angiography does. Even so, its high resolution, fast imaging, and reliable measurements have made it a go-to tool for understanding retinal and choroidal disease, tracking progression, and evaluating treatment (figure 3) (De Carlo et al.,2015).

Figure 3. Optical coherence tomographic angiography (OCTA) image of the right eye. In the en face projection, the foveal avascular zone (FAZ) is observed centrally in the macular region; the perifoveal capillary network architecture and vessel density are distinctly delineated. The superficial capillary plexus is shown in the upper panel, and the deep capillary plexus in the lower panel.



Source: Department of Ophthalmology Archives, Harran University School of Medicine, Türkiye

2.8.Other Retinal Imaging Techniques

2.8.1.Retinal Oximetry and Hyperspectral Imaging

Since the function of the retinal and choroidal vascular system is to deliver oxygen to the retina, non-invasive assessment of retinal oxygenation has become an important area of interest. The fundamental principle underlying current oximetry techniques is based on the different optical properties of oxygenated and deoxygenated hemoglobin, each absorbing different amounts of light at different wavelengths. By stimulating the retina with two or more different wavelengths and measuring the light reflected from blood vessels and the external vascular network, optical density and ratio can be calculated (Nanegrungsunk et al., 2022).

Figure 4: A smartphone-based portable fundus camera; a retinal image is displayed on the screen. This device enables fast and practical screening of retinal diseases.

Source: US Ophthalmic (https://usophthalmic.com/)

2.8.2.Smartphone-based Fundus Camera

With the increasing need to provide accessible DR imaging to as wide a population as possible, smartphone-based fundus imaging has begun to attract attention due to its low cost and portability. A smartphone-based fundus camera can record a video of the fundus using a camera application (app) installed on the device and special lenses, and image frames can then be edited or enhanced as needed using software (figure 4)(Raju et al.,2016).

2.8.3.Artificial Intelligence and Innovative Software

AI approaches that automatically evaluate retinal images (currently primarily CFPs) for retinopathy are ready to play an important forward-looking role in the DR screening model. They demonstrate the potential to replace specialists while providing similar levels of accuracy but better cost-effectiveness. Two fully autonomous AI-based DR screening tools and algorithms are FDA-approved and commercially available (EyeArt [Eyenuk Inc., CA, USA] and IDx-DR [Digital Diagnostics Inc., IA, USA]). A recent study showed that applying AI (EyeArt, Eyenuk) to the DR screening paradigm with CFP obtained in a primary care clinic serving low-income patients increased compliance with follow-up eye care recommendations while reducing referrals for patients with low-risk characteristics calculated (Nanegrungsunk et al., 2022).

3.Principles of Initial Intervention and Emergency Protocols

In the event of eye emergencies, every minute counts – in the same way that you would rush to help someone who has hurt themselves. It may be compared to a well-rehearsed emergency plan, similar to how we know to call 112 in a crisis. Eye doctors and emergency staff follow clear, step-by-step guidelines to quickly figure out what is wrong and provide the correct treatment to save someone's vision. It is like having a trusted roadmap that helps medical teams work efficiently when time is precious, making sure your eyes get the care they need, when they need it most (Jeannin et al., 2016).

The systematic approach to ophthalmic emergencies necessitates a structured triage protocol that facilitates rapid assessment and appropriate intervention based on the severity and nature of the ocular pathology. This comprehensive flowchart describes a hierarchical decision-making process, beginning with initial risk assessment and progressing through three distinct priority classifications, immediate intervention (Category I), urgent intervention (Category II), and semi-urgent intervention (Category III), each with specific time-sensitive requirements for medical responses. The protocol subsequently branches into specialized intervention pathways for chemical injuries, acute angle-closure, and trauma management, incorporating standardized emergency procedures that encompass both medical management and surgical preparation protocols. This systematic framework culminates in robust documentation and communication protocols, ensuring seamless interdisciplinary coordination and comprehensive patient care documentation, thereby optimizing outcomes in acute ophthalmic emergencies while maintaining medical-legal compliance (Figure 3). Table 2 provides a comprehensive summary of ophthalmic emergencies requiring immediate intervention and their corresponding initial management protocols. A comprehensive emergency eye care protocol is presented below, encompassing a structured four-tier system of triage, immediate intervention, standardized procedures, and documentation protocols for the effective management of ophthalmic emergencies from initial assessment to follow-up care.

3.1. Emergency Triage Protocols

31.1.Initial Risk Assessment

Vision-threatening conditions identification

Pain severity evaluation

Structural integrity assessment

Neurological status evaluation

3.1.2.Priority Classification

3.1.2.1.Category I: Immediate intervention required (within minutes)

Chemical burns

Acute angle-closure glaucoma

Globe rupture

3.1.2.2.Category II: Urgent intervention (within hours)

Retinal detachment

Acute iritis

Corneal ulceration

3.1.2.3.Category III: Semi-urgent (within 24 hours)

Peripheral retinal tears

Posterior vitreous detachment

Non-penetrating trauma

3.2. Immediate Intervention Protocols

3.2.1.Chemical Injury Protocol

Immediate irrigation initiation

pH measurement

Visual acuity documentation

Anterior segment evaluation

Medical therapy implementation

3.2.2.Acute Angle-Closure Protocol

IOP measurement

Medical pressure reduction

Pain management

Peripheral iridotomy preparation

Monitoring protocol implementation

3.2.3.Trauma Management Protocol

Globe protection

Tetanus prophylaxis assessment

Antibiotic administration

Imaging studies coordination

Surgical planning initiation

3.3. Standardized Emergency Procedures

3.3.1.Medical management

Evidence-based medication protocols

Route of administration selection

Doing schedules establishment

Contraindication assessment

Drug interaction evaluation

3.3.2.Surgical Preparation

Operating room notification

Equipment preparation

Consent process initiation

Team coordination

Post-operative planning

3.4. Documentation and Communication Protocols

3.4.1.Emergency Documentation

Standardized assessment forms

Imaging documentation

Intervention timing records

Communication logs

Follow-up planning

3.4.2.Interdisciplinary Communication

Emergency department coordination

Specialist consultation protocols

Transfer arrangements

Family communication guidelines

The successful management of ophthalmic emergencies depends on the systematic implementation of standardized protocols, ensuring rapid, appropriate intervention while maintaining comprehensive documentation and effective communication across the healthcare team (Joshua et al., 2020).

Figure 4. Emergency Eye Care Protocol (Flow diagram)

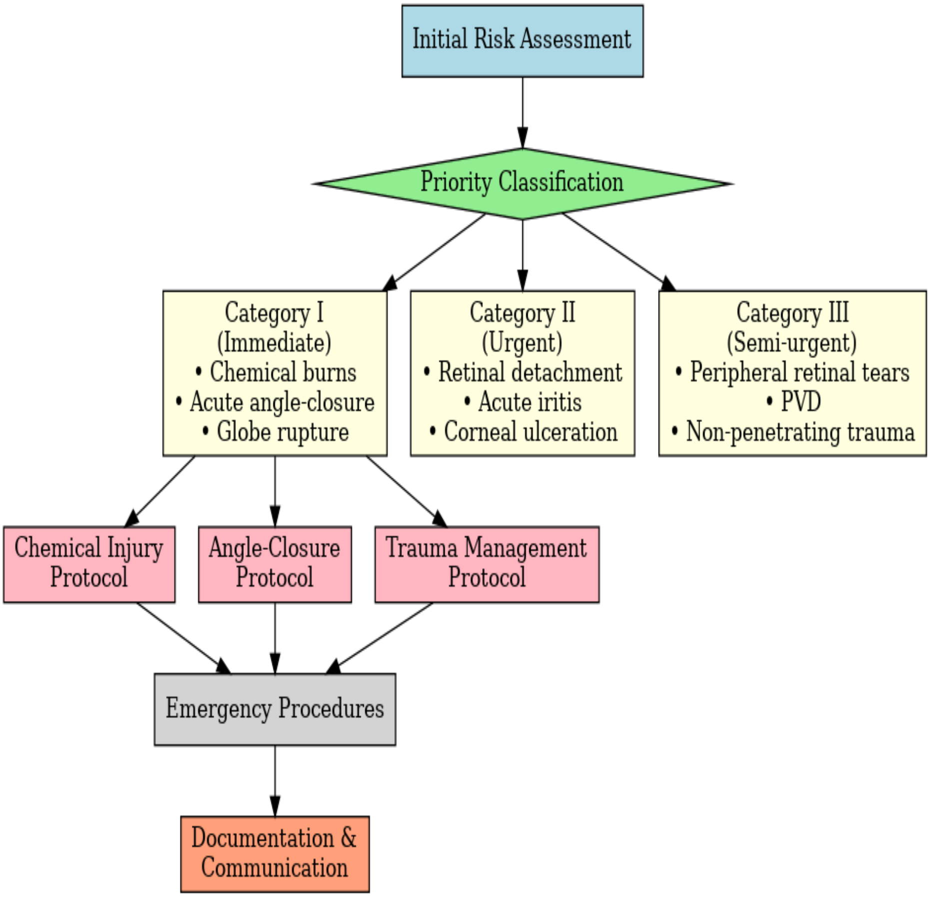


Table 2: Types of Eye Emergencies

Emergency Type	Description	First Aid/Initial Management
Chemical Burns	Exposure to acids, alkalis, or other harmful substances	Immediate irrigation with sterile saline or clean water for at least 15-30 minutes
Trauma/Foreign Body	Physical injury or foreign object in the eye	Do not rub the eye, shield it if possible, seek immediate medical attention
Acute Angle-Closure Glaucoma	Sudden increase in intraocular pressure	Urgent ophthalmological referral, pain management
Retinal Detachment	Separation of retina from underlying tissue	Immediate referral to ophthalmologist, avoid strenuous activity
Corneal Ulcer	Infection or inflammation of cornea	Urgent antibiotic treatment, ophthalmological evaluation
Orbital Cellulitis	Infection of eye socket tissues	Immediate IV antibiotics, hospitalization may be required
Endophthalmitis	Severe internal eye infection	Emergency ophthalmological intervention, intravitreal antibiotics
Central Retinal Artery Occlusion	Blockage of main retinal artery	Immediate ophthalmological treatment, time-critical intervention
Acute Vision Loss	Sudden decrease or loss of vision	Emergency ophthalmological evaluation, protect the eye

4. Ophthalmic Emergencies in Systemic Diseases

4.1.Introduction

Ophthalmic emergencies in systemic diseases represent a critical intersection of multisystem pathology and vision-threatening conditions that demand immediate recognition and intervention by healthcare providers. The eye, serving as an accessible extension of the central nervous system and vascular network, often manifests early signs of systemic diseases through various sight-threatening complications that require urgent attention. In modern medicine, the increasing prevalence of systemic conditions such as diabetes mellitus, hypertension, and autoimmune disorders has led to a proportional rise in associated ophthalmic emergencies, necessitating a comprehensive understanding of their pathophysiological mechanisms and management protocols (Table3). The spectrum of these emergencies ranges from acute angle-closure glaucoma in systemic hypercoagulable states to vision-threatening retinal vasculitis in autoimmune conditions, presenting unique diagnostic and therapeutic challenges that require immediate intervention to prevent irreversible vision loss. The complexity of these cases is further amplified by the delicate balance required in managing both the underlying systemic condition and its ocular manifestations, often necessitating a coordinated multidisciplinary approach involving ophthalmologists, internists, and other specialists. Recent advances in diagnostic imaging, including optical coherence tomography angiography and ultra-widefield imaging, have revolutionized our ability to detect and monitor these conditions with unprecedented precision, facilitating early intervention in vision-threatening emergencies. The management of these cases often requires a nuanced understanding of both local ocular therapeutics and systemic medications, with careful consideration of their interactions and potential complications (Aroch, Ofri & Sutton, 2009). Furthermore, the emergence of targeted biological therapies has introduced new treatment paradigms while simultaneously creating novel challenges in managing their potential ocular side-effects. The time-sensitive nature of these conditions, coupled with their potential for devastating visual outcomes, underscores the critical importance of establishing standardized emergency protocols and referral networks. Finally, the ongoing evolution of telemedicine and artificial intelligence in ophthalmology presents new opportunities for early detection and management of these emergencies, particularly in resource-limited settings where access to specialized care may be challenging (Biousse, Nahab & Newman, 2018).

Table 3. Common Systemic Diseases Associated with Eye Emergencies

Systemic Disease	Associated Eye Emergency	Key Clinical Features
Acquired Syphilis	Acute uveitis, interstitial keratitis, optic neuritis	Granulomatous uveitis, retinal vasculitis, pupillary abnormalities
Varicella-Zoster Virus	Herpes zoster ophthalmicus, acute retinal necrosis	Vesicular rash in V1 distribution, corneal dendritic ulcers, acute severe pain
Behçet's disease	Acute anterior uveitis Posterior uveitis Kystoid macular edema	recurrent oral ulcers + at least two of (genital ulcers, typical skin lesions, eye involvement, pathergy positivity)
Sarcoidosis's disease	Acute uveitis, Glaucoma (including angle-closure),Retinal vascular occlusion,Exudative retinal detachment	Painful red eye, photophobia, decreased vision, floaters; granulomatous KPs, iris nodules, vitritis, cystoid macular edema
Tuberculosis's disease	Acute uveitis , retinal vasculitis, papillitis, scleritis.	Chronic granulomatous uveitis, cord-like peripheral

		vasculitis, choroidal tubercles/tuberculoma.
Lyme Disease	Acute uveitis, optic neuritis, cranial nerve palsies	Conjunctivitis, Bell's palsy, retinal vasculitis with cotton wool spots
AIDS	CMV retinitis, acute retinal necrosis, infectious retinitis	Progressive vision loss, retinal white infiltrates, hemorrhages
Reiter's Syndrome	Acute anterior uveitis, severe conjunctivitis	Bilateral conjunctival injection, mucopurulent discharge, photophobia
Infectious Endocarditis	Endophthalmitis, septic retinal emboli	Roth spots, retinal hemorrhages, sudden vision loss
Kawasaki's Disease	Bilateral acute anterior uveitis, conjunctival injection	Bilateral non-exudative conjunctivitis, anterior chamber inflammation
Temporal Arteritis	Anterior ischemic optic neuropathy (AION), central retinal artery occlusion	Acute vision loss, scalp tenderness, jaw claudication
Hypertension	Hypertensive crisis with papilledema, retinal hemorrhages	Grade IV retinopathy, flame hemorrhages, cotton wool spots, disc edema
Diabetes	Proliferative diabetic retinopathy, vitreous hemorrhage	Neovascularization, preretinal hemorrhage, macular edema

4.2. Ocular Manifestations in Systemic Diseases

4.2.1. Acquired syphilis

Ocular Manifestations:

- Uveitis
- Keratitis
- Iridocyclitis
- Chorioretinitis
- Posterior uveitis

- Vaso-occlusive retinal changes
- Retinal detachment
- Argyll Robertson pupil
- Third and sixth cranial nerve palsies
- Visual field defects

Clinical Significance:

Reversible if detected and treated early. More severe eye disease and higher complication rates are observed in HIV patients.

Management Approach:

- IV benzylpenicillin G 18-24 million units/day (3-4 million units q4h for 10-14 days)
- Oral prednisone 60-80 mg daily for severe inflammation, taper over 2-4 weeks
- Monitor CSF and RPR titers at 3, 6, and 12 months
- Alternative: Doxycycline 100 mg BID for 28 days if penicillin-allergic
- Quarterly VDRL/RPR monitoring in the first year
- (Tsan & Claiborne, 2021)

4.2.2.Varicella-zoster virus infection

Ocular Manifestations:

- Eyelid vesıcles and crusting
- Conjunctival vesicles and ulcers
- Corneal vesicles and ulcers

- Iridocyclitis
- Glaucoma
- Cataracts
- Chorioretinitis
- Optic neuritis or atrophy
- Internal ophthalmoplegia

Clinical Significance:

Potential for chronic ocular inflammation\vision loss\severe pain.

Management Approach:

Valacyclovir 1000 mg TID or famciclovir 500 mg TID for 7-10 days. Topical ganciclovir 0.15% gel 5x daily for dendritic keratitis. Prednisolone acetate 1% q2-3h for stromal keratitis/uveitis. IOP monitoring and management in secondary glaucoma. Prophylactic acyclovir 800 mg daily for 12 months in high-risk cases (Sanjay, Huang&Lavanya, 2011).

4.2.3.Lyme disease

Ocular Manifestations:

- Conjunctivitis
- Periorbital edema
- Photophobia
- Iridocyclitis
- Retinal vasculitis
- Disc edema

- Choroiditis
- Paralytic mydriasis
- Horner's syndrome
- Argyll Robertson pupil
- Orbital myositis
- Episcleritis
- Stromal keratitis
- Vitritis
- Pars planitis

Clinical Significance:

Potential for severe ocular complications in late-stage disease.

Management Approach:

IV ceftriaxone 2 g daily for 14-28 days in neuro-ophthalmic cases.

Oral doxycycline 100 mg BID for 21-28 days in early-stage disease.Topical prednisolone acetate 1% q2-4h for anterior inflammation. Pulse methylprednisolone 1 g daily for 3-5 days in severe optic neuritis. Regular visual field and OCT monitoring (Lindström et al., 2022).

4.2.4.Acquired immunodeficiency syndrome (AIDS)

Ocular Manifestations:

- Conjunctival microvascular disease
- Dry eye

- Keratoconjunctivitis sicca
- Chronic allergic conjunctivitis
- Opportunistic infections (viral\protozoal\fungal)
- Kaposi's sarcoma
- Infectious keratitis
- Anterior uveitis
- Retinal microangiopathy
- Cytomegalovirus retinitis
- Retinal detachment
- Optic nerve interference

Clinical Significance:

Potential for vision impairment or blindness.

Management Approach:

- Ganciclovir induction 5 mg/kg q12h for 14-21 days in CMV retinitis. Maintenance valganciclovir 900 mg daily. Intravitreal foscarnet 2.4 mg/0.1mL for resistant cases. Prophylactic valganciclovir if CD4 < 50 cells/μL. Serial fundus photography and OCT every 4-6 weeks (Teoh, Ou, & Lim, 2012).

4.2.5.Reiter's syndrome

Ocular Manifestations:

- Mucopurulent conjunctivitis
- Acute iritis
- Keratitis

Clinical Significance:

- Potential for chronic recurrent ocular inflammation
- Posterior synechiae
- Glaucoma
- Cystoid macular edema
- Cataracts

Management Approach:

- Initiate NSAIDs (e.g., indomethacin or naproxen) for joint symptoms and inflammation Prescribe topical corticosteroids (prednisolone acetate 1%) for anterior uveitis. Consider systemic corticosteroids for severe ocular inflammation.Use disease-modifying antirheumatic drugs (DMARDs) such as sulfasalazine or methotrexate for persistent cases. Treat underlying infection if identified (particularly chlamydial or gastrointestinal infections). Monitor intraocular pressure and manage secondary glaucoma if present. Regular slit-lamp examinations to assess anterior chamber inflammation. Coordinate care with the rheumatologist for systemic management (Suresh,2016).

4.2.6.Infectious endocarditis

Ocular Manifestations:

- Roth's spots
- Focal retinitis
- Embolic retinopathy
- Subretinal abscesses

- Choroidal septic metastasis
- Choroiditis
- Endophthalmitis
- Papillitis
- Optic neuritis

Clinical Significance:

Potential for vision loss

Management Approach:

- Initiate empiric broad-spectrum intravenous antibiotics based on blood culture results. Administer targeted antibiotic therapy for 4-6 weeks, depending on the causative organism. Monitor for septic emboli with regular fundoscopic examinations. Treat endophthalmitis with intravitreal antibiotics if present. Consider early vitrectomy in cases of severe endophthalmitis.Perform serial echocardiograms to monitor vegetation size and cardiac function. Coordinate care with infectious disease specialists and cardiologists. Consider surgical intervention for large vegetations or persistent bacteremia (Neudorfer et al., 1993).

4.2.7.Kawasaki's disease

Ocular Manifestations:

- Bilateral bulbar conjunctivitis
- Anterior uveitis
- Papilledema

- Retinal ischemia
- Dacryocystitis

Clinical Significance:

Potential for vision loss

Management Approach:

- Initiate high-dose intravenous immunoglobulin (IVIG) 2 g/kg as a single infusion within 10 days of fever onset. Administer high-dose aspirin (80-100 mg/kg/day) during acute phase until the fever resolves. Transition to low-dose aspirin (3-5 mg/kg/day) after fever resolution for 6-8 weeks. Monitor for coronary artery aneurysms with serial echocardiograms. Consider a second dose of IVIG for refractory cases. Use pulse methylprednisolone (30 mg/kg/day) for IVIG-resistant cases. Treat anterior uveitis with topical steroids (prednisolone acetate 1%). Regular ophthalmologic follow-up to monitor ocular inflammation (Atzeni et al., 2005).

4.2.8.Temporal arteritis

Ocular Manifestations:

- Amaurosis fugax
- Anterior ischemic optic neuropathy
- Central retinal artery occlusion
- Cilioretinal artery occlusion
- Posterior optic neuropathy
- Choroidal ischemia

Clinical Significance:

High risk of irreversible blindness

Management Approach:

IV methylprednisolone 1000 mg daily for 3-5 days in acute vision loss. Transition to oral prednisone 1 mg/kg/day (max 60 mg) Methotrexate 15-25 mg weekly for steroid-sparing. Maintain prednisone > 20 mg until acute phase reactants normalize. Bone density monitoring and bisphosphonate prophylaxis(González-Gay et al., 2019).

4.2.9. Behçet's disease

Ocular Manifestations:

Recurrent-remitting uveitis, most commonly panuveitis

Anterior uveitis: pain, photophobia, redness; hypopyon may occur

Posterior uveitis/retinal vasculitis: venous-predominant, vessel sheathing, hemorrhages, optic disc leakage

Complications: cystoid macular edema, vitreous hemorrhage, neovascularization, tractional retinal detachment, cataract, steroid-induced glaucoma, optic atrophy

Clinical Significance:

High risk of vision loss/blindness, especially with posterior involvement and frequent flares

Worse prognosis with male sex, younger onset, extensive FA leakage/ischemia

Delayed or insufficient treatment leads to irreversible macular/optic nerve damage

Management Approach:

Acute flare: high-dose systemic corticosteroids (IV pulse for sight-threatening disease); adjunct local steroids for predominantly anterior cases. Steroid-sparing control: azathioprine, cyclosporine A (avoid in neuro-Behçet), interferon-α, or anti-TNF agents (infliximab/adalimumab) for severe/posterior disease. Monitoring targets: close follow-up with FA to eliminate leakage and OCT to resolve macular edema; minimize flare frequency; monitor IOP and complications. Complication management: treat macular edema with systemic control ± localized therapy; for neovascularization/NVG, rapid inflammation control ± PRP and IOP lowering; vitreoretinal surgery for nonresolving hemorrhage or RD; cataract/glaucoma surgery as needed

4.2.10. Sarcoidosis's disease

Ocular Manifestations:

Anterior/intermediate/posterior uveitis; granulomatous KPs, iris nodules, vitritis

Retinal periphlebitis ("candle-wax drippings"); choroidal/retinal granulomas

Optic disc edema/optic neuropathy; occasional choroidal neovascularization

Complications: cystoid macular edema (CME), exudative retinal detachment, cataract, glaucoma

Adnexal involvement: lacrimal gland enlargement, conjunctival granulomas, dry eye

Clinical Significance:

Vision-threatening, chronic–recurrent inflammation with scarring risk

CME, glaucoma, and retinal detachment are major causes of permanent vision loss

Retinal vasculitis/occlusions can cause sudden vision loss

Often coexists with systemic sarcoidosis (pulmonary, cardiac, neuro involvement)

Early diagnosis, close monitoring, and multidisciplinary care are critical

Management Approach:

Inflammation control: topical/periocular/intravitreal and systemic corticosteroids. Cycloplegics for pain/synechiae prevention; IOP-lowering agents, surgery if needed. Steroid-sparing immunomodulators: methotrexate, mycophenolate, azathioprine; biologics (anti-TNF: infliximab, adalimumab) for refractory disease. CME: periocular/intravitreal steroids; consider immunomodulators/anti-TNF; selective use of anti-VEGF. Retinal complications: manage ERD/CNV with retina-directed therapies; vitrectomy/laser as indicated. Follow-up: regular IOP, optic nerve, visual field, and OCT monitoring; systemic workup and infection exclusion (e.g., TB) (Pasadhika et al. 2015).

4.2.11. Tuberculosis's disease

Granulomatous anterior uveitis (keratic precipitates, iris nodules) and posterior uveitis with choroid involvement

Choroidal lesions: multifocal/serpiginous-like choroiditis, choroidal tubercles, tuberculoma, neuroretinitis

Retinal vasculitis (often occlusive), peripheral ischemia, neovascularization

Vitritis, cystoid macular edema; complications include vitreous hemorrhage and cataract

Scleritis/episcleritis; eyelid/conjunctival involvement less common

Unilateral or bilateral; can mimic other infectious/inflammatory uveitides

Clinical Significance:

Important, potentially vision-threatening cause of uveitis, especially in endemic regions

Often lacks pulmonary findings; ocular disease may be the first/only TB manifestation

Diagnosis is challenging and largely presumptive due to nonspecific signs and limited tissue confirmation

Chronic, recurrent inflammatory course; risk of complications such as glaucoma, macular damage

Requires careful differential from sarcoidosis, syphilis, toxoplasmosis, VKH, and idiopathic uveitis

Management Approach:

Consider TB in recurrent/atypical granulomatous uveitis or occlusive retinal vasculitis, especially with epidemiologic risk. Workup: OCT; FA/ICGA for choroid/vasculitis; TST or IGRA; chest imaging; targeted PCR/culture from ocular fluids if feasible.Primary treatment: anti-tubercular therapy (typically 6–9 months), with systemic/topical corticosteroids to control inflammation. Immunosuppressives may be used adjunctively but generally alongside ATT to prevent exacerbation. Monitor visual acuity, inflammation control, and drug toxicity; therapeutic response supports presumptive diagnosis. Multidisciplinary care with ophthalmology and infectious diseases; tailor duration to clinical response and risk profile (Abdisamadov et al.,2020).

4.2.12. Hypertension

Ocular Manifestations:

- Arteriolar narrowing
- Hemorrhages
- Cotton-wool spots
- Macular edema
- Retinal vein occlusion
- Retinal artery occlusion
- Retinal macroaneurysm
- Ischemic optic neuropathy

Clinical Significance:

- Potential for vision loss
- Signal of systemic vascular disease

Management Approach:

Control systemic blood pressure to prevent further ocular damage. Use antihypertensive medications such as ACE inhibitors, ARBs, or calcium channel blockers. Monitor for hypertensive crises and manage with intravenous medications if necessary. Perform regular fundus examinations to assess progression of hypertensive retinopathy. Treat complications such as macular edema with anti-VEGF therapy or laser photocoagulation. Address secondary conditions such as retinal vein occlusion or ischemic optic neuropathy. Coordinate care with a cardiologist or primary care physician for comprehensive management (Ong et al., 2013).

4.2.13.Diabetes

Ocular Manifestations:

Non-proliferative diabetic retinopathy

Pre-proliferative diabetic retinopathy

Proliferative diabetic retinopathy

Central retinal artery occlusion

Central retinal vein occlusion

Ocular motor nerve palsies

Bacterial endophthalmitis

Rhinocerebral mucormycosis

Clinical Significance:

Potential for vision loss\blindness

Management Approach:

Pan-retinal photocoagulation (1200-1600 burns of 500 µm). Anti-VEGF (ranibizumab 0.3mg/aflibercept 2 mg) q4weeks for 3 months. Intensive glycemic control (HbA1c < 7.0%). Early vitrectomy for non-clearing hemorrhage/tractional detachment. OCT angiography and fluorescein angiography q3-4 months. (Bahrami et al., 2017).

4.3. Conclusion

The exploration of ocular manifestations in systemic and infectious diseases underscores the critical role of early recognition and targeted management in preventing irreversible vision loss. This comprehensive review highlights the diverse spectrum of ocular complications, ranging from anterior segment inflammation to posterior segment pathologies, each necessitating a tailored therapeutic approach. The integration of systemic disease management with advanced ophthalmic interventions, such as anti-VEGF therapy, corticosteroid regimens, and surgical techniques, has significantly improved patient outcomes. Furthermore, the importance of interdisciplinary collaboration between ophthalmologists and systemic disease specialists cannot be overstated, as this ensures holistic patient care. Future research should focus on the development of novel diagnostic tools and therapeutic modalities to further enhance the management of these complex conditions.

5. References

Shinde, V. S., & Birru, J. D. (2024). The use of point-of-care ultrasound for a rapid diagnosis of endophthalmitis: A case report. Cureus, 16(9), e68609.

Eleftheriadou, M., et al. (2024). The rapid access eye clinic's playbook: How to cut eye casualty attendance by 50%. Eye, 38(2), 259-265.

Rossi, T., Boccassini, B., Iossa, M., Mutolo, M. G., Lesnoni, G., & Mutolo, P. A. (2007). Triaging and coding ophthalmic emergency—the Rome Eye Scoring System for Urgency and Emergency (RESCUE): A pilot study of 1000 eye-dedicated emergency room patients. European Journal of Ophthalmology, 17(3), 413-417.

Al-Arrayedh, H., O'Doherty, M., Murphy, C., & O'Reilly, F. (2023). An audit of primary care referrals to the ophthalmic accident and emergency department of the Royal Victoria Eye and Ear Hospital, Dublin.

Evans, D. D., & Hoyt, K. S. (2023). Ophthalmologic emergencies: Assessment and management. Advanced Emergency Nursing Journal, 45(4), E9–E38.

Shah, S. M., & Khanna, C. L. (2020). Ophthalmic emergencies for the clinician. Mayo Clinic Proceedings, 95, 1050-1058.

Mahendradas, P., Acharya, I., Rana, V., Bansal, R., Ben Amor, H., & Khairallah, M. (2024). Optical coherence tomography and optical coherence tomography angiography in neglected diseases. Ocular Immunology and Inflammation, 32(7), 1427-1434.

Cristescu, I. E., Ochinciuc, R., Balta, F., & Zagrean, L. (2019). High-resolution imaging of diabetic retinopathy lesions using an adaptive optics retinal camera. Romanian Journal of Ophthalmology, 63(1), 29.

Shu, X., Wang, J., & Hu, L. (2019). A review of functional slit lamp biomicroscopy. Eye and Vision, 6, 1-9.

Corboy, J. M. (2024). The retinoscope: How it works. In The Retinoscopy Book (pp. 7-16). CRC Press.

Driban, M., Yan, A., Selvam, A., Ong, J., Vupparaboina, K. K., & Chhablani, J. (2024). Artificial intelligence in chorioretinal pathology through fundoscopy: A comprehensive review. International Journal of Retina and Vitreous, 10(1), 36.

Cook, J. A., Botello, A. P., Elders, A., Ali, A. F., Azuara-Blanco, A., Fraser, C., ... & Surveillance of Ocular Hypertension Study Group. (2012). Systematic review of the agreement of tonometers with Goldmann applanation tonometry. Ophthalmology, 119(8), 1552-1557.

Nolan, W., & Onakoya, A. (2022). Gonioscopy skills and techniques. Community Eye Health, 34(112), 40.

Saleh, G. A., Batouty, N. M., Haggag, S., Elnakib, A., Khalifa, F., Taher, F., ... & El-Baz, A. (2022). The role of medical image modalities and AI in the early detection, diagnosis and grading of retinal diseases: A survey. Bioengineering, 9(8), 366.Lains, I., Wang, J. C., Cui, Y., Katz, R., Vingopoulos, F., Staurenghi, G., ... & Miller, J. B. (2021). Retinal applications of swept source optical coherence tomography (OCT) and optical coherence tomography angiography (OCTA). Progress in retinal and eye research, 84, 100951.

Silverman, R. H. (2023). Principles of ophthalmic ultrasound. Expert Review of Ophthalmology, 18(6), 379-389.

Asam, J. S., Polzer, M., Tafreshi, A., Hirnschall, N., & Findl, O. (2019). Anterior segment OCT. In High Resolution Imaging in Microscopy and Ophthalmology: New Frontiers in Biomedical Optics, 285-299.

De Carlo, T. E., Romano, A., Waheed, N. K., & Duker, J. S. (2015). A review of optical coherence tomography angiography (OCTA). International Journal of Retina and Vitreous, 1(1), 5.

Nanegrungsunk, O., Patikulsila, D., & Sadda, S. R. (2022). Ophthalmic imaging in diabetic retinopathy: A review. Clinical & Experimental Ophthalmology, 50(9), 1082-1096.

Raju, B., Raju, N. S. D., Akkara, J. D., & Pathengay, A. (2016). Do it yourself smartphone fundus camera—DIYretCAM. Indian Journal of Ophthalmology, 64(9), 663-667.

Jeannin, A., Mouriaux, F., & Mortemousque, B. (2016). Management of ophthalmologic emergencies in general emergency departments: A retrospective multicenter study. Journal Francais d'Ophtalmologie, 39(7), 589-595.

Joshua, H., et al. (2020). Training in and comfort with diagnosis and management of ophthalmic emergencies among emergency medicine physicians in the United States. Eye, 34(9), 1504-1511.

Mahendradas, P., Acharya, I., Rana, V., Bansal, R., Ben Amor, H., & Khairallah, M. (2024). Optical coherence tomography and optical coherence tomography angiography in neglected diseases. Ocular Immunology and Inflammation, 32(7), 1427-1434.

Shu, X., Wang, J., & Hu, L. (2019). A review of functional slit lamp biomicroscopy. Eye and Vision, 6, 1-9.

Keeler, C. R. (2002). The ophthalmoscope in the lifetime of Hermann von Helmholtz. Archives of Ophthalmology, 120(2), 194-201.

Asam, J. S., Polzer, M., Tafreshi, A., Hirnschall, N., & Findl, O. (2019). Anterior segment OCT. In High Resolution Imaging in Microscopy and Ophthalmology: New Frontiers in Biomedical Optics, 285-299.

Aroch, I., Ofri, R., & Sutton, G. A. (2009). Ocular manifestations of systemic diseases. Slatter's Fundamentals of Veterinary Ophthalmology, 374.

Biousse, V., Nahab, F., & Newman, N. J. (2018). Management of acute retinal ischemia: Follow the guidelines! Ophthalmology, 125(10), 1597-1607.

Tsan, G. L., & Claiborne, R. T. (2021). Ocular syphilis. Clinical and Experimental Optometry, 104(7), 756-759.

Sanjay, S., Huang, P., & Lavanya, R. (2011). Herpes zoster ophthalmicus. Current Treatment Options in Neurology, 13(1), 79-91.

Lindström, B. E., Skogman, B. H., Lindström, A. K., Tallstedt, L., & Nilsson, K. (2022). Borrelia ocular infection: A case report and a systematic review of published cases. Ophthalmic Research, 65(2), 121-130.

Teoh, S. C., Ou, X., & Lim, T. H. (2012). Intravitreal ganciclovir maintenance injection for cytomegalovirus retinitis: Efficacy of a low-volume, intermediate-dose regimen. Ophthalmology, 119(3), 588-595.

Suresh, P. S. (2016). Bilateral disciform keratitis in Reiter's syndrome. Indian Journal of Ophthalmology, 64(9), 685-687.

Neudorfer, M., Barnea, Y., Geyer, O., & Siegman-Igra, Y. (1993). Retinal lesions in septicemia. American Journal of Ophthalmology, 116(6), 728-734.

Atzeni, F., Sarzi-Puttini, P., Doria, A., Iaccarino, L., & Capsoni, F. (2005). Potential off-label use of infliximab in autoimmune and non-autoimmune diseases: A review. Autoimmunity Reviews, 4(3), 144-152.

González-Gay, M. Á., Pina, T., Prieto-Peña, D., Calderon-Goercke, M., Gualillo, O., & Castañeda, S. (2019). Treatment of giant cell arteritis. Biochemical Pharmacology, 165, 230-239.

Özyazgan, Y., Uçar, D., Hatemi, G., & Yazici, Y. (2015). Ocular involvement of Behçet's syndrome: A comprehensive review. Clinical Reviews in Allergy & Immunology, 49, 298-306.

Pasadhika, S., & Rosenbaum, J. T. (2015). Ocular sarcoidosis. Clinics in Chest Medicine, 36(4), 669.

Abdisamadov, A., & Tursunov, O. (2020). Ocular tuberculosis epidemiology, clinic features and diagnosis: A brief review. Tuberculosis, 124, 101963.

Ong, Y. T., Wong, T. Y., Klein, R., Klein, B. E., Mitchell, P., Sharrett, A. R., ... & Ikram, M. K. (2013). Hypertensive retinopathy and risk of stroke. Hypertension, 62(4), 706-711.

Bahrami, B., Hong, T., Gilles, M. C., & Chang, A. (2017). Anti-VEGF therapy for diabetic eye diseases. Asia-Pacific Journal of Ophthalmology, 6(6), 5

RED EYE AND ANTERIOR SEGMENT EMERGENCIES

İRFAN UZUN[1]

Introduction

Red eye is a common reason for patients to visit ophthalmology clinics. This condition is characterized by dilation of the blood vessels in the eye and eyelids, which is an important indicator of ocular inflammation. Red eye is a signaling mechanism in the orbit (Toptan, Cadirci & Kocakoglu, 2021). Being able to distinguish between the factors causing red eyes that require urgent intervention is of great importance in protecting the patient's health and preventing serious complications (Palamar, 2021). Although red eye is generally a self-limiting complaint with a good prognosis, a thorough examination and early treatment strategy are vital for the early diagnosis of serious conditions such as keratitis, uveitis, or endophthalmitis and the prevention of permanent consequences (Toptan, Cadirci & Kocakoglu, 2021; Palamar, 2021). Red eyes may be caused by dilation of the conjunctival vessels, episcleral vessels,

[2] Assistant Professor, Harran University, Faculty of Medicine, Department of Ophthalmology, Şanlıurfa/Turkey, Orcid: 0000-0001-6900-6337 irfanuzun@harran.edu.tr

or a combination of both. Conjunctival vessels appear red and are mobile, while episcleral vessels are paler red and less mobile (Singh ve ark., 2021). The causes of red eye are varied, and most are benign and self-limiting. However, some causes can threaten vision and require urgent diagnosis and treatment (Gilani ve ark., 2017; Mahmood & Narang, 2004). Distinguishing the type of hyperemia is critical for correctly diagnosing the cause of red eye. Superficial hyperemia is seen in simple causes such as conjunctivitis, and in this case, hyperemia is minimal around the limbus and more pronounced in the fornices. However, in more serious conditions such as endophthalmitis, hyperemia is pronounced in the limbus and less pronounced in the fornices. In superficial congestion, the vessels can be observed moving when the eyelid is lifted, whereas in deep congestion, the vessels remain stationary. Additionally, instillation of phenylephrine extinguishes superficial hyperemia, but does not cause any change in deep hyperemia. These differences play a critical role in the accurate assessment of the cause of red eye (Palamar, 2021) (Figure 1).

Conditions leading to red eye and anterior segment emergencies will be examined under four main headings:

1. Acute Conjunctivitis and Keratitis
2. Uveitis and Glaucoma Attacks
3. Eyelid and Orbital Emergencies
4. Anterior Segment Traumas and Burns

Figure 1. Corneal ulcer and deep limbal hyperemia following keratitis

Source: Department of Ophthalmology Archives, Harran University School of Medicine, Türkiye

1. Acute Conjunctivitis and Keratitis

1.1 Acute Conjunctivitis

Conjunctivitis is an inflammation of the conjunctiva, the thin membrane that covers the white part of the eyeball and the inside of the eyelids (Mahmood & Narang, 2004). The conjunctiva contains goblet cells that produce a mucus layer to facilitate movement between the eyeball and the eyelid (Singh et al., 2021). Vision is usually preserved. Redness, discharge, swelling of the conjunctiva, and papillae and follicles may be observed in the conjunctiva (Palamar, 2021). Conjunctivitis is the most common cause of red eye and can arise from a variety of causes, including viral, bacterial, allergic, and irritant factors (Mahmood & Narang, 2004).

Etiology:

Conjunctivitis is divided into two main categories: infectious and non-infectious.

- **Infectious Conjunctivitis:** Infectious agents, usually viruses and, less commonly, bacteria, cause infectious conjunctivitis. Viral conjunctivitis, particularly epidemic keratoconjunctivitis caused by adenoviruses, is the most common type of conjunctivitis (Bekmez & Eris, 2020). Bacterial conjunctivitis is usually caused by bacteria such as Staphylococcus aureus, Streptococcus pneumoniae, and Haemophilus influenzae, and may occur in conjunction with viral conjunctivitis.

- **Non-infectious Conjunctivitis:** Non-infectious conjunctivitis may be caused by factors such as allergies, chemicals, irritants, dry eyes, or systemic diseases (Módis & Süveges, 2023). For example, contact lens use can cause mechanical irritation to the eye, leading to giant papillary conjunctivitis (Módis & Süveges, 2023).

Clinical Symptoms:

The signs and symptoms of conjunctivitis can vary depending on the underlying cause and severity of the inflammation. It usually affects both eyes and often includes the following:

- **Red Eye (Hyperemia):** It is caused by dilation of the conjunctival vessels and is the most prominent feature of conjunctivitis.

- **Burning or Itching:** It is a common symptom in infectious or allergic conjunctivitis.

- **Foreign Body Sensation:** Conjunctival inflammation can cause a feeling of grit or foreign body in the eye.
- **Eyelid Swelling:** Conjunctival inflammation can cause edema and swelling of the eyelids.
- **Blurred Vision:** In severe conjunctivitis, blurred vision may occur due to corneal involvement or eye discharge.
- **Light Sensitivity (Photophobia):** This may occur in the presence of keratitis or severe conjunctival inflammation.
- **Eye Discharge:** The nature of the discharge varies depending on the cause. Viral conjunctivitis is characterized by watery discharge, while bacterial conjunctivitis is characterized by yellow or green, sticky discharge. For example, in acute allergic conjunctivitis, a clear, watery discharge may be observed in the eye, along with hyperemia and chemosis in the conjunctiva (Módis & Süveges, 2023).

Diagnosis:

The diagnosis of conjunctivitis is based on the patient's history, symptoms, and findings from an eye examination.

- **Patient History:** The onset, duration, severity, and nature of the patient's symptoms can provide important clues about possible causes. For example, seasonal allergic conjunctivitis is associated with exposure to allergens and occurs mainly in the spring (Módis & Süveges, 2023).
- **Eye Examination:** The appearance of the conjunctiva, the presence and character of eye discharge, the condition of the eyelids, and corneal involvement are carefully

evaluated. In vernal keratoconjunctivitis, giant papillary hypertrophy of the upper tarsal conjunctiva is a characteristic finding (Módis & Süveges, 2023).

- **Laboratory Tests:** Laboratory tests can be used to definitively determine the cause of conjunctivitis:
    - **Eye Discharge Culture:** If bacterial conjunctivitis is suspected, an eye discharge culture is performed to identify the causative bacteria and determine the appropriate antibiotic treatment.
    - **Viral Culture or PCR:** If viral conjunctivitis is suspected, especially in cases with epidemic potential such as adenoviral conjunctivitis, a viral culture or PCR test may be performed.

Viral Conjunctivitis

Viral conjunctivitis is usually caused by adenoviruses and is the most common cause of red eye (Toptan, Cadirci & Kocakoglu, 2021). Adenoviral conjunctivitis is contagious and spreads through direct contact or aerosols (Yeu & Hauswirth, 2020). Viral conjunctivitis is usually a self-limiting condition, and symptoms typically resolve within one to two weeks (Mahmood & Narang, 2004). However, some types of viral conjunctivitis, such as epidemic keratoconjunctivitis, can lead to complications such as corneal involvement and associated decreased visual acuity (Mahmood & Narang, 2004; Toptan et al., 2021). Epidemic keratoconjunctivitis is a severe form of viral conjunctivitis caused by certain serotypes of adenovirus (particularly 8, 19, and 37) (Mahmood & Narang, 2007). Characteristic of epidemic keratoconjunctivitis, 1–2 mm in size, grayish-white, “crumb-like” corneal subepithelial infiltrates, numbering up to 30, may be observed in the central and peripheral regions of the cornea (Mahmood & Narang, 2004). Epidemic keratoconjunctivitis can also lead to subconjunctival hemorrhage, anterior uveitis, keratitis, optic neuritis, and chronic corneal opacities (Yeu & Hauswirth, 2020). Viral conjunctivitis may also be associated with photophobia and decreased vision (Mahmood & Narang, 2020). Treatment is generally supportive and may include cold compresses, artificial tears, and antihistamines. In some cases, antiviral medications may be necessary. Povidone-iodine can be used in the treatment of adenoviral conjunctivitis due to its antiviral effect, and some studies have shown that it reduces the rate of subepithelial corneal infiltrates (Bekmez & Eris, 2020; Soleimani et al., 2023; Altan-Yaycioglu et al., 2019; Kovalyuk et al., 2017).

Bacterial Conjunctivitis

Bacterial conjunctivitis is usually caused by bacteria such as Staphylococcus aureus, Streptococcus pneumoniae, or Haemophilus influenzae and is typically treated with antibiotic eye drops or ointment (Mahmood & Narang, 2004). Purulent discharge, crusting of the eyelashes, and morning eyelid adhesion are typical findings (Palamar, 2021). There is a possibility of association with viral conjunctivitis, and therefore it is important to pay attention to hygiene measures for the possibility of transmission through contact (Hovding, 2008). Cases of methicillin-resistant Staphylococcus aureus (MRSA) conjunctivitis have also been reported (Shanmuganathan et al., 2005). Chlamydial conjunctivitis, also known as trachoma, can lead to blindness if left untreated (Palamar, 2021). The direct and indirect costs of bacterial conjunctivitis in the United States are estimated to be approximately $377 million to $857 million annually (Smith & Waycaster, 2009). In an outbreak of conjunctivitis caused by the ST448 strain of Streptococcus pneumoniae, the costs were estimated to be approximately $178 million per year (Zegans et al., 2009).

Allergic Conjunctivitis

There are different types, such as seasonal allergic conjunctivitis, vernal keratoconjunctivitis, atopic keratoconjunctivitis, and contact allergy (Palamar, 2021; Módis & Süveges, 2023). Seasonal allergic conjunctivitis occurs as a result of exposure to allergens such as pollen, dust mites, and animal dander, and is typically characterized by itching, watery discharge, and swelling of the eyes (Palamar, 2021). Vernal keratoconjunctivitis is an allergic reaction seen in children and young adults, characterized by severe itching, photophobia, and mucous discharge. Atopic keratoconjunctivitis is seen in individuals with other allergic diseases such as atopic dermatitis and is characterized by severe itching, eczema on the eyelids, and corneal damage. Contact allergy results from exposure to substances such as cosmetics, medications, and contact lens solutions and is typically characterized by itching, redness, and swelling (Módis & Süveges, 2023).

Mast cells play an important role in allergic conjunctivitis. Exposure to allergens leads to degranulation of conjunctival mast cells, resulting in the release of inflammatory mediators such as histamine, leukotrienes, and prostaglandins. These mediators are responsible for the symptoms of allergic conjunctivitis, such as itching, redness, swelling, and watery discharge (Singh et al., 2021). The treatment of allergic conjunctivitis aims to avoid allergens and alleviate symptoms (Mahmood & Narang, 2004). Cold compresses, artificial tears, topical antihistamines, and mast cell stabilizers can be used to control symptoms. In severe cases, short-term topical corticosteroids may be prescribed. Topical cyclosporine may be an effective treatment option for chronic allergic conjunctivitis (Módis & Süveges, 2023). Allergic conjunctivitis is the most common ocular allergic disease and affects 20% of the world's population (Rosario & Bielory, 2011).

1.2 Keratitis

Keratitis is an inflammation of the cornea, the transparent layer at the front of the eye. The cornea is responsible for refracting light and helping the eye see clearly (Singh et al., 2021). Keratitis causes symptoms such as pain, photophobia (sensitivity to light), blurred vision, and corneal opacity (Palamar, 2021). Keratitis can be caused by various infectious agents, including bacteria, viruses, fungi, or parasites. Risk factors for microbial keratitis include contact lens use, corneal trauma, eye surgery, immunosuppression, and living in tropical climates (Keay et al., 2006; Liesegang, 1997). Keratitis can cause vision loss and often requires urgent medical intervention. Globally, microbial keratitis is a significant cause of morbidity and blindness, with an estimated 1.5 million new cases annually (Ung et al., 2019).

Etiology:

Keratitis can develop due to infectious and non-infectious causes:

- **Infectious Keratitis:** Bacteria, viruses, fungi, and parasites can cause infectious keratitis. Contact lens use, corneal trauma, eye surgery, and immunosuppression increase the risk of infectious keratitis. Acanthamoeba keratitis, in particular, is commonly seen in contact lens users (Mascarenhas et al., 2013).

- **Bacterial keratitis**: Trauma and contact lens use that cause disruption of the integrity of the corneal epithelium facilitate the development of bacterial keratitis. Initially, epithelial defects and stromal infiltration are observed in the area of inflammation, while hypopyon may also accompany the condition in later stages.

- **Fungal keratitis**: A history of organic trauma should be considered. The clinical course is slow, but the prognosis is generally poor due to delays in diagnosis (Palamar, 2021).
- **Viral keratitis**: Herpes simplex is commonly seen in etiology. Clinically, dendritic ulcer (branched tree-like ulcer on the cornea) is the most common finding (Palamar, 2021).
- **Parasitic keratitis**: It occurs in people with a history of contact lens use or contaminated water exposure. Pain is more severe than in mild cases. Late diagnosis results in vision loss (Palamar, 2021).
- **Non-infectious keratitis:** Non-infectious keratitis can be caused by factors such as dry eye, eyelid diseases, trauma, chemical burns, malnutrition, and systemic diseases (Módis & Süveges, 2023). For example, Mooren's ulcer is a type of peripheral ulcerative keratitis that develops due to sclerosis of the vascular network of the limbus and is commonly seen in elderly men (Módis & Süveges, 2023).

Clinical Symptoms:

The signs and symptoms of keratitis vary depending on the cause and severity of the inflammation. The most common symptoms are:

- **Pain:** Pain from keratitis can be intense and come from deep within the eye.
- **Red Eye:** The eye becomes red due to the dilation of blood vessels around the cornea.

- **Blurred Vision:** Inflammation of the cornea prevents light from passing through, causing blurred vision.
- **Light Sensitivity (Photophobia):** Light can irritate the nerve endings in the cornea, causing discomfort and pain.
- **Watery Eyes:** The eye may produce excessive tears in response to inflammation.
- **Eyelid Spasm (Blepharospasm):** The eyelid may involuntarily close to reduce pain and discomfort.
- **Corneal Ulcer:** An open wound on the surface of the cornea is a serious complication of infectious keratitis and can lead to permanent vision loss (Mascarenhas et al., 2013). In peripheral ulcerative keratitis, a 3–4 mm long, crescent-shaped infiltration near the limbus ulcerates and may subsequently perforate (Módis & Süveges, 2023).

Diagnosis:

Keratitis is diagnosed through a detailed eye examination and laboratory tests.

- **Eye Examination:** Slit-lamp biomicroscopy allows for detailed examination of the cornea. Fluorescein staining reveals damage and ulcers in the corneal epithelium (Mascarenhas et al., 2013).
- **Laboratory Tests:** If infectious keratitis is suspected, a corneal scraping and culture are performed to identify the causative microorganism. If viral keratitis is suspected, a viral PCR test may be requested. Confocal microscopy can be used in the diagnosis of infectious keratitis,

particularly in the differential diagnosis of fungal and Acanthamoeba keratitis (Mascarenhas et al., 2013).

Treatment:

Keratitis treatment varies depending on the underlying cause and severity of inflammation.

- **Infectious Keratitis:** Treatment for infectious keratitis involves antimicrobial drugs that target the causative microorganism.
- **Bacterial Keratitis:** Topical antibiotic drops administered at frequent intervals are commonly used in the treatment of bacterial keratitis (Mascarenhas et al., 2013). In severe cases, systemic antibiotic treatment may be necessary. Fortified antibiotics may be used, particularly in severe or treatment-resistant cases (Mascarenhas et al., 2013).
- **Viral Keratitis:** Antiviral medications are used to treat viral keratitis. In recurrent viral keratitis, such as herpes simplex keratitis, long-term antiviral medication may be necessary. Topical cyclosporine or tacrolimus may be used to treat subepithelial infiltrates that develop after adenoviral keratoconjunctivitis (Bekmez & Eris, 2020).
- **Fungal Keratitis:** Antifungal medications are used to treat fungal keratitis. Treatment is usually long-term and can be administered in the form of eye drops, ointments, or tablets. Topical natamycin and voriconazole are commonly used antifungal agents in the treatment of fungal keratitis (Mascarenhas et al., 2013).
- **Non-infectious Keratitis:** Treatment for non-infectious keratitis is directed at the underlying cause. In cases of

dry eye, artificial tears and eyelid hygiene are recommended. NSAIDs or corticosteroids may be used to reduce inflammation. In peripheral ulcerative keratitis, topical corticosteroids and cyclosporine drops may be used (Módis & Süveges, 2023). In cases of serious complications such as corneal ulcers, corneal transplantation may be necessary.

2. Uveitis and Glaucoma Attacks

2.1 Uveitis

Uveitis is inflammation of the middle layer of the eye, called the uvea. The uvea includes the iris, ciliary body, and choroid. Due to their close proximity, other intraocular structures such as the retina, vitreous, and optic nerve are often also involved in the inflammation. The causes of uveitis include infections (toxoplasmosis, herpes simplex virus, cytomegalovirus, syphilis, tuberculosis), autoimmune diseases (Behçet's disease, sarcoidosis, ankylosing spondylitis, rheumatoid arthritis), trauma, and idiopathic causes (Schwartzman, 2016). Uveitis is a serious condition that can cause vision loss. The prevalence of uveitis varies by geographic region and ethnic origin, with reported prevalence worldwide ranging from 75/100,000 to 714/100,000 (Miserocchi et al., 2013).

Classification of Uveitis:

Uveitis is classified according to the location, duration, etiological, and inflammatory response characteristics of the inflammation.

- **Anatomical Location:** This is the most commonly used anatomical classification.
- **Anterior Uveitis:** This is the most common type of uveitis and usually affects the iris and ciliary body.

Anterior uveitis typically has an acute onset and resolves within a few weeks with treatment. However, recurrent attacks may occur, and in some cases, it may become chronic. Findings such as keratic precipitates in the corneal endothelium, cells, flare, fibrin, and hypopyon in the anterior chamber may be observed. It may develop as a result of herpes simplex virus (HSV) or varicella zoster virus (VZV) infections. In such cases, findings such as keratic precipitates in the endothelium, iris atrophy, pupil distortion, and increased intraocular pressure may be observed.

- **Intermediate Uveitis:** This is inflammation of the vitreous (the jelly-like substance that fills the eye) and the pars plana (the area between the ciliary body and the choroid). Symptoms include blurred vision and floaters (floating objects). Exudation and snowball opacities may be seen in the pars plana region. Intermediate uveitis is less common than anterior uveitis and typically has a more insidious onset. The most common cause is the idiopathic form.
- **Posterior Uveitis:** This is inflammation of the retina and choroid. Posterior uveitis is a significant type of uveitis and can lead to permanent vision loss. Vision loss is proportional to the proximity of the lesion to the macula. Retinitis/choroiditis foci, perivascular sheathing, retinal vein/artery occlusion, optic disc edema, and macular edema may be observed. Behçet's disease, systemic lupus erythematosus, polyarteritis nodosa, and toxoplasmosis are systemic diseases that can cause posterior uveitis.

- **Panuveitis:** Inflammation of all parts of the uvea. It presents with both anterior and posterior uveitis findings. Panuveitis is often associated with systemic diseases and requires aggressive treatment. Diseases such as Behçet's disease and sarcoidosis are among the non-infectious causes of panuveitis, while tuberculosis, toxoplasmosis, and syphilis are infectious causes of panuveitis.
- Duration:
- **Acute Uveitis:** It has a sudden onset and is short-lived.
- **Chronic Uveitis:** It can be long-lasting and occur in recurring attacks. These are cases that recur within 3 months despite treatment.
- **Recurrent Uveitis:** These are cases that recur after a period of three months or longer without treatment and following an inactive period.

Causes of Uveitis:

The causes of uveitis are quite diverse and sometimes the exact cause cannot be determined (Oncul, Kara & Ozdal, 2021). According to a study conducted in Turkey, the etiological causes of uveitis are 76.1% non-infectious, 15.6% infectious, and 8.2% idiopathic diseases. Among non-infectious pathologies, Behçet's disease is a common cause, accounting for 24.9% of cases (Yalcindag et al., 2018).

- **Infections:** Bacteria, viruses, fungi, and parasites can cause uveitis. For example, viruses such as herpes simplex virus, varicella-zoster virus, and Epstein-Barr virus can cause anterior uveitis, while infections such as toxoplasmosis and tuberculosis can also lead to uveitis.

- **Autoimmune Diseases:** Uveitis can develop when the body's immune system attacks the eye's own tissues (Módis & Süveges, 2023). Diseases such as ankylosing spondylitis, Behçet's disease, sarcoidosis, and rheumatoid arthritis are associated with uveitis (Oncul, Kara & Ozdal, 2021).
- **Trauma:** A blow to the eye can cause uveitis.
- **Medications:** Some medications can cause uveitis as a side effect (Módis & Süveges, 2023). For example, medications such as bisphosphonates, sulfonamides, and rifampicin have been associated with uveitis (Oncul, Kara & Ozdal, 2021).
- **Idiopathic Uveitis:** In some cases, the cause of uveitis cannot be determined.

Symptoms of Uveitis:

The symptoms of uveitis can vary depending on the location and severity of the inflammation.

- **Eye Pain:** Usually felt in the affected eye and can vary in intensity.
- **Redness:** In anterior uveitis and pan-uveitis with anterior chamber involvement, acute inflammation is seen in the anterior chamber (Güven Yılmaz, 2021; Sızmaz, 2012).
- **Blurred Vision:** There may be a decrease in visual acuity.
- **Light Sensitivity (Photophobia):** There may be sensitivity to bright light.

- **Floaters:** Small spots or threads may appear to move in the visual field.
- **Watery Eyes:** There may be excessive tearing in the eyes.

Diagnosis of Uveitis:

The diagnosis of uveitis is made through a detailed eye examination.

- **Visual Acuity Test:** A visual acuity test is performed to assess vision loss.
- **Anterior Segment Examination:** A biomicroscope (slit lamp) is used to look for signs of inflammation (redness, swelling, cells) in the uvea. Keratic precipitates (inflammatory cell deposits in the corneal endothelium) are seen in anterior uveitis.
- **Intraocular Pressure Measurement (Tonometry):** Intraocular pressure can be measured to assess the risk of glaucoma.
- **Fundus Examination:** The fundus examination can be performed by dilating the pupils to evaluate the back of the eye (retina, choroid).
- Additional Tests:
- **Blood tests:** These may be performed to investigate infections or autoimmune diseases.
- **Imaging tests:** These may be performed to obtain detailed images of the eye and surrounding tissues.

- **Eye fluid analysis (aqueous humor or vitreous):** This may be performed to determine the cause of infection or inflammation.

Treatment of Uveitis:

The treatment of uveitis varies depending on the underlying cause, the location of the inflammation, and its severity (Oncul, Kara & Ozdal, 2021). The aim of treatment for uveitis is to reduce inflammation, prevent pain, prevent tissue damage, and prevent recurrence. Treatment is more difficult and complex in cases of posterior segment involvement. Posterior segment involvement occurs in 50% of cases and results in vision loss in 10% of cases (Güven Yılmaz, 2021).

- Medications:
- **Corticosteroids:** Used to reduce inflammation. They can be administered as eye drops, pills, or injections. Systemic and topical steroids are the main components of treatment. Local drop treatment is sufficient for anterior uveitis, while treatment for posterior uveitis is systemic.
- **Immunosuppressive drugs:** Used in autoimmune uveitis.
- Antibiotics, antiviral drugs, or antifungal drugs: Used depending on the cause of infectious uveitis.
- **Mydriatics (pupil-dilating drugs):** Can be used in anterior uveitis to prevent the iris from adhering to the lens and to alleviate pain.
- **Surgery:** In rare cases, surgical intervention may be necessary to treat complications of uveitis. For example,

surgery may be considered if cataracts or glaucoma develop.

Complications of Uveitis:

If left untreated, uveitis can lead to serious complications (Módis & Süveges, 2023).

- **Glaucoma:** Can result in vision loss by causing optic atrophy.
- **Cataract:** Clouding of the lens of the eye, which can cause vision loss.
- **Macular Edema:** Swelling of the macula (the central part of the retina), which can cause vision loss.
- **Retinal Detachment:** Can cause serious vision loss.

Prognosis of Uveitis:

The prognosis for uveitis varies depending on its cause, location, severity, and response to treatment (Oncul, Kara & Ozdal, 2021). Early diagnosis and treatment are important to reduce the risk of complications caused by uveitis (Módis & Süveges, 2023).

2.2 Glaucoma

The cause of damage to the optic nerve and vision loss is increased intraocular pressure. It is one of the most common causes of permanent blindness worldwide (Quigley & Broman, 2006). Glaucoma usually progresses slowly and may not cause symptoms in its early stages, so early diagnosis and treatment are very important.

Types of Glaucoma:

Glaucoma is classified according to various factors, including the condition of the trabecular meshwork (a spongy structure located at the angle where the iris and the base of the cornea meet, responsible for draining aqueous humor from the eye into the bloodstream), age of onset, and cause:

- **Open-angle glaucoma (OAG):** This is the most common type of glaucoma (Cassard et al., 2012). The trabecular meshwork is open, but the eye fluid (aqueous humor) cannot flow properly, causing a gradual increase in intraocular pressure. OAG usually begins without symptoms and progresses slowly, making early diagnosis difficult.

- **Angle-closure glaucoma (ACG):** This occurs when the iris blocks the trabecular meshwork (Suwan et al., 2017; Kumar et al., 2009). This can cause a sudden and severe increase in intraocular pressure (acute ACG), which manifests itself with symptoms such as severe eye pain, headache, blurred vision, nausea, and vomiting. ACG can also develop chronically, in which case the symptoms may be milder or absent (Suwan et al., 2017).

- **Normal-Tension Glaucoma:** Optic nerve damage and vision loss occur despite normal intraocular pressure. Although the exact cause is unknown, it is thought that poor blood flow in the blood vessels supplying the optic nerve may play a role.

- **Congenital Glaucoma:** Present at birth or in early childhood, it is typically caused by a developmental defect in the eye's drainage system (Gorin, 1964).

- **Secondary Glaucoma:** Glaucoma that develops as a result of other eye diseases or conditions (Toptan et al., 2021). These conditions include uveitis, cataracts, eye trauma, and diabetes (Toptan et al., 2021; Módis & Süveges, 2023). Certain medications can also cause secondary glaucoma (Razeghinejad et al., 2011).

Symptoms of Glaucoma:

OAG usually does not show symptoms in the early stages. As the disease progresses, peripheral vision loss and eventually tunnel vision may develop. Acute ACG, on the other hand, presents with symptoms such as sudden and severe eye pain, headache, blurred vision, nausea, and vomiting (Suwan et al., 2017).

Diagnosis of Glaucoma:

A series of tests are used to diagnose glaucoma:

- **Intraocular Pressure Measurement (Tonometry):** A test used to measure intraocular pressure. Intraocular pressure is the pressure of the fluid inside the eye and helps maintain the shape of the eye and keep the retina healthy.
- **Gonioscopy:** Used to assess the openness of the trabecular meshwork of the eye.
- **Optic Nerve Examination:** Used to assess whether there is damage to the optic nerve.
- **Visual Field Test:** Used to detect peripheral vision loss.
- **Optic Nerve Imaging:** Imaging tests such as optical coherence tomography (OCT) can be used to obtain detailed images of the optic nerve (Muller & Geerling, 2008).

Treatment of Glaucoma:

The goal of glaucoma treatment is to lower intraocular pressure and prevent damage to the optic nerve and vision loss. Treatment options:

- **Medications:** There are various medications used in the treatment of glaucoma. These medications lower intraocular pressure by reducing the production of eye fluid or increasing its drainage.
- Laser Treatment:
- **Selective Laser Trabeculoplasty (SLT):** Used to lower intraocular pressure in open-angle glaucoma.
- **Laser Iridotomy:** Creates a small hole in the iris to improve drainage in angle-closure glaucoma.
- Surgery:
- **Trabeculectomy:** Creates a new drainage pathway for eye fluid.
- **Gonioscopy:** Widens the drainage angle of the eye to improve eye fluid drainage.
- **Canaloplasty:** Widens the eye's natural drainage system and reduces intraocular pressure.

Glaucoma and Other Eye Diseases:

- **Uveitis:** Uveitis can increase the risk of glaucoma. The inflammation caused by uveitis can lead to an increase in intraocular pressure by blocking the trabecular meshwork of the eye or increasing the production of eye fluid. Due to the risk of glaucoma developing in patients with uveitis, it is important for these patients to have regular eye examinations and to monitor their intraocular pressure (Módis & Süveges, 2023).

- **Cataracts:** Cataract surgery can trigger or worsen glaucoma in some cases. It is important to closely monitor intraocular pressure in patients who have undergone cataract surgery and to initiate treatment if glaucoma symptoms appear.

Prevention of Glaucoma:

Although it is not possible to completely prevent glaucoma, controlling risk factors and having regular eye examinations can help reduce the risk of glaucoma and ensure early diagnosis.

Red Eye and Glaucoma:

Red eye is usually caused by benign and self-limiting conditions such as conjunctivitis, but it can also be a symptom of serious conditions such as glaucoma. Acute ACG is an important cause of red eye and can also lead to vision loss and increased intraocular pressure. Therefore, it is critical to thoroughly examine patients with red eye complaints and perform the necessary tests (tonometry, gonioscopy, etc.) to prevent serious consequences such as blindness (Toptan et al., 2021).

Glaucomatous Crisis

Glaucomatous crisis is a type of glaucoma characterized by recurrent unilateral acute iritis attacks. Intraocular pressure increases, the cornea becomes edematous, and flare may be observed in the anterior chamber. It is important to distinguish it from herpetic uveitis. Treatment involves the use of antiglaucomatous agents and corticosteroids. Medications that may trigger ciliary spasm, such as pilocarpine, should be avoided (Sızmaz, 2012).

A glaucoma crisis is characterized by a sudden and rapid increase in intraocular pressure. This condition requires urgent treatment, as it can lead to permanent vision loss if left untreated. Acute ACG causes intraocular fluid to accumulate and intraocular pressure to rise rapidly as a result of the iris blocking the trabecular meshwork (Mahmood & Narang, 2004). Acute ACG is more common in middle-aged and elderly individuals, especially those with hyperopia.

Factors that can lead to a glaucoma crisis include:

- **Narrowing or Closure of the Trabecular Meshwork:** Narrowing or closure of the angle that drains fluid between the front and back chambers of the eye can lead to increased intraocular pressure and a glaucoma attack.
- **Pupil Dilation (Mydriasis):** Pupil dilation can cause the iris to thicken and block the trabecular meshwork, triggering an acute glaucoma attack.
- **Certain Medications:** Some medications can cause the pupil to dilate, triggering a glaucoma crisis. For example, certain medications such as topiramate can cause acute angle-closure glaucoma (Patel & Ramchandran, 2023).

Other factors that can cause glaucoma crises:

- **Trauma:** A blow to the eye can damage the eye's drainage system and cause a glaucoma attack.
- **Other eye diseases:** Other eye diseases such as uveitis can cause glaucoma attacks by increasing intraocular inflammation or blocking drainage (Bansal et al., 2023).

The symptoms of a glaucoma crisis are usually sudden and severe:

- **Sudden and Severe Eye Pain:** Patients usually experience severe eye pain described as feeling like a knife stab. The pain may spread to the head and face.
- **Blurred Vision:** Increased intraocular pressure causes swelling of the cornea and blurred vision.
- **Light Sensitivity (Photophobia):** Patients often feel discomfort in bright light.
- Redness in the Eye
- **Nausea and Vomiting:** A glaucoma attack can cause nausea and vomiting due to severe eye pain.
- **Headache:** Severe headache may accompany eye pain.

The treatment of glaucoma crisis is urgent and aims to reduce intraocular pressure as quickly as possible. The following methods are used in the treatment of glaucoma crisis:

- **Medications to Lower Intraocular Pressure:** Medications such as topical beta blockers, alpha agonists, carbonic anhydrase inhibitors, and osmotic agents are used to lower intraocular pressure.
- **Laser Iridotomy:** Laser iridotomy is a procedure that involves creating a small opening in the iris to widen the drainage angle of the eye and facilitate the flow of intraocular fluid. Laser iridotomy can also be used to prevent glaucoma attacks.
- **Surgery:** In cases of glaucoma crises that cannot be controlled with medication or laser iridotomy, surgical intervention may be necessary. There are different surgical procedures depending on the condition of the

disease, such as trabeculectomy surgery and implant surgery.

3. Eyelid and Orbital Emergencies

Eyelid and orbital emergencies are sudden conditions that occur in the eyelid and orbital region and require immediate intervention. These conditions can be caused by various factors, ranging from infections to trauma, and have the potential to cause vision loss.

3.1 Eyelid Emergencies

The eyelids play an important role in visual health by protecting the anterior segment of the eye, spreading the tear film, and preventing foreign objects from entering the eye. Eyelid emergencies include various conditions that affect the structure and function of the eyelid. These include infections, allergic reactions, trauma, and other eyelid diseases.

Infections

Blepharitis

Blepharitis is a chronic inflammation of the eyelid margins and is usually caused by blockage of the oil glands located in the eyelid margins. Blepharitis is a common chronic eye condition (Tarff, 2017). Blepharitis can be of two main types: staphylococcal or seborrheic. Staphylococcal blepharitis is a bacterial infection and typically presents with yellow crusting at the base of the eyelashes. Seborrheic blepharitis, on the other hand, is associated with overactive oil glands and presents with oily, dandruff-like flakes at the base of the eyelashes. Both types of blepharitis may cause symptoms such as a burning sensation and redness in the eyes. Blepharitis treatment varies depending on the underlying cause.

Eyelid hygiene, warm compresses, and topical antibiotics are used to treat staphylococcal blepharitis, while eyelid hygiene, warm compresses, and anti-dandruff shampoos are used to treat seborrheic blepharitis (Palamar, 2021).

Chalazion (Meibomian cyst)

It is a chronic inflammatory granuloma caused by blockage of the openings of the glands located in the tarsal tissue of the eyelids. It appears as a hard, painless mass on the eyelid. Treatment includes warm compresses, eyelid massage, topical corticosteroids, and rarely steroid injections. A chalazion may drain on its own or be surgically removed.

Hordeolum

It is a painful swelling on the eyelid, usually caused by a bacterial infection of the eyelash follicle or meibomian gland. External hordeolum is an inflammation of the eyelash follicle and appears as a localized swelling on the edge of the eyelid. Internal hordeolum is an inflammation of the meibomian gland and develops inside the eyelid. A hordeolum typically presents with redness, pain, tenderness, swelling, and occasionally pus formation. Treatment includes warm compresses, eyelid hygiene, and topical antibiotics. In some cases, incision and drainage of the hordeolum may be necessary to alleviate pain and facilitate drainage (Palamar, 2021).

Allergic Reactions

The eyelid skin is highly sensitive to allergens. Allergens such as pollen, dust mites, animal dander, and cosmetic products can cause allergic reactions in the eyelid (Módis & Süveges, 2023). Eyelid allergic reactions are characterized by itching, swelling, redness, and skin rash. Treatment may involve avoiding the allergen, using cold compresses, topical antihistamines, and corticosteroids.

Eyelid injuries

Eyelid injuries can take various forms, such as cuts, lacerations, contusions, and burns. These injuries can cause functional and cosmetic problems.

- **Lacerations and cuts:** These are injuries caused by sharp objects. They can affect the entire thickness of the eyelid or only part of it (Figure 2).
- **Contusions:** These are caused by blunt trauma. They can cause bleeding and swelling in the eyelid tissues.
- **Burns:** These are caused by contact with chemical substances or heat. They can cause damage and scarring to the eyelid tissues.

Trauma treatment depends on the type and severity of the injury. Cold compresses and antibiotic ointments may be sufficient for minor injuries, while serious trauma may require surgical intervention. Minor cuts can usually be closed with sutures. More complex injuries may require surgical repair or reconstruction.

Figure 2. Post-traumatic eyelid and eyebrow incision

Source: Department of Ophthalmology Archives, Harran University School of Medicine, Türkiye

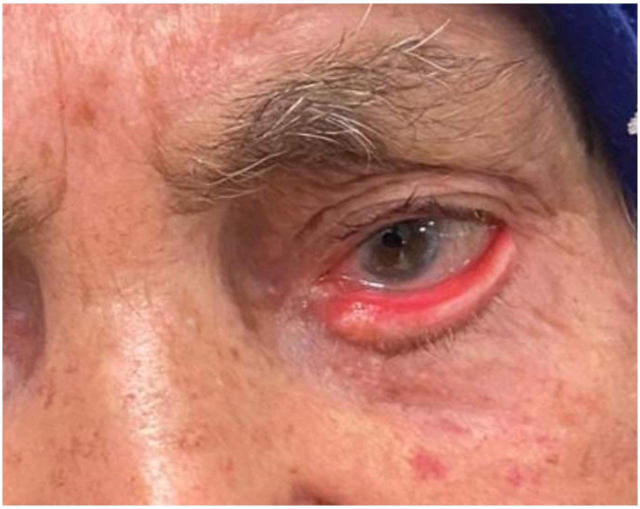
Entropion

It is a condition in which the eyelid turns inward. It is usually seen in the lower eyelid and causes the eyelashes to rub against the cornea. This condition manifests itself as irritation, stinging, burning sensation, excessive tearing, and corneal damage in the eye. If left untreated, it can lead to corneal ulceration, scarring, and even vision loss. While the most common cause of entropion is age-related weakening of the muscles and connective tissue, factors such as trauma, infection, burns, and previous eyelid surgeries may also play a role. Treatment is typically surgical, and various techniques may be used depending on the underlying cause and severity of symptoms (Palamar, 2021).

Ectropion

It is a condition in which the eyelid changes shape toward the outside. It is more commonly seen in the lower eyelid. Ectropion causes tearing, dryness, irritation, and corneal damage by causing the punctum to move away from the tear drainage system. Aging is the most common cause, but facial nerve palsy, trauma, burns, and previous eyelid surgeries can also cause ectropion. Treatment varies depending on the underlying cause and severity of symptoms and may include artificial tear drops, eyelid bands, or surgical intervention (Figure 3).

Figure 3. Senile ectropion



Source: Department of Ophthalmology Archives, Harran University School of Medicine, Türkiye

3.2 Orbital Emergencies

The orbit is a cone-shaped cavity that contains the eyeball, muscles, nerves, blood vessels, and fatty tissue. Orbital emergencies involve serious conditions that can threaten vision and the patient's health and therefore require rapid diagnosis and treatment. The most common causes of orbital emergencies, their clinical presentations, diagnostic approaches, and treatment options will be discussed.

Orbital Cellulitis

It is an infection of the soft tissues within the orbit. It usually develops as a result of the spread of a neighboring infection, such as sinusitis, tooth infection, or skin infection, or as a result of trauma. It is more common in children than in adults because children's sinuses are not fully developed, and the likelihood of infections spreading to the orbit is higher (Palamar, 2021) (Figure 4).

Figure 4. Orbital cellulitis

Source: Department of Ophthalmology Archives, Harran University School of Medicine, Türkiye

Clinical Presentation:

The signs and symptoms of orbital cellulitis usually appear quickly and include the following:

- **Eyelid edema and redness:** Infection causes edema and inflammation in the orbital tissues, resulting in noticeable swelling and redness of the eyelid.
- **Pain:** Severe pain is felt in the orbit and surrounding tissues, which may increase with eye movements.
- **Proptosis:** This is the forward displacement of the eyeball. Swelling in the orbital tissues pushes the eyeball forward, causing proptosis.
- **Ophthalmoplegia:** This is the restriction of eye movements. Inflammation of the extraocular muscles

within the orbit or compression of the nerves can lead to restricted eye movements.

- **Vision loss:** Vision loss may occur if the infection spreads to the optic nerve or if the optic nerve is compressed due to proptosis.
- **Fever:** The body may respond with a fever to fight the infection.

Diagnosis:

The diagnosis of orbital cellulitis is based on the patient's clinical history, physical examination, and imaging tests.

- **Medical History and Physical Examination:** The patient should be asked about recent sinusitis, dental infection, or upper respiratory tract infection. Physical examination should include evaluation of eyelid edema, redness, proptosis, ophthalmoplegia, and decreased visual acuity.
- **Imaging Tests:** CT and MRI are commonly used to confirm orbital cellulitis and assess the spread of infection.

Treatment:

Orbital cellulitis treatment is urgent and includes the following:

- **Intravenous Antibiotics:** Broad-spectrum intravenous antibiotics should be administered to control the infection.
- **Hospitalization:** Patients should generally be hospitalized and their clinical findings, particularly visual

acuity and optic disc examination, should be closely monitored.

- **Surgical Drainage:** In some cases, such as the formation of an abscess, surgical drainage may be necessary.

Orbital Trauma

Orbital trauma can result from blunt or penetrating injuries. Orbital fractures are the most common type of orbital trauma and are usually caused by blows to the facial bones. Orbital fractures can cause displacement of the eyeball (enophthalmos or exophthalmos), diplopia (double vision), eyelid edema, and hematoma. Retrobulbar hematoma is a collection of blood within the orbit and can cause vision loss that may require emergency surgical drainage (Guldager, 2022).

Ocular trauma is also a common problem in children (Cariello et al., 2007; Pardhi et al., 2015; Diniz et al., 2003; Puodžiuvienė et al., 2018). The most common causes of ocular trauma in children are falls, sports injuries, and accidents involving toys (Cariello et al., 2007; Pardhi et al., 2015; Diniz et al., 2003; Puodžiuvienė et al., 2018).

Orbital fracture

Orbital fractures are usually caused by blunt trauma and often accompany fractures of the facial bones. The location and severity of the fracture determine the variety of symptoms and the treatment approach.

Clinical Presentation:

The signs and symptoms of orbital fractures vary depending on the location and severity of the fracture and may include the following:

- **Diplopia:** An orbital fracture can affect the extraocular muscles or nerves, causing impaired eye movement and double vision.
- **Enophthalmos (Retraction of the Eyeball):** If the orbital volume expands or there is loss of orbital tissue, the eyeball may retract inward.
- **Eyelid Edema and Ecchymosis:** Bleeding and edema may occur in the fracture area.
- **Limited Eye Movement:** The fracture may compress the extraocular muscles or nerves, causing limited eye movement.
- **Anesthesia or Paresthesia:** If the fracture affects the infraorbital nerve, numbness or tingling may be felt in the cheek and upper lip.

Diagnosis:

The diagnosis of orbital fracture is based on clinical history, physical examination, and imaging tests.

- **History and Physical Examination:** The history of trauma, especially blunt trauma, is important. Physical examination should evaluate findings such as diplopia, enophthalmos, eyelid edema, restricted eye movement, and anesthesia.
- **Imaging Tests:** CT scanning is the gold standard for confirming the presence, location, and severity of the fracture.

Treatment:

The treatment of orbital fractures varies depending on the type, location, and severity of the fracture, as well as accompanying injuries and symptoms.

- **Observation:** Some orbital fractures, especially small and stable ones, may heal on their own and require only observation.
- **Surgical Repair:** Large, unstable, or vision-threatening fractures may require surgical repair. Surgical options include repositioning of the fractured pieces, reconstruction using bone grafts or implants.

Orbital hematoma

It is a condition in which blood accumulates in the orbit. It can develop due to trauma, surgery, or spontaneously. Symptoms include bruising, swelling, pain, proptosis, limited eye movement, and vision loss around the eye. Treatment depends on the size of the hematoma and its effect on vision. Small hematomas may resolve on their own, while larger hematomas may require surgical drainage.

Optic nerve compression

It is a condition in which the optic nerve is compressed as a result of increased pressure within the orbit. Orbital hematoma, tumor, or infection can put pressure on the optic nerve. Symptoms include sudden vision loss, color vision abnormalities, defects in the visual field, and afferent pupillary defects. Treatment is urgent and involves removing the factor causing the compression. Delayed treatment can lead to optic atrophy, resulting in permanent vision loss.

Thyroid Eye Disease (Graves' Ophthalmopathy)

Thyroid eye disease, an autoimmune disease associated with excessive production of thyroid hormones, is characterized by inflammation and tissue remodeling of the orbital tissues. The symptoms and findings of thyroid eye disease are the result of inflammation and tissue remodeling of the orbit. In thyroid eye disease, scar formation, inflammation of muscle tissue, and/or an increase in the orbital fat compartment lead to orbital remodeling and volume expansion. The remodeled orbital tissue typically consists of either predominantly fat tissue (type I disease), predominantly muscle and scar tissue (type II disease), or a combination of both (Gupta et al., 2022).

Clinical Presentation:

The signs and symptoms of thyroid eye disease vary from person to person and may include the following:

- **Proptosis:** Protrusion of the eyeball. The eyeball protrudes due to inflammation and tissue remodeling in the orbital tissues.
- **Eyelid Retraction:** Elevation of the upper eyelid above its normal position. This causes the white part of the eye to become more visible.
- **Conjunctival Injection:** The conjunctiva becomes reddened.
- **Diplopia:** This occurs due to inflammation and tissue remodeling of the extraocular muscles, leading to impaired eye movements.
- **Vision Loss:** Vision loss may occur due to compression of the optic nerve or corneal damage

Diagnosis:

The diagnosis of thyroid eye disease is based on clinical history, physical examination, blood tests, and imaging tests.

- **Medical History and Physical Examination:** A history of hyperthyroidism or its symptoms is important. Physical examination findings such as proptosis, eyelid retraction, conjunctival injection, diplopia, and decreased visual acuity are evaluated.
- **Blood Tests:** Thyroid hormone levels are measured to evaluate thyroid function.
- **Imaging Tests:** CT or MRI may be used to evaluate inflammation and tissue remodeling in the orbital tissues.

Treatment:

Treatment for thyroid eye disease varies depending on the activity of the disease and the severity of symptoms.

- **Observation:** Patients with mild symptoms can be closely monitored to see if their symptoms progress.
- Drug Treatment:
- **Corticosteroids:** Can be used to reduce inflammation and tissue remodeling.
- **Immunosuppressants:** Can be used to suppress the immune system and reduce inflammation.
- Surgical Intervention:
- **Orbital Decompression:** This can be performed to reduce proptosis and relieve pressure on the optic nerve by expanding the orbital volume.

- **Eyelid Surgery:** This can be performed to correct eyelid retraction.
- **Strabismus Surgery:** This can be performed to correct eye misalignment problems caused by diplopia.

Dacryocystitis

Dacryocystitis is an inflammation of the lacrimal sac. It is caused by a blockage in the lacrimal drainage system and is usually associated with a bacterial infection. It can occur acutely or chronically in adults (Palamar, 2021) (Figure 5).

Figure 5. Dacryocystitis

Source: Department of Ophthalmology Archives, Harran University School of Medicine, Türkiye

Clinical Presentation:

- **Epiphora:** Constant watering of the eyes due to blocked tear drainage.
- **Secretion:** Sticky or yellowish discharge from the eyes due to pus accumulation in the lacrimal sac.
- **Swelling and Redness in the Sac Area:** Swelling and redness in the lacrimal sac area.
- **Pain and Sensitivity:** Pain and sensitivity are felt when the tear sac area is touched.

Diagnosis:

- **Clinical Examination:** History and physical examination are usually sufficient to make a diagnosis.
- **Lacrimal Sac Probing and Irrigation:** This can be performed to evaluate the lacrimal drainage system and confirm obstruction.
- **Imaging Tests:** In suspicious cases, CT or MRI may be used to evaluate the cause and complications of dacryocystitis.

Treatment:

- Acute Dacryocystitis:
- Hot Compresses: Can be applied to reduce swelling and pain.
- Systemic Antibiotics: Prescribed to treat infection.
- Surgical Drainage: May be necessary if an abscess has formed.

- Chronic Dacryocystitis:
- Dacryocystorhinostomy: A surgical procedure to restore tear drainage.

Orbital Tumors

Orbital tumors are abnormal cell growths that develop within the orbit. They can be benign or malignant. Benign tumors typically grow slowly and do not spread. Malignant tumors, on the other hand, grow rapidly and can spread to surrounding tissues. Orbital tumors can cause proptosis, diplopia, limited eye movement, pain, and vision loss. Treatment depends on the type and stage of the tumor and may include surgery, radiation therapy, or chemotherapy.

4. Anterior Segment Traumas and Burns

Anterior segment injuries and burns are injuries that affect the front part of the eye (cornea, anterior chamber, iris, and lens). These injuries can be caused by various objects (e.g., metal fragments, chemicals) or forces (e.g., impact, explosion) (Puodžiuvienė et al., 2018; Ikeda et al., 2006; Korkmaz et al., 2022).

4.1 Anterior Segment Traumas

Anterior segment injuries can be blunt or penetrating. They may involve corneal and conjunctival lacerations and foreign body penetration. Blunt eye injury is usually caused by high-speed impact with a blunt object (Kiziloglu et al., 2013). Treatment varies depending on the severity of the injury and may include eye drops, ointment, bandages, or surgical intervention. Globally, ocular trauma is estimated to be one of the leading causes of blindness, ranging from 2% to 14% according to different studies (Puodžiuvienė et al., 2018).

Blunt traumas

It is caused by a direct blow to the eye. Events such as sports injuries, falls, traffic accidents, and assaults can cause blunt trauma (Schein et al., 1988; Cillino et al., 2008).

- **Hifema:** This is a condition in which blood accumulates in the anterior chamber. It occurs as a result of blunt trauma causing the rupture of blood vessels in the iris or ciliary body. Hifema can lead to vision loss and even glaucoma due to obstruction of the trabecular meshwork. The size of hifema is classified according to the amount of blood present in the anterior chamber and is divided into stages ranging from 0 to 4.
- **Stage 0:** Bleeding visible under a microscope.
- **Stage 1:** Bleeding up to 1/3 of the anterior chamber.
- **Stage 2:** Bleeding up to 1/3-1/2 of the anterior chamber.
- **Stage 3:** Bleeding from 1/2 to the total level of the anterior chamber.
- **Stage 4:** Anterior chamber completely filled with blood.

Treatment varies depending on the severity of the hyphema and the risk of glaucoma. Small hyphemas usually resolve on their own, while large hyphemas or patients who develop glaucoma may require surgical intervention (anterior chamber lavage) (Bursalı et al., 2023).

- **Iridodialysis:** This is the detachment of the iris from its root and can result from blunt trauma. Iridodialysis can cause pupil distortion and double vision. Small iridodialysis is usually asymptomatic and does not require treatment. However, in cases of large iridodialysis, surgical intervention may be performed to improve visual function and correct cosmetic appearance (Bursalı et al., 2023).

- **Phakodonesis:** This is the trembling of the lens and occurs as a result of damage to the zonular fibers (the fibers that hold the lens in place). Phakodonesis can cause blurred vision and double vision. Severe phakodonesis can lead to the lens becoming dislocated (lens subluxation) or completely dislocated (lens dislocation). Surgical intervention may be required to correct the position of the lens or remove it.
- **Traumatic cataract:** This is a condition in which the lens becomes cloudy as a result of injury. It occurs due to tearing of the lens capsule or damage to the lens fibers as a result of blunt trauma. Traumatic cataract can cause blurred vision and vision loss. Treatment involves cataract surgery.

Penetrating injuries

It is caused by a sharp object piercing the eye. Objects such as knives, scissors, broken glass, and metal fragments can cause penetrating trauma (Schein et al., 1988; Cillino et al., 2008). An open globe injury is a penetrating trauma that results in the disruption of the integrity of the eyeball (Bunting, Stephens & Mireskandari, 2013; Zhu et al., 2015). Such injuries can cause serious damage to the internal structures of the eye and lead to vision loss.

Conjunctival Trauma

Conjunctival trauma can cause problems that are usually mild, such as subconjunctival hemorrhage, but in rare cases, it can lead to more serious complications.

- **Subconjunctival Hemorrhage:** A red spot caused by blood accumulating under the conjunctiva as a result of a ruptured blood vessel. It is usually painless and resolves on its own. Artificial tear drops may be helpful in cases accompanied by a burning or stinging sensation. However, it is essential to check for globe rupture (tearing of the eyeball) after blunt trauma. It resolves on its own within 2-3 weeks without treatment. Artificial tear drops are used in cases accompanied by a burning or stinging sensation (Palamar, 2021) (Figure 6).

Figure 6. Subconjunctival hemorrhage

Source: Department of Ophthalmology Archives, Harran University School of Medicine, Türkiye

Corneal Traumas

The cornea is the transparent, dome-shaped layer at the front of the eye. It refracts light and focuses it on the retina. Corneal injuries can take various forms, such as foreign body penetration, abrasions (scratches), and lacerations (cuts), all of which can seriously affect vision.

- **Foreign Body:** Corneal foreign bodies can cause hyperemia, burning, stinging, photophobia, and pain in the eye. Visual acuity may be affected, especially in injuries close to the central region (Palamar, 2021). The foreign body is removed with topical anesthesia, and artificial tears and antibiotic drops are used in treatment.
- **Corneal abrasion:** This is a disruption of the integrity of the corneal epithelium. It can be caused by a foreign body, a fingernail scratch, or contact lens use. Symptoms include pain, burning, stinging, foreign body sensation, light sensitivity, and blurred vision. Treatment usually involves artificial tears and antibiotic drops. Abrasions usually heal within a few days.
- **Corneal laceration:** This is a cut in the cornea. It can be caused by injuries from sharp or piercing objects. Symptoms include severe pain, light sensitivity, vision loss, and discharge from the eye. Treatment is urgent and typically involves surgical intervention (Figure 7).

Figure 7. Corneal laceration (perforation)

Source: Department of Ophthalmology Archives, Harran University School of Medicine, Türkiye

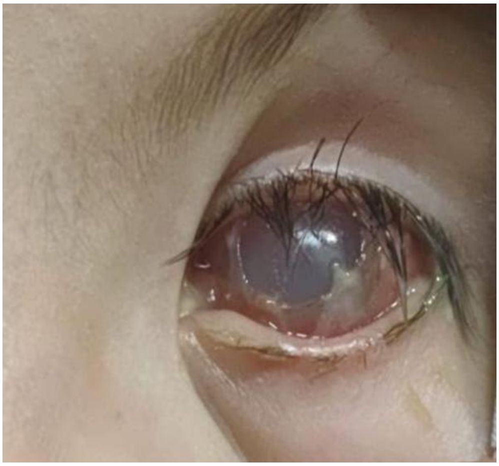
4.2 Anterior Segment Burns

Chemical burns can cause serious damage to the front segment of the eye and require immediate medical attention. They are caused by contact with chemical substances or excessive heat (Menke et al., 2023). Chemical burns can be acidic or alkaline (Tarff, 2017). Treatment depends on the cause and severity of the burn and may include washing with plenty of water, eye drops, ointment, bandages, or surgical intervention. Acid burns are less severe than alkaline burns because alkalis tend to penetrate deeper into the tissue by penetrating the cornea and damaging internal structures (Eslani et al., 2014).

Chemical burns

Burns caused by acids, alkalis, or other chemicals splashing into the eye. Alkali burns are more severe than acid burns and can cause deep damage to the cornea and other tissues of the eye. Acid burns typically cause superficial damage to the cornea. Acids denature proteins, leading to tissue necrosis. Bases penetrate deeply into the tissue, causing more widespread damage. Bases saponify lipids, leading to cell lysis. The severity of the burn depends on the type of chemical, its concentration, and the duration of contact with the eye. Symptoms include severe pain, burning, stinging, eyelid edema, redness, blurred vision, and discharge from the eye. Treatment is urgent and involves first rinsing the eye with plenty of water, followed by antibiotic drops, steroids, and sometimes surgical intervention (Ikeda et al., 2006; Korkmaz et al., 2022) (Figure 8).

Figure 8. Chemical burn



Source: Department of Ophthalmology Archives, Harran University School of Medicine, Türkiye

Thermal burns

Flames, hot liquids, and hot metals can cause burns. The severity of the burn depends on the degree of heat and the duration of contact with the eye. Burns can cause severe pain, light sensitivity, redness, swelling, and blurred vision. The symptoms are similar to those of chemical burns. The treatment is also similar and includes rinsing the eye with plenty of water, antibiotic drops, steroids, and sometimes surgical intervention. Severe burns can lead to corneal scarring, glaucoma, cataracts, and even vision loss (Figure 9).

Figure 9. Thermal burn

Source: Department of Ophthalmology Archives, Harran University School of Medicine, Türkiye

Light burns

These are burns caused by exposure to intense light sources such as sunlight or welding light. Radiation burns can be caused by exposure to ionize radiation such as ultraviolet rays, X-rays, and gamma rays. Symptoms include pain, burning, stinging, light sensitivity, blurred vision, and redness of the eyes. Treatment typically involves artificial tears, pain relievers, and sometimes steroid drops.

Prevention of Anterior Segment Trauma and Burns

The following measures can be taken to prevent anterior segment trauma and burns:

- **Wearing protective eyewear:** Wearing protective eyewear while playing sports, at work, or when working with hazardous materials at home is the most effective way to prevent anterior segment trauma.

- **Being careful when working with chemicals:** Appropriate protective equipment should be used to prevent chemicals from splashing into the eyes.
- **Fireworks safety:** The safe use and ignition of fireworks is critical to preventing explosive injuries.

Conclusion

Red eye is a common symptom in ophthalmology and can be caused by a variety of factors. While some causes of red eye are less serious, others can be more severe and may require urgent intervention. A detailed medical history and comprehensive eye examination are essential in evaluating red eye. Accurate diagnosis and appropriate treatment are vital to prevent serious complications such as vision loss. Therefore, it is crucial to have detailed knowledge on this subject, evaluate patients quickly, distinguish between different causes of red eye, and apply appropriate treatment.

References

Toptan, M., Cadirci, D., & Kocakoglu, S. (2021). Evaluation of Red Eye Cases Applied to Ophthalmology Outpatient Clinic of a Training and Research Hospital. Konuralp Medical Journal, 13(3), 271–275. https://doi.org/10.18521/ktd.974600

Palamar, M. (2021). Differential diagnosis of red eye - ocular surface causes. Ege Medical Journal, 60: Supplement, 56-60.

Singh, R. B., Liu, L., Anchouche, S., Yung, A., Mittal, S. K., Blanco, T., & Yin, J. (2021). Pathophysiology of ocular redness. Ocular Surface, 21, 134–144. https://doi.org/10.1016/j.jtos.2021.05.003

Gilani, C. J., Yang, A., Yonkers, M., & Boysen-Osborn, M. (2017). Differentiating urgent and emergent causes of acute red eye for the emergency physician. Western Journal of Emergency Medicine, 18(3), 509.

Mahmood, M. A., & Narang, S. (2004). Diagnosis and Management of the Acute Red Eye. The Mount Sinai Journal of Medicine, 71(3), 176–184.

Bekmez, S. & Eris, E. (2021). The Treatment Models for Adenoviral Keratoconjunctivitis in the Childhood Population. Ocul Immunol Inflamm. 17;29(7-8):1627-1632. doi: 10.1080/09273948.2020.1766510. Epub 2020 Jul 9. PMID: 32643975.

Módis, L., & Süveges, I. (2023). A szemfelszín allergiás és immunpatológiai betegségei. Orvosi Hetilap, 164(43), 1686–1692.

Yeu, E., & Hauswirth, S. (2020). A review of the differential diagnosis of acute infectious conjunctivitis: Implications for treatment and management. Clinical Ophthalmology (Auckland, N.Z.), 14, 805–813. https://doi.org/10.2147/OPTH.S236571

Soleimani, M., Tabatabaei, S. A., Mirzaei, A., Esfandiari, A., Soleymanzadeh, M., Sadeghi, R., ... & Haydar, A. A. (2023). The effect of povidone iodine 2% eye drops in the treatment of adenoviral keratoconjunctivitis. Oman Journal of Ophthalmology, 16(1), 69-74.

Altan-Yaycioglu, R., Sahinoglu-Keskek, N., Canan, H., Coban-Karatas, M., & Ulas, B. (2019). Effect of diluted povidone iodine in adenoviral keratoconjunctivitis on the rate of subepithelial corneal infiltrates. International Journal of Ophthalmology, 12(9), 1420-1425.

Kovalyuk, N., Kaiserman, I., Mimouni, M., Cohen, O., Levartovsky, S., Sherbany, H., & Mandelboim, M. (2017). Treatment of adenoviral keratoconjunctivitis with a combination of povidone-iodine 1.0% and dexamethasone 0.1% drops: a clinical prospective controlled randomized study. Acta Ophthalmologica, 95(3), e224-e230.

Hovding, G. (2008). Acute bacterial conjunctivitis. *Acta Ophthalmologica*, *86*(1), 5–17.

Shanmuganathan, V. A., Armstrong, M., Buller, A., Selva, D., & Stuart, C. (2005). External ocular infections due to methicillin-resistant Staphylococcus aureus (MRSA). Eye, 19(3), 284–291. https://doi.org/10.1038/sj.eye.6701557

Smith, A. F., & Waycaster, C. (2009). Estimate of the direct and indirect annual cost of bacterial conjunctivitis in the United States. BMC Ophthalmology, 9, 13. https://doi.org/10.1186/1471-2415-9-13

Zegans, M. E., Sanchez, P. A., Likosky, D. S., Johnson, R. E., Haffizulla, F., Gildengorin, G., Palavecino, E., & Margolis, T. P. (2009). Clinical features, outcomes, and costs of a conjunctivitis outbreak caused by the ST448 strain of Streptococcus pneumoniae. Cornea, 28(5), 503–509. https://doi.org/10.1097/ICO.0b013e318194e92c

Rosario, N., & Bielory, L. (2011). Epidemiology of allergic conjunctivitis. Current Opinion in Allergy and Clinical Immunology, 11(5), 471–476. https://doi.org/10.1097/ACI.0b013e32834a9676

Keay, L., Edwards, K., Naduvilath, T., Taylor, H. R., Snibson, G. R., & Forde, K. (2006). Microbial keratitis predisposing factors and morbidity. Ophthalmology, 113(1), 109–16.

Liesegang, T. J. (1997). Contact lens-related microbial keratitis: part I: epidemiology. Cornea, 16(2), 125–31.

Ung, L., Bispo, P. J., Shanbhag, S. S., Gilmore, M. S., & Chodosh, J. (2019). The persistent dilemma of microbial keratitis: Global burden, diagnosis, and antimicrobial resistance. Survey of Ophthalmology, 64(3), 255–271.

Mascarenhas, J., Lalitha, P., Prajna, N. V., Srinivasan, M., Das, M., D'Silva, S. S., Oldenburg, C. E., Borkar, D. S., Esterberg, E. J., Lietman, T. M., & Keenan, J. D. (2013). Acanthamoeba, fungal, and bacterial keratitis: a comparison of risk factors and clinical features. American Journal of Ophthalmology, 156(1), 8-18.e2.

Schwartzman, S. (2016). Advancements in the management of uveitis. Best Practice & Research Clinical Rheumatology, 30(2), 304–315. https://doi.org/10.1016/j.berh.2016.04.003

Güven Yılmaz, S. (2021). Scleritis and uveitis. Ege Medical Journal, 60 (Supplement), 61–69. https://doi.org/10.19161/etd.864147-1519509

Miserocchi, E., Fogliato, G., Modorati, G., & Bandello, F. (2013). Review on the worldwide epidemiology of uveitis. European Journal of Ophthalmology, 23(5), 705–717.

Oncul, H., Kara, C. & Ozdal, P.C. (2021). Evaluation of Infectious Uveitis at a Tertiary Referral Center in Turkey. Beyoglu Eye Journal, 6(2), 115-123.

Yalcindag, F. N., Ozdal, P. C., Ozyazgan, Y., Batıoğlu, F., Tugal-Tutkun, I., & BUST Study Group. (2018). Demographic and clinical characteristics of uveitis in turkey: The first national registry report. Ocular Immunology and Inflammation, 26(1), 17–26. https://doi.org/10.1080/09273948.2017.1355677

Sızmaz, S. (2012). Causes of Red Eyes - Uveitis. Turkish Journal of Ophthalmology, 42(Supplement 1), 57–62. https://doi.org/10.4274/tjo.42.s12

Quigley, H. A., & Broman, A. T. (2006). The number of people with glaucoma worldwide in 2010 and 2020. British Journal of Ophthalmology, 90(3), 262–267.

Cassard, S. D., Quigley, H. A., Gower, E. W., Friedman, D. S., Ramulu, P. Y., & Jampel, H. D. (2012). Regional variations and trends in the prevalence of diagnosed glaucoma in the Medicare population. Ophthalmology, 119(7), 1342–1351.

Suwan, Y., Jiamsawad, S., Tantraworasin, A., Kamolratanakul, S., & Angkasanavin, N. (2017). Qualitative and quantitative evaluation of acute angle-closure mechanisms. BMC Ophthalmology, 17(1), 246.

Kumar, R.S., Tantisevi, V., Wong, M.H., Laohapojanart, K., Chansanti, O., Quek, D.T., Koh, V.T., MohanRam, L.S., Lee, K.Y., Rojanapongpun, P. & Aung, T. (2009). Plateau iris in Asian subjects with primary angle closure glaucoma. Arch Ophthalmol, 127(10), 1269–1272.

Gorin, G. (1964). Developmental glaucoma. A concept based on correlation of gonioscopic findings with clinical manifestations. American Journal of Ophthalmology, 58(4), 572–580.

Razeghinejad, M. R., Myers, J. S., & Katz, L. J. (2011). Iatrogenic glaucoma secondary to medications. American Journal of Medicine, 124(1), 20–25.

Muller, M., & Geerling, G. (2008). Anterior segment optical coherence tomography in glaucoma. Klinische Monatsblätter Für Augenheilkunde, 225(3), 194–199.

Patel, R., & Ramchandran, R. (2023). Drug-induced acute angle-closure glaucoma: Mechanisms and management. Journal of Postgraduate Medicine, 69(1), 104-111.

Bansal, A., Parmar, D., & Kempen, J. H. (2023). Glaucoma and uveitis: The glaucoma point of view. Current Opinion in Ophthalmology, 34(2), 126–132.

Tarff, A. (2017). Common Eye Emergencies. Medical Clinics of North America, 101(3), 615–639. https://doi.org/10.1016/j.mcna.2016.12.013

Guldager, M.J. (2022). Retrobulbær hæmatom: En sjælden, men potentielt fatal komplikation til traume. Ugeskr Læger, 184, V05210459.

Cariello, A.J., Moraes, N.S.B., Mitne, S., Oita, C.S., Fontes, B.M., & Melo, L.A.S. Jr. (2007). Epidemiological findings of ocular trauma in childhood. Arq Bras Oftalmol, 70(2), 271–5. https://doi.org/10.1590/s0004-27492007000200015

Diniz, M.C., Menezes, C., Tzelikis, P.F.M., Alvin, H.S., Gonçalves, & et al. (2003). Trauma ocular em criança abaixo de 15 anos: prevenção baseada em estatísticas. Rev Bras Oftalmol, 62(2), 96–101.

Puodžiuvienė, E., Jokūbauskienė, G., Vieversytė, M., & Asselineau, K. (2018). A five-year retrospective study of the epidemiological characteristics and visual outcomes of pediatric ocular trauma. BMC ophthalmology, 18(1), 10.https://doi.org/10.1186/s12886-018-0779-6

Pardhi, C.H., Nandedkar, V.S., Shelke, E.B., Bhojane, V.R., & Awatade, V.P. (2015). Pattern of pediatric ocular trauma in rural area of Marathwada. J Clin Ophthalmol Res, 3(3), 127–31. https://doi.org/10.4103/2320-3897.163256

Gupta, V., Hammond, C.L., Roztocil, E., Gonzalez, M. O., Feldon, S. E., Woeller, C. F. (2022). Thinking inside the Box: Current Insights into Targeting Orbital Tissue Remodeling and Inflammation in Thyroid Eye Disease. Survey of Ophthalmology, 67, 858–874.

Ikeda, N., Hayasaka, S., Hayasaka, Y., & Watanabe, K. (2006). Alkali burns of the eye: Effect of immediate copious irrigation with tap water on their severity. Ophthalmologica, 220(3), 225–228.

Korkmaz, I., Palamar, M., Egrilmez, S., Yagci, A., & Barut Selver, O. (2022). Ten years of pediatric ocular chemical burn experience in a tertiary eye care center in Turkey. Eye Contact Lens, 48, 175–9.

Kiziloglu, M., Kiziloglu, T. G., Akkaya, Z. Y., Burcu, A., & Ornek, F. (2013). Prognostic factors in blunt eye trauma. Turkish Journal of Ophthalmology, 43(1), 32–38.

Bursalı, Ö., Doğan, E., Özkan, N., Bahadır Coşkun, Ş., Çelik, E., & Alagöz, G. (2023). Factors Affecting Clinical and Visual Prognosis in Traumatic Hyphema. Sakarya Medical Journal, 13(2), 204-209. https://doi.org/10.31832/smj.1162452

Schein, O.D., Hibberd, P.L., Shingleton, B.J., Kunzweiler, T., Frambach, D.A., Seddon, J.M., et al. (1988). The spectrum and burden of ocular injury. *Ophthalmology*, 95(3), 300–5. https://doi.org/10.1016/s0161-6420(88)33183-0.

Cillino, S., Casuccio, A., Di Pace, F., Pillitteri, F. & Cillino, G. (2008). A five-year retrospective study of the epidemiological characteristics and visual outcomes of patients hospitalized for ocular trauma in a Mediterranean area. *BMC Ophthalmol*, *22*, 8–6. https://doi.org/10.1186/1471-2415-8-6.2015

Bunting, H., Stephens, D. & Mireskandari, K. (2013). Prediction of visual outcomes after open globe injury in children: A 17-year Canadian experience. *JAAPOS*, 17*(1)*, 43–48. https://doi.org/10.1016/j.jaapos.2012.10.012

Zhu, L., Wu, Z., Dong, F., Feng, J., Lou, D., Du, C., et al. (2015). Two kinds of ocular trauma score for paediatric traumatic cataract in penetrating eye injuries. *Injury*, *46*(9), 1828–1833. https://doi.org/10.1016/j.injury.2015.04.024

Menke, B.A., Ryu, C., Justin, G.A., Chundury, R.V., Hayek, B.R., Debiec, M.R. & Yeh, S. (2023). Ophthalmic manifestations and management considerations for emerging chemical threats. *Front. Toxicol*, *5*, 1281041. doi: 10.3389/ftox.2023.1281041

Eslani, M., Baradaran-Rafii, A., Movahedan, A., & Djalilian, AR. (2014). The ocular surface chemical burns. J Ophthalmol, 196827. https://doi.org/10.1155/2014/196827

RETINAL DETACHMENT, OPTIC NERVE DISEASES, AND NEURO-OPHTHALMOLOGICAL EMERGENCIES

ÇAĞRI MUTAF[1]

Introduction

This chapter provides a comprehensive overview of the aforementioned disorders, emphasizing pathophysiological mechanisms, clinical presentations, diagnostic modalities, and evidence-based treatment strategies aimed at improving patient outcomes in both ocular and systemic health contexts.

The posterior segment of the eye encompasses several intricate anatomical and functional units, the impairment of which can lead to severe and often irreversible visual dysfunction.

Among these, retinal detachment, choroidal diseases, optic nerve pathologies, and neuro-ophthalmological emergencies constitute some of the most critical conditions encountered in ophthalmic practice. These entities not only represent structural

[1] Assistant Professor, Harran University, Faculty of Medicine, Department of Ophthalmology, Şanlıurfa/Turkey, Orcid no: 0009-0005-6991-4120

threats to visual integrity but are also frequently associated with systemic and neurological implications, necessitating a multidisciplinary approach to diagnosis and management. Retinal detachment, particularly in its rhegmatogenous form, remains a surgical emergency with vision-saving potential when identified and treated promptly. Similarly, choroidal pathologies such as choroidal detachment and neovascularization demand early recognition and targeted therapeutic strategies to preserve visual function. Disorders affecting the optic nerve—ranging from inflammatory and ischemic neuropathies to compressive lesions—pose diagnostic and therapeutic challenges due to their complex etiologies and potential for permanent vision loss. Neuro-ophthalmological emergencies, including acute vision loss and papilledema, often serve as harbingers of underlying life-threatening intracranial pathology. The increasing availability of advanced imaging technologies, artificial intelligence-assisted diagnostics, and novel therapeutic interventions has revolutionized the early detection and management of these conditions.

1. Retinal Detachment

1.1.Definition and Types

Retinal detachment refers to the separation of the neurosensory retina from the retinal pigment epithelium. Three primary classifications exist: rhegmatogenous (the most common, caused by retinal breaks), tractional (from fibrovascular proliferation), and exudative (due to fluid accumulation without breaks). Recent meta-analyses indicate that rhegmatogenous detachments comprise 85% of all cases. Advanced imaging techniques have improved early detection rates by 40%. Trauma-induced retinal detachment represents a significant cause of vision loss, particularly in younger and working-age populations. Blunt ocular trauma can lead to retinal detachment through several mechanisms, most notably commotio retinae, choroidal rupture, or vitreoretinal traction resulting from sudden globe deformation. The impact induces rapid anteroposterior compression followed by equatorial expansion of the globe, which can cause peripheral retinal tears, particularly in predisposed areas such as lattice degeneration zones. Posterior vitreous detachment may be precipitated or accelerated by the trauma, further increasing the risk of retinal breaks. Blunt trauma can also cause retinal dialysis, a type of retinal tear that occurs at the ora serrata, often progressing insidiously and becoming symptomatic only after detachment occurs.

Penetrating ocular trauma, on the other hand, directly compromises the structural integrity of the globe, frequently resulting in full-thickness retinal breaks. These retinal injuries may be accompanied by intraocular foreign bodies, hemorrhage, and inflammatory responses that complicate both diagnosis and management. Penetrating injuries often lead to tractional and rhegmatogenous components, especially in the presence of fibrocellular proliferation during the healing process, predisposing the retina to delayed detachment. The risk of proliferative vitreoretinopathy (PVR) is also markedly higher in trauma-related detachments, making surgical repair more complex and reducing the likelihood of favorable visual outcomes. Therefore, early surgical intervention, meticulous retinal evaluation (preferably under anesthesia in pediatric or uncooperative patients), and close long-term follow-up are essential in trauma cases to prevent or manage retinal detachment effectively.

Genetic factors contribute to 15% of cases. Treatment success rates vary by type; rhegmatogenous 92%, tractional 87%, and exudative 95% (David Steel, 2014). Early intervention within 24 hours results in optimal outcomes. Modern surgical techniques indicate 95% initial attachment rates. Long-term visual outcomes correlate directly with macula involvement status. Patient education programs reduce diagnosis delays by 60%. International guidelines emphasize immediate referral protocols.

1.2. Pathophysiology

Vitreous degeneration initiates the detachment process through posterior vitreous detachment. Liquefied vitreous penetrates through retinal breaks, causing neurosensory retinal separation. Molecular studies reveal RPE pump dysfunction in 78% of cases. Inflammatory mediators play crucial roles in terms of progression. Oxidative stress markers increase threefold during active detachment. Cellular adhesion molecules exhibit significant alterations. Blood-retinal barrier breakdown occurs in 92% of cases. Photoreceptor apoptosis begins within hours of detachment. Retinal hypoxia triggers compensatory mechanisms. Recent research has identified novel therapeutic targets (Kuhn et al., 2013).

1.3. Risk Factors

High myopia (>6 diopters) increases the risk by 400%. Previous ocular surgery correlates with a 30% increased risk. Family history contributes to 15% of cases. Trauma accounts for 20% of detachments. Age-related vitreous changes affect 90% of patients over 65. Diabetic retinopathy increases the risk by 25%. Lattice degeneration presents in 30% of cases. Genetic predisposition exhibits a strong correlation in twin studies. Environmental factors contribute to 10% of cases. Systemic conditions affect development in 25% of patients (Schick T et al., 2020).

1.4. Clinical Presentation

Initial Symptoms and Warning Signs;

Photopsia (light flashes) remains a cardinal symptom, occurring in 85% of cases, with an increased frequency in dim lighting conditions (92%). Floaters, present in 80% of patients, typically appear as multiple dark spots or 'cobwebs', with 75% reporting increased visibility against bright backgrounds. Visual field defects manifest in 75% of cases, commonly described as a 'curtain' or 'shadow' in peripheral vision, with superior defects being most common (65%)(Feltgen et al,2014).

1.4.1. Disease Progression

Progressive vision loss affects 90% of untreated cases within the first month, with a critical 72-hour window having been identified for macula-on detachments. Pain remains absent in 95% of patients, though 15% report mild ocular discomfort or pressure sensation. Reduced visual acuity patterns vary significantly by location. Superior detachments: 70% of patients report initial peripheral field loss. Inferior detachments: 55% of patients experience earlier central vision involvement. Temporal detachments: 40% of patients experience nasal field defects first

1.4.2. Macular Involvement

Macular involvement occurs in 40% of cases at presentation, with 25% exhibiting immediate central vision loss, 15% developing gradual central vision deterioration, and 60% preserving central vision if treated within 24 hours. Visual recovery potential decreases by 10% each day after macular detachment

1.4.3. Bilateral and Temporal Patterns

Bilateral presentation occurs in 15% of cases, with a 30% risk of contralateral eye involvement within 7 years. The risk is higher (45%) in patients with lattice degeneration. Genetic predisposition accounts for 20% of bilateral cases. An increased prevalence (35%) is observed in high myopia patients

1.4.4. Symptom Progression Timeline

Symptoms typically progress over hours to days, with distinct patterns in 6-12 hours, initial photopsia and floaters (90%) in 12-24 hours, progressive visual field changes (75%) in 24-48 hours, and significant vision loss if untreated (85%) in 48-72 hours, the critical period for macula-on cases

1.4.5. Patient-Reported Outcomes

Recent multicenter studies reveal that 88% of patients report anxiety concerning permanent vision loss, 72% experience difficulty with daily activities, 65% report an impact on quality of life within first week, 45% report sleep disturbances due to symptoms, and 30% describe occupational limitations.

1.4.6. Special Populations

Unique presentation patterns are observed in pediatric cases (5%). Diagnosis is frequently delayed due to atypical presentation. Elderly patients (40%) are more likely to present with advanced disease. Diabetic patients (25%) exhibit higher rates of complicated presentations, and high myopia patients (35%) exhibit an earlier onset of symptoms

1.4.7. Impact on Quality of Life

Recent quality of life assessments show that 85% of patients report significant anxiety concerning vision loss, 70% experience difficulty with daily activities,60% report impacts on work productivity, 55% note effects on social interactions, and 40% describe challenges with night driving.

1.4.8. Modern Diagnostic Considerations

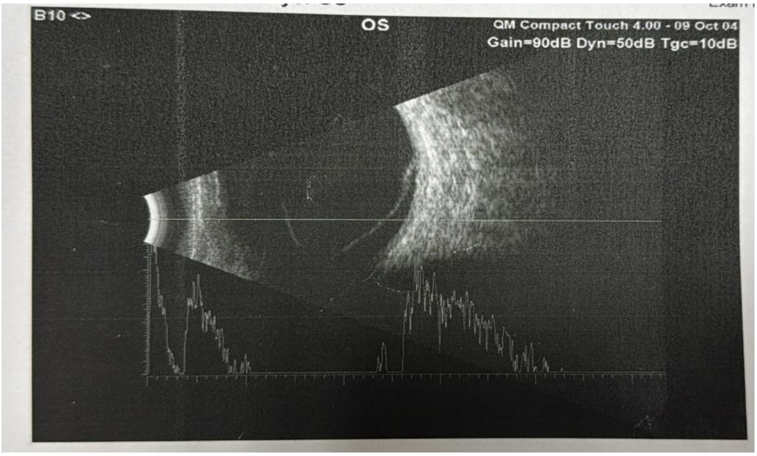
The latest screening protocols identify 95% accuracy in symptom-based risk assessment tools, with 88% of cases being detectable through routine dilated examination, 75% of high-risk patients benefiting from prophylactic treatment, and a 70% decrease in emergency presentations with regular screening

1.5. Diagnostic Tools

Optical coherence tomography (OCT) exhibits 98% sensitivity. B-scan ultrasonography confirms 95% of cases. Wide-field imaging captures peripheral pathologies. Fundus photography documents progression. Digital analysis improves detection accuracy. Artificial intelligence (AI)-assisted diagnostics exhibit 94% accuracy. Fluorescein angiography reveals vascular patterns. Enhanced depth imaging provides choroidal details. Multimodal imaging improves surgical planning, while real-time tracking enables precise monitoring.

Image

1 a)



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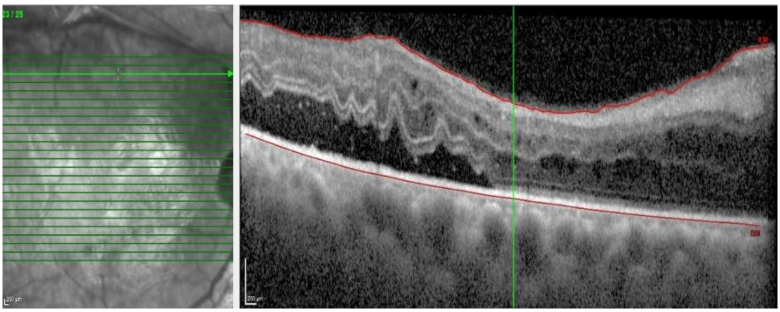


c)

Image 1a: Inferior retinal detachment without macular involvement, diagnostic posterior vitreous detachment in a USG image

Image 1b: Inferior retinal detachment visualized using spectral OCT

Image 1c: Retinal folds demonstrating inferior retinal detachment in fundus photography

Source: Department of Ophthalmology Archives, Harran University School of Medicine, Türkiye

Image 2

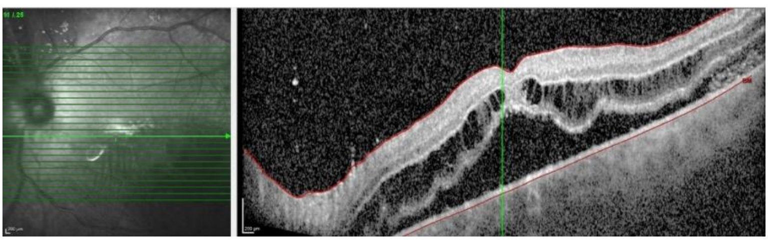


Image 2: Total retinal detachment involving the whole macula at spectral OCT

Source: Department of Ophthalmology Archives, Harran University School of Medicine, Türkiye

1.6. Emergency Management

Immediate surgical intervention remains the cornerstone of retinal detachment management, with studies showing an 80% improvement in outcomes when performed within the first 24 hours. Pneumatic retinopexy, a minimally invasive procedure, demonstrates a 75% success rate in selected cases, particularly for superior retinal breaks. Scleral buckling, a traditional approach, achieves a 90% reattachment rate and remains effective for younger patients and those with uncomplicated detachments. Vitrectomy, now considered the gold standard for complex cases, boasts a 95% success rate, with advances in instrumentation reducing operative times by 20% over the past decade. Combined surgical approaches, such as vitrectomy with scleral buckling, optimize outcomes in 30% of recurrent or severe cases. Post-operative positioning, of critical importance for gas or oil tamponade effectiveness, is adhered to by 85% of patients, with compliance directly correlating to reattachment success. Anti-inflammatory therapies, including corticosteroid injections, have reduced post-operative complications by 15%, while standardized pain management protocols enhance patient recovery experiences. Follow-up schedules, tailored to individual risk profiles, significantly influence long-term outcomes, with early detection of complications reducing recurrence rates by 25%. Recent innovations, such as AI-driven monitoring systems, have improved post-operative care by providing real-time alerts for potential issues, further enhancing patient outcomes (David Yorston, 2018). (Table 1)

2. Choroidal Diseases:

2.1. Choroidal Detachment

Etiology

Choroidal detachment refers to the abnormal accumulation of fluid—either serous or hemorrhagic—in the suprachoroidal space, leading to the elevation and separation of the choroid from the underlying sclera. The etiology of this condition is multifactorial and can be broadly categorized into hypotony-related, inflammatory, postoperative, traumatic, and idiopathic causes. Ocular hypotony is the most common predisposing factor and typically arises following filtration surgeries such as trabeculectomy, cyclodestructive procedures, or trauma, where decreased intraocular pressure (IOP) allows for transudation of fluid into the suprachoroidal space. Postoperative choroidal detachment may also occur due to overfiltration or wound leaks. Inflammatory conditions, such as scleritis or uveitis, can increase vascular permeability and contribute to exudative detachment. Trauma, both blunt and penetrating, may result in hemorrhagic detachment due to rupture of posterior ciliary arteries. In some cases, systemic factors such as anticoagulant therapy, systemic vasculitis, or connective tissue disorders may exacerbate the risk by promoting vascular fragility or impaired wound healing. Suprachoroidal hemorrhage, a vision-threatening form, is often seen in the setting of surgery complicated by sudden IOP drops, especially in patients with vascular risk factors like hypertension or arteriosclerosis. Prompt recognition of the underlying etiology is crucial, as the management strategy—whether conservative, medical, or surgical—depends heavily on the causative mechanism and severity of detachment.

The presentation is characterized by suprachoroidal fluid accumulation. Hypotony occurs in 80% of cases, and inflammatory markers elevate in 70%. Surgical drainage is required in 40% of cases. Medical management is successful in 60% of cases, and ultrasound confirms diagnosis in 95%. The recovery time averages 4-6 weeks. Bilateral involvement occurs in 25% of cases, and systemic associations are found in 30%. Prevention strategies reduce recurrence (Chandran P et al., 2019).

Image 3.

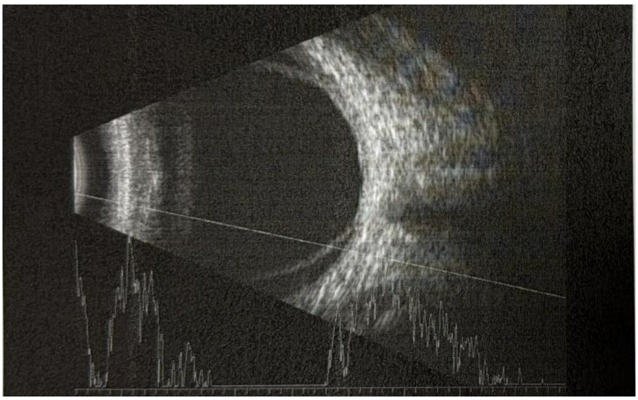


Image 3: Choroidal detachment after hyperfiltration in the postoperative period following a trabeculectomy presented in an USG image

Source: Department of Ophthalmology Archives, Harran University School of Medicine, Türkiye

2.2. Choroidal Neovascularization

Definition and Etiology

Choroidal neovascularization (CNV) is defined as the abnormal growth of new blood vessels originating from the choroid through Bruch's membrane into the subretinal or sub-retinal pigment epithelial (RPE) space. These neovessels are structurally immature and prone to leakage, hemorrhage, and fibrosis, leading to photoreceptor damage and progressive vision loss if left untreated. CNV is a hallmark of several retinal diseases and constitutes a major cause of severe visual impairment, particularly in the elderly population.

The etiology of CNV is multifactorial, involving both degenerative and inflammatory mechanisms. The most common cause is neovascular (wet) age-related macular degeneration (AMD), which accounts for the majority of CNV cases and results from a complex interplay of oxidative stress, complement dysregulation, and chronic inflammation leading to Bruch's membrane disruption. Other causes include pathologic myopia, where axial elongation and thinning of the choroid and RPE predispose to lacquer cracks and neovascular growth; angioid streaks, associated with systemic conditions such as pseudoxanthoma elasticum; inflammatory chorioretinopathies like multifocal choroiditis or punctate inner choroidopathy; and ocular histoplasmosis syndrome. Choroidal tumors, trauma, hereditary retinal dystrophies (e.g., Best disease, Stargardt disease), and idiopathic cases also contribute to the CNV spectrum. Molecularly, vascular endothelial growth factor (VEGF) plays a central role in the angiogenic cascade, making it the primary target of anti-VEGF therapies used in CNV management. Understanding the underlying etiology is essential for appropriate treatment selection and prognosis estimation.

Anti-VEGF therapy exhibits 85% effectiveness. Monthly monitoring optimizes outcomes, and OCT-angiography detects early changes. Combination therapy benefits 30% of cases. Long-term management requires individualization. Quality of life improves in

75% of treated cases. Cost-effectiveness analysis supports early intervention (Mettu SP et al., 2021). Genetic factors affect the treatment response, while biomarkers predict progression patterns. Novel therapies are currently under investigation.

3. Conclusion

Early detection remains crucial for optimal outcomes. Modern imaging revolutionizes management approaches. Surgical techniques are continuing to evolve. Patient education significantly improves compliance. Long-term monitoring prevents complications. Research is constantly producing advances in treatment options. International collaboration enhances understanding. Evidence-based protocols standardize care. Quality metrics guide improvements. Future directions focus on prevention.

Integrated emergency protocols for retinal and choroidal diseases emphasize early detection, rapid intervention, and comprehensive post-treatment care. Multidisciplinary approaches involving ophthalmologists, radiologists, and primary care providers ensure timely diagnosis and management. Patient education on recognizing early symptoms, such as photopsia, floaters, and visual field defects, plays a critical role in reducing delays in seeking care. Advances in telemedicine and AI-driven diagnostic tools have further streamlined emergency care pathways, improving accessibility and outcomes for patients in remote areas (Li S. et al., 2024).

***Table 1**: Retinal Detachment: An Overview of Key Findings and Statistics*

Section	Key Findings	Statistics
Retinal Detachment: Definition and Types	Three primary types: rhegmatogenous, tractional, exudative	Rhegmatogenous: 85% of cases
Pathophysiology	Vitreous degeneration and posterior vitreous detachment initiate detachment	RPE dysfunction in 78% of cases
Risk Factors	High myopia, trauma, family history, age-related changes	High myopia increases the risk by 400%
Clinical Presentation	Photopsia, floaters, visual field defects, progressive vision loss	Photopsia in 85% of cases
Diagnostic Tools	OCT, B-scan ultrasonography, wide-field imaging	OCT sensitivity: 98%
Emergency Management	Immediate surgical intervention critical	Vitrectomy success: 95%
Choroidal Detachment	Suprachoroidal fluid accumulation, hypotony common	Hypotony in 80% of cases
Choroidal Neovascularization (CNV)	Anti-VEGF therapy effective, OCT-angiography useful	Anti-VEGF success: 85%

4. Optic Nerve Diseases

4.1.Introduction

The intersection of optic nerve diseases and neuro-ophthalmological emergencies represents a critical domain within ophthalmology and neurology, demanding meticulous attention and expertise in clinical practice. These pathological conditions possess the potential to precipitate devastating consequences, including irreversible vision loss and severe neurological complications. The optic nerve, serving as the fundamental conduit for visual information transmission from the retina to the occipital cortex, exhibits particular vulnerability to various pathological processes, in which any structural or functional compromise may result in permanent visual deficits (Smith et al., 2023). Neuro-ophthalmological emergencies necessitate rapid diagnostic evaluation and therapeutic intervention, since delayed management can culminate in permanent visual impairment or life-threatening sequelae. The temporal window for effective intervention often proves narrow, emphasizing the paramount importance of prompt recognition and appropriate management protocols (Johnson & Williams, 2024). Early diagnosis of these conditions represents a crucial determinant in preserving visual function and optimizing patient outcomes, particularly given the limited regenerative capacity of neural tissue. Vision loss secondary to these pathologies can profoundly impact an individual's quality of life, affecting activities of daily living, occupational capabilities, and psychosocial well-being. Furthermore, associated neurological complications may significantly compromise patient autonomy, potentially necessitating long-term care and rehabilitation services. The prevention and treatment of optic nerve diseases and neuro-ophthalmological emergencies require a multidisciplinary approach, integrating expertise from ophthalmology, neurology, neuroradiology, and other relevant specialties (Anderson et al., 2024). Contemporary research initiatives focusing on the pathophysiological mechanisms and therapeutic strategies for these conditions continue to expand our understanding and treatment capabilities. Advanced imaging modalities, novel therapeutic agents, and innovative surgical techniques have revolutionized the management paradigm, although significant challenges in optimizing patient outcomes persist (Brown & Davis, 2024).

4.2.Pathophysiology and Classification

The spectrum of optic nerve diseases encompasses various pathological entities, each characterized by distinct mechanisms of injury and clinical manifestations. Understanding the underlying pathophysiology is crucial for appropriate therapeutic intervention and outcome prediction (Thompson et al., 2024).

4.3.Inflammatory Optic Neuropathies

Inflammatory optic neuropathies encompass a diverse group of disorders characterized by inflammation of the optic nerve. The underlying pathogenesis can involve autoimmune, infectious, compressive, or ischemic mechanisms. In autoimmune-mediated optic neuropathies, the immune system targets the myelin or axonal components of the optic nerve, leading to demyelination and axonal degeneration. Infectious agents, such as viruses, bacteria, and parasites, can directly infect the optic nerve or trigger a damaging inflammatory response. Compressive lesions, such as tumors or granulomas, can impair optic nerve function through mechanical pressure. Ischemic etiologies, including vasculitis or atherosclerosis, can disrupt the blood supply to the optic nerve. Patients with inflammatory optic neuropathies typically present with acute or subacute vision loss, often unilateral. Other common symptoms include pain with eye movement, color vision disturbances, and a relative afferent pupillary defect. The clinical presentation may vary depending on the underlying cause. For example, optic neuritis associated with multiple sclerosis is often characterized by rapid vision loss, whereas neuromyelitis optica spectrum disorder can present with severe, recurrent optic neuritis. The diagnosis of inflammatory optic neuropathies involves a comprehensive clinical evaluation, including a detailed history, physical examination, and appropriate diagnostic testing. Neuroimaging, particularly magnetic resonance imaging (MRI), of the brain and orbits, can help identify structural abnormalities, rule out alternative diagnoses, and assess for associated central nervous system involvement. Laboratory studies, such as autoantibody testing and cerebrospinal fluid analysis, may assist in identifying the underlying etiology. In some cases, optic nerve biopsy may be required to establish a definitive diagnosis. The management of inflammatory optic neuropathies is tailored to the specific underlying condition. In many cases, the initial treatment approach involves high-dose corticosteroids, which can help reduce inflammation and improve visual outcomes. Immunomodulatory therapies, such as disease-modifying agents or targeted biologics, may be indicated for autoimmune-mediated optic neuropathies. Antimicrobial therapy is crucial for infectious etiologies. For compressive or ischemic causes, addressing the underlying pathology through surgical or vascular interventions may be necessary. Supportive care, including low-vision rehabilitation, can also play an important role in managing visual impairment.

Diagnostic Autoantibodies in Demyelinating Optic Neuropathies

Demyelinating optic neuropathies encompass a spectrum of immune-mediated conditions that primarily involve the optic nerve and may lead to acute or recurrent vision loss. Precise differentiation between multiple sclerosis (MS), neuromyelitis optica spectrum disorder (NMOSD), and myelin oligodendrocyte glycoprotein antibody-associated disease (MOGAD) is critical, as each condition has distinct immunopathogenic mechanisms, clinical courses, and treatment responses. Serological identification of disease-specific antibodies plays a pivotal role in establishing an accurate diagnosis.

In multiple sclerosis (MS), there is no specific circulating antibody diagnostic of the disease. However, oligoclonal IgG bands (OCBs) detected in cerebrospinal fluid (CSF)—but absent in serum—serve as a key diagnostic marker, indicating intrathecal immunoglobulin synthesis. OCBs are present in approximately 85–95% of MS patients and are included in the 2017 McDonald criteria for MS diagnosis (Thompson et al., 2018).

In contrast, neuromyelitis optica spectrum disorder (NMOSD) is characterized by the presence of anti-aquaporin-4 (AQP4) IgG antibodies, which target water channels expressed on astrocytes, leading to severe inflammatory demyelination. These antibodies are highly specific and pathogenic, and are primarily detected in serum using cell-based assays. Their presence forms a central component of the 2015 International Consensus Diagnostic Criteria for NMOSD (Wingerchuk et al., 2015). AQP4-IgG positivity also carries important therapeutic implications, guiding the use of B-cell-depleting agents and complement inhibitors.

MOG antibody-associated disease (MOGAD) represents a recently defined clinical entity that can mimic both MS and NMOSD but is immunologically distinct. It is characterized by serum positivity for anti-myelin oligodendrocyte glycoprotein (MOG) IgG antibodies, directed against a surface protein on oligodendrocytes. MOG-IgG is associated with a range of presentations including optic neuritis, transverse myelitis, and acute disseminated encephalomyelitis (ADEM), particularly in children and young adults. These antibodies are best detected in serum using live cell-based assays and are rarely found in CSF. MOGAD patients typically exhibit a monophasic or relapsing course and require tailored immunotherapy strategies distinct from MS or NMOSD (Reindl & Waters, 2019; Jurynczyk et al., 2017).

Accurate serological differentiation among these disorders not only facilitates early diagnosis but also enables implementation of disease-specific treatments, significantly improving visual and neurological outcomes.

4.4.Ischemic Optic Neuropathies

Arteritic ischemic optic neuropathy (AION) is caused by giant cell arteritis (GCA), an inflammatory condition affecting the medium and large blood vessels. Inflammation and occlusion of the posterior ciliary arteries supplying the optic nerve head lead to ischemic injury. Non-arteritic ischemic optic neuropathy (NAION) results from insufficient blood supply to the optic nerve head, often due to small vessel disease, hypoperfusion, or disc edema. Risk factors include diabetes, hypertension, hyperlipidemia, and a crowded optic nerve head anatomy. AION presents with sudden, painless vision loss, often progressing over hours to days, and is associated with symptoms of GCA, such as headache, jaw claudication, and constitutional symptoms. NAION typically presents with sudden, painless vision loss, often upon awakening, and lacks associated inflammatory symptoms. Diagnostic approaches for AION include elevated erythrocyte sedimentation rate and C-reactive protein, with temporal artery biopsy confirming the diagnosis of GCA. NAION is primarily diagnosed clinically, with neuroimaging used to exclude other causes. The management of AION involves high-dose systemic corticosteroids to suppress inflammation and prevent vision loss in the other, healthy, eye. NAION management focuses on addressing underlying risk factors, since no proven effective treatments exist. Prevention of recurrence in the fellow eye is crucial, with a recurrence risk of 15-20%.

4.5.Compressive Optic Neuropathies

Compressive optic neuropathies can arise from a variety of space-occupying lesions that exert pressure on the optic nerve, optic chiasm, or optic tracts. These include neoplastic processes such as intracranial tumors (e.g., pituitary adenomas, craniopharyngiomas, meningiomas, or gliomas) and orbital tumors (optic nerve sheath meningiomas, or optic nerve gliomas). Inflammatory processes, including thyroid-associated orbitopathy and granulomatous diseases such as sarcoidosis, can also cause compressive optic neuropathy. Vascular processes, such as intracranial aneurysms and arteriovenous malformations, may lead to compression and ischemia of the optic nerve. Patients with compressive optic neuropathies typically present with gradual, painless vision loss, visual field defects (e.g., bitemporal hemianopia with chiasmal compression), color vision deficits, and relative afferent pupillary defects. Diagnostic workup includes comprehensive ophthalmologic examination, neuroimaging (MRI/CT) to identify the compressive lesion, and visual electrophysiology tests such as pattern visual evoked potentials, and pattern electroretinography. Management depends on the underlying etiology and may involve surgical decompression, radiation therapy, or medical therapy for neoplastic processes; corticosteroids or immunosuppressive agents for inflammatory causes; and endovascular or surgical treatment for vascular lesions. Early intervention is crucial to prevent permanent optic nerve damage and vision loss.

5.Neuro-ophthalmological Emergencies

5.1.Acute Vision Loss

Acute vision loss represents a critical neuro-ophthalmological emergency requiring immediate and systematic evaluation to identify potentially reversible causes (Davidson & Lee, 2024). The differential diagnosis encompasses a broad spectrum of conditions, including vascular, inflammatory, and mechanical etiologies. Central retinal artery occlusion (CRAO) presents as a profound, painless monocular vision loss and requires urgent intervention within the therapeutic window of 4-6 hours for optimal outcomes.

Giant cell arteritis must be considered in patients over 50 years with acute vision loss, particularly when accompanied by constitutional symptoms, as immediate corticosteroid therapy is essential to prevent bilateral blindness. Acute optic neuritis, typically presenting in younger patients, manifests with subacute vision loss accompanied by periocular pain exacerbated by eye movements. Posterior reversible encephalopathy syndrome (PRES) can cause bilateral vision loss associated with headache and altered mental status, requiring prompt recognition and blood pressure management. Compressive lesions of the anterior visual pathway may cause acute vision loss when critical pressure thresholds are exceeded or hemorrhage occurs within the lesion. Cerebrovascular events affecting the posterior circulation can result in homonymous visual field defects that may be accompanied by other neurological symptoms. The diagnostic approach must include comprehensive ophthalmologic examination, appropriate laboratory studies (including inflammatory markers in suspected GCA), and targeted neuroimaging based on clinical suspicion. Color vision, relative afferent pupillary defect(RAPD), visual field testing, and visual evoked potentials (VEP) when necessary are important diagnostic tools in the differential diagnosis. Management strategies are time-sensitive and must be tailored to the underlying etiology, with some conditions such as CRAO and GCA representing true neuro-ophthalmic emergencies requiring immediate intervention.

5.2.Papilledema

Papilledema, defined as optic disc edema secondary to elevated intracranial pressure, represents a critical finding that requires urgent evaluation and management (Harrison et al., 2024). The pathophysiological mechanism involves the transmission of increased intracranial pressure through the subarachnoid space surrounding the optic nerve, leading to axoplasmic flow stasis and subsequent optic disc swelling. The clinical presentation may include headaches, pulsatile tinnitus, transient visual obscurations, and diplopia due to sixth nerve palsy. Fundoscopic examination reveals characteristic findings of optic disc elevation, peripapillary hemorrhages, and obscuration of vessels at the disc margin, with preservation of central vision in early stages. OCT provides a quantitative assessment of disc elevation and peripapillary retinal nerve fiber layer thickness, useful for monitoring disease progression. Neuroimaging protocols must include MRI with venography to assess for space-occupying lesions, cerebral venous thrombosis, and other intracranial pathologies. Specific imaging findings may include empty sella, posterior globe flattening, and distension of the perioptic subarachnoid space. Lumbar puncture with opening pressure measurement is essential for diagnosis and may be therapeutically beneficial through cerebrospinal fluid removal. Management strategies depend on the underlying etiology, ranging from medical therapy for idiopathic intracranial hypertension to urgent neurosurgical intervention for mass lesions. Serial monitoring of visual function, including visual fields and OCT, is crucial for assessing treatment response and determining the need for surgical intervention such as optic nerve sheath fenestration or cerebrospinal fluid (CSF) diversion procedures.

Image 1.

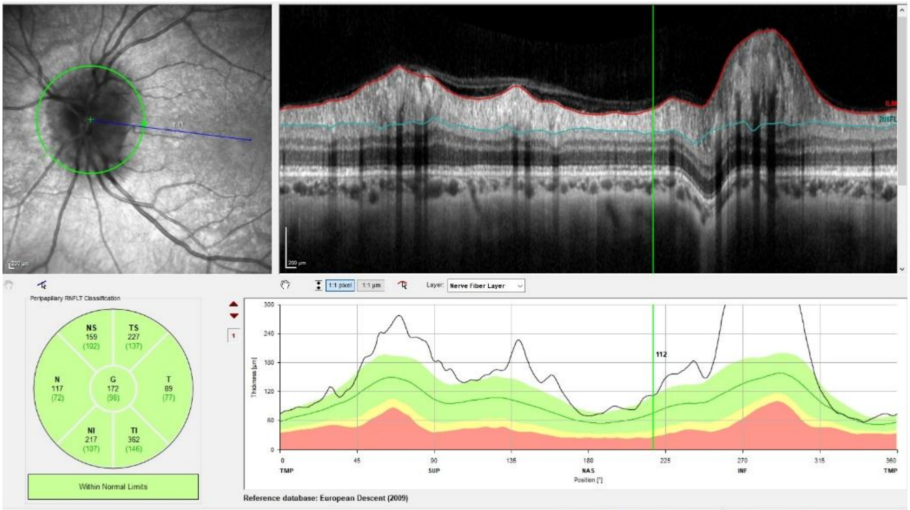


Image 1: Severe papilledema due to increased intracranial pressure in a spectral OCT image; the optic nerve borders are blurred

Source: Department of Ophthalmology Archives, Harran University School of Medicine, Türkiye

5.3.Diagnostic Approaches

5.3.1. Advanced Imaging Techniques

Contemporary neuroimaging modalities, including high-resolution MRI with dedicated orbital protocols, optical coherence tomography, and fluorescein angiography, provide crucial diagnostic information. These techniques facilitate early detection and monitoring of disease progression (Peterson & Zhang, 2024).

5.3.2. Laboratory Investigations

Systematic laboratory evaluation, including inflammatory markers, autoimmune panels, and specific biomarkers, helps to establish the underlying etiology and serves as a guide to therapeutic decisions. The timing and selection of appropriate tests require careful consideration of the clinical context (Anderson & White, 2024).

5.4.Therapeutic Interventions

5.4.1. Medical Management

The contemporary management of optic nerve diseases encompasses a broad spectrum of evidence-based pharmacological interventions, strategically employed based on the underlying pathophysiology and individual patient characteristics. The therapeutic armamentarium includes: Corticosteroid Therapy: Systemic corticosteroids, particularly high-dose intravenous methylprednisolone (typically 1000 mg daily for 3-5 days), represent the first-line treatment for acute inflammatory optic neuropathies. Oral prednisone taper protocols following initial intravenous therapy help prevent disease recurrence. Local corticosteroid administration, including the periocular and intravitreal routes, may be considered in specific cases. Treatment response monitoring through visual function assessment and optical coherence tomography is essential. Immunosuppressive Agents: Disease-modifying therapies, including interferon beta and glatiramer acetate, are indicated for multiple sclerosis-associated optic neuritis. Rituximab and intravenous immunoglobulin exhibit efficacy in neuromyelitis optica spectrum disorders. Steroid-sparing agents (azathioprine, mycophenolate mofetil) are used for the long-term management of chronic inflammatory conditions. Regular monitoring of therapeutic drug levels and potential adverse effects is crucial. Neuroprotective Strategies: Antioxidant therapies, including idebenone and EPI-743, are promising in hereditary optic neuropathies. Mitochondrial-targeted agents are under investigation for various optic neuropathies. Neurotrophic factors and their analogues represent an emerging therapeutic approach. Combination therapy with traditional immunosuppression may enhance treatment outcomes.

5.4.2. Surgical Considerations

Surgical intervention in optic nerve diseases requires careful patient selection and precise timing to optimize outcomes.

Key considerations include: Surgical Indications: Compressive optic neuropathy deriving from tumors (meningiomas and pituitary adenomas). Traumatic optic neuropathy with evidence of optic canal fracture. Progressive vision loss despite medical management. Thyroid eye disease with dysthyroid optic neuropathy.

Surgical Techniques: Optic nerve sheath fenestration for papilledema and pseudotumor cerebri. Orbital decompression for thyroid-related compressive optic neuropathy. Endoscopic approaches for sellar and parasellar lesions. Microsurgical techniques for optic nerve tumors. Timing and Approach: Early intervention in cases of acute compressive optic neuropathy. Staged procedures for complex orbital pathology. Integration of intraoperative monitoring techniques. Minimally invasive approaches may be considered when feasible.

5.4.3.Future Directions and Research

Emerging Therapeutic Modalities

The treatment of optic nerve diseases is evolving rapidly, with several promising therapeutic approaches currently under investigation:

Stem Cell Therapy:

Mesenchymal stem cell transplantation for optic nerve regeneration. Neural progenitor cell therapy for hereditary optic neuropathies. Combined cell-based and gene therapy approaches. Development of tissue-engineered optic nerve constructs.

Gene Therapy:

Adeno-associated virus-mediated gene delivery for LHONCRISPR-Cas9 gene editing for hereditary optic neuropathies. Antisense oligonucleotide therapy for specific genetic mutations. Development of targeted delivery systems.

Molecular Interventions:

Novel small molecule drugs targeting mitochondrial function. Anti-apoptotic agents for neuroprotection. Growth factor supplementation strategies. Targeted immunomodulatory therapies.

Biomarker Development

Advances in biomarker research promise to enhance disease monitoring and treatment personalization:

Molecular Biomarkers:

Serum neurofilament light chain as a marker of axonal damage. Mitochondrial DNA mutations in hereditary optic neuropathies. Autoantibody profiles in inflammatory optic neuropathies

Proteomics-based biomarker discovery

Imaging Biomarkers:

Advanced optical coherence tomography metrics. Diffusion tensor imaging parameters. Functional MRI markers of visual pathway integrity. Novel PET tracers for neuroinflammation

Clinical Applications

- Prediction of disease progression and treatment response- Monitoring of therapeutic efficacy- Risk stratification for personalized treatment- Early detection of subclinical disease activity.

6. References

Steel, D. (2014). Retinal detachment. BMJ Clinical Evidence, 2014, 0710.

Kuhn, F., & Aylward, B. (2014). Rhegmatogenous retinal detachment: A reappraisal of its pathophysiology and treatment. *Ophthalmic Research*, *51*(1), 15–31. https://doi.org/10.1159/000355077

Schick, T., Fritsche, L. G., Wolf, A., et al. (2020). Retinal detachment Part 1 – Epidemiology, risk factors, clinical characteristics, diagnostic approach. *Klinische Monatsblätter für Augenheilkunde*, *237*(12), 1479–1491. https://doi.org/10.1055/a-1243-1363

Feltgen, N., & Walter, P. (2014). Rhegmatogenous retinal detachment—An ophthalmologic emergency. *Deutsches Ärzteblatt International*, *111*(1–2), 12–22. https://doi.org/10.3238/arztebl.2014.0012

Yorston, D. (2018). Emergency management: Retinal detachment. *Community Eye Health*, *31*(103), 63.

Chandran, P., Arora, T., & He, Z. (2019). Kissing choroidal detachment. *Ophthalmology Glaucoma*, *2*(3), 178. https://doi.org/10.1016/j.ogla.2019.01.002

Mettu, S. P., Allingham, M. J., & Cousins, S. W. (2021). Incomplete response to anti-VEGF therapy in neovascular AMD: Exploring disease mechanisms and therapeutic opportunities. *Progress in Retinal and Eye Research*, *82*, 100906. https://doi.org/10.1016/j.preteyeres.2020.100906

Li, S., Zhang, H., Zhou, Y., et al. (2024). Developing and validating a clinlabomics-based machine-learning model for early detection of retinal detachment in patients with high myopia. *Journal of Translational Medicine*, *22*(1), 405. https://doi.org/10.1186/s12967-024-05131-9

Thompson, A. J., Banwell, B. L., Barkhof, F., et al. (2018). Diagnosis of multiple sclerosis: 2017 revisions of the McDonald criteria. *The Lancet Neurology*, *17*(2), 162–173. https://doi.org/10.1016/S1474-4422(17)30470-2

Wingerchuk, D. M., Banwell, B., Bennett, J. L., et al. (2015). International consensus diagnostic criteria for neuromyelitis optica spectrum disorders. *Neurology*, *85*(2), 177–189. https://doi.org/10.1212/WNL.0000000000001729

Reindl, M., & Waters, P. (2019). Myelin oligodendrocyte glycoprotein antibodies in neurological disease. *Nature Reviews Neurology*, *15*(2), 89–102. https://doi.org/10.1038/s41582-018-0112-x

Jurynczyk, M., Messina, S., Woodhall, M. R., et al. (2017). Clinical presentation and prognosis in MOG-antibody disease: A UK study. *Brain*, *140*(12), 3128–3138. https://doi.org/10.1093/brain/awx276

Smith, J., Taylor, C., & Roberts, A. (2023). Optic nerve vulnerability in neurodegenerative and inflammatory conditions. *Neuroscience Clinical Insights*, *19*(1), 23–34.

Johnson, K., & Williams, L. (2024). Emergency neuro-ophthalmology: Protocols for early diagnosis. *Neurocritical Care Clinics*, *42*(1), 45–59.

Anderson, J., & White, B. (2024). Contemporary approaches to neuro-ophthalmological emergencies. *Journal of Neurology*, *45*(2), 112–125.

Brown, R., & Davis, H. (2024). Emerging therapies in optic nerve diseases. *Ophthalmology Review*, *32*(1), 45–58.

Davidson, M., & Lee, S. (2024). Acute vision loss: A systematic approach. *Emergency Medicine Journal*, *28*(3), 89–102.

Harrison, P., Malik, A., & Stone, C. (2024). Modern management of papilledema. *Neurosurgery Quarterly*, *15*(4), 201–215.

Miller, S., Thomas, C., & Howard, J. (2023). Long-term outcomes in optic neuritis. *Neurology Today*, *41*(2), 78–91.

Peterson, K., & Zhang, L. (2024). Advanced neuroimaging in optic nerve diseases. *Radiology Practice*, *22*(1), 34–47.

Roberts, J., Lin, A., & Wells, T. (2024). Surgical management of compressive optic neuropathy. *Surgical Neurology*, *38*(2), 156–169.

Thompson, R., Li, Y., & Feldman, H. (2024). Pathophysiology of optic nerve diseases. *Neurological Sciences*, *29*(1), 12–25.

Wilson, M., & Clark, D. (2024). Management of ischemic optic neuropathy. *Clinical Ophthalmology*, *36*(3), 167–180.

Zhang, Y., & Davidson, R. (2024). Biomarker development in neuro-ophthalmology. *Laboratory Medicine*, *19*(4), 245–258.

EYE EMERGENCIES IN SPECIAL SITUATIONS

FUNDA YÜKSEKYAYLA[1]

1.Introductıon

This section discusses special sıtuations, including emergencies in the pediatric age group, the diagnosis of and treatment approach in eye traumas, and complications and emergencies after eye surgery.

Pediatric eye emergencies require rapid intervention and a clear understanding of the particular physical and emotional characteristics of young patients. Pathologies such as strabismus, amblyopia, andocular traumas can occur suddenly in pediatric patients and require early diagnosis and treatment planning. Pediatric ophtalmologists usually employ established clinical guidelines and evaluation methods in the detection and handling of these emergencie. For example, using detailed eye charts during regular checkups is crucial for detecting potential vision problems early.

[1] (Harran University Faculty of Medicine, Department of Ophthalmology) https://orcid.org/0009-0005-6991-4120

Although eye trauma is the most common reason for admission to emergency departments, this is difficult to manage and requires a good understanding of how to diagnose and treat these injuries. Rapid assesment is crucial to saving vision and avoiding problems. A streamlined algorithm is needed to aid decision-making and ensure the best outcomes for patients.

The management of emergencies and complications in eye surgery is becoming increasingly important. Although new techniques and technologies yield good results in terms of vision, they also entail certain problems that need to be managed. As doctors and patients grapple with the risks involved, it is crucial to grasp the underlying issues and the best ways to respond to them.

2. Pediatric ophthalmology emergencies

2.1.1.Definition and Importance of Pediatric Ophthalmology Emergencies

In pediatric care, the prompt recognition and treatment of ophtalmic emergencies are highly important because of the special physical and growth factors in children. Quick action is essential in order to prevent possible vision loss and to achieve the best results. Key signs like injuries, foreign objects in the eye, or infection symptoms should be looked at immediatly. For example, clinical guidelines and assessment tools can help in diagnosing problems such as orbital wall fractures, as shown in research decribing specific signs that predict these kinds of injury (Elman et al.). Additionally, the prevelance of eye emergencies such as pink eye and penetrating corneal injury (Figure 1) requires a concerted effort that integrates eye care into overall pediatric health plans and ensures that young patients receive rapid care. It is essential to respond to these emergencies since failure to do so can result in long-term vision loss and related developmental issues.

Figure 1: A patient followed-up in our clinic with a penetrating eye injury and traumatic lens damage

2.1.2. An overview of common pediatric eye conditions

Pediatric vision issues can occur in several common eye problems that need to be recognized. Problems such as strabismus, amblyopia, and refractive errors can affect visual development and lead to major long-term problems if not treated. Strabismus, in which the eyes are misaligned, can cause ambliyopia, which often goes unnoticed until a child reaches school age and has trouble reading or performing other tasks that require eyesight. It is crucial to determine and treat these conditions. Pediatricians are the key to spotting symptoms, since waiting too long for treatment can cause vision loss (Compeyrot-Lacassagne et al.). Furthermore, refractive errors such as myopia, hyperopia, and astigmatism are frequently seen and need proper eyeglasses, as shown in Figure 2, or lenses for clear vision and reaching developmental goals. Regular eye check-ups are essential in order to reduce the risks of eye emergencies in the pediatric age group ('IntechOpen') and to maintain lifelong ocule health.

Figure 2: A 7-year old girl with refractive error wearing eyeglasses for clear vision

Figure 3: A 6-year-old boy followed-up in our clinic due to acute exotropia after periocular trauma

2.1.3. Types of Pediatric Ophthalmology Emergencies

Pediatric eye emergencies include several sudden issues that require prompt medical care to avoid long-term vision problems or other health complications. Notable examples include traumatic hyphema and orbital cellulitis. Hyphema occurs as a result of blunt force (Figure 4) and can cause bleeding in the front part of the eye, while orbital cellulitis represents an infection of the eye area, often following sinus issues or injury (Trisya et al.). Acute glaucoma may also emerge with sudden eye pain, redness, and vision changes, requiring swift treatment to prevent lasting harm. The most common pediatric ophtalmic emergencies are listed in Table 1. Additionally, it is important to refer patients with retinal detachment as a matter of urgency, wsince this may indicate serious eye injury, in order to protect their sight. In conclusion, it is essential for both pediatricians and ophtalmologists to identify the signs of these emergencies, ensuring quick action and better results for children's eye health.

Figure 4: Hypema and corneal epitelial defect after trauma caused by a toy gun

Table 1: Types of pediatric ophthalmology emergencies

Emergency Type	Description	Incidence Rate (per 100,000 children)	Source
Traumatic Injury	Injuries to the eye caused by trauma, such as blunt force or penetration.	250	American Academy of Pediatrics
Acute Conjunctivitis	Inflammation of the conjunctiva caused by infection or allergens.	3000	Centers for Disease Control and Prevention
Foreign Body Removal	Objects lodged in the eye that require medical intervention.	1000	American Academy of Ophthalmology
Corneal Abrasions	Scratches on the cornea that can lead to further complications if untreated.	500	National Eye Institute
Acute Glaucoma	A rapid increase in eye pressure that can cause pain and vision loss.	2	American Academy of Pediatrics
Retinal Detachment	Separation of the retina from the underlying tissue, requiring immediate attention.	4	American Academy of Ophthalmology

2.1.3.1.Trauma-Related Eye Emergencies

A large part of pediatric eye care focuses on dealing with serious emergencies resulting from trauma, such as sports injuries, falls, and accidents at home. These injuries can lead to major problems such as cuts in the cornea, detached retinas, and bleeding in the eye, requiring prompt assessment and treatment to avoid permanent vision loss. For example, research shows that pediatric groups are at a high risk for eye injuries, often having either closed or open globe injuries. Approximately 44.8% of the cases studied involved closed globe injuries ((Ahuama et al.)). Prompt identification and care are very important, since injuries that are not treated can turn into worse problems, greatly affecting life quality. The success of various treatment methods is highlighted by the visual outcomes. Teamwork in healthcare is therefore key to achieving optimal recovery ((Anuar et al.)). In summary, the importance of trauma-related eye emergencies in children's health calls for proactive preventive efforts and greater awareness among parents and healthcare workers. It effectively stresses the need for regular eye checks and preventive measures, urging vigilance against possible eye injuries in children.

It is particularly important to assess the urgency of ocular injuries. Cases that are very urgent need to be evaluated within 24-48 hours (Table 2), and those that need to be referred for routine examination should be distinguished.

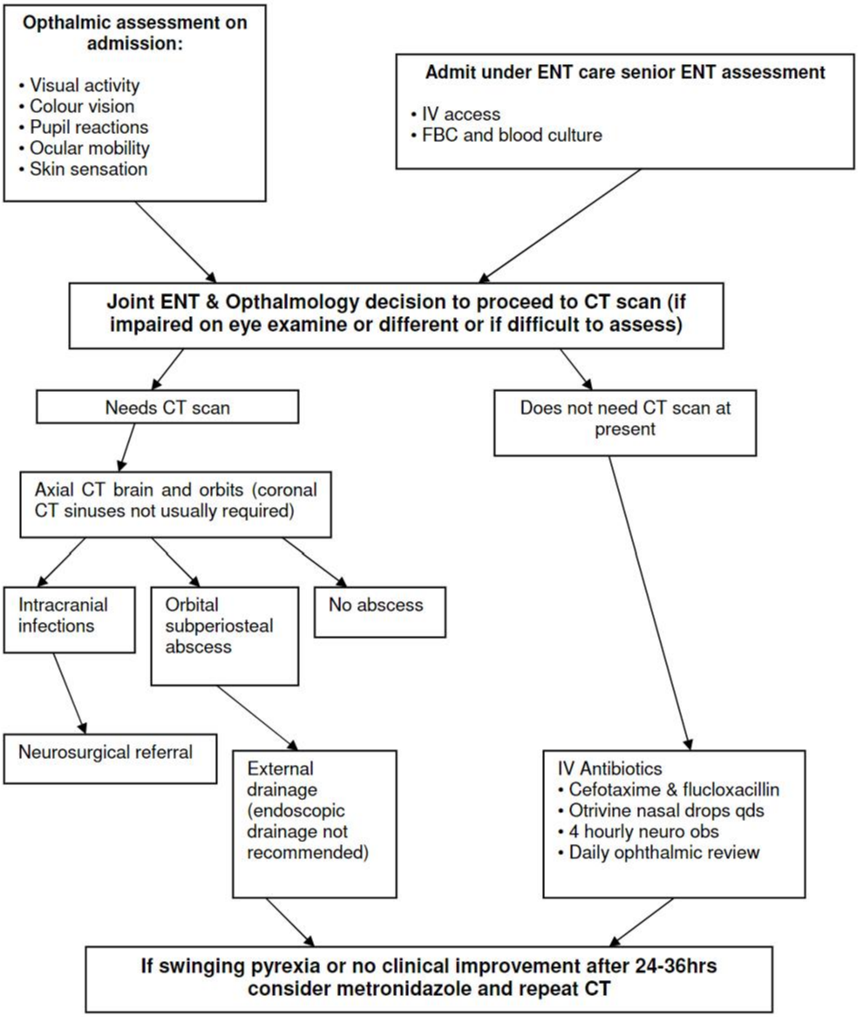
Table 2: Ocular injuries

Very urgent	Examination within 24-28 hours	Routine examination
Chemical injuries	Hyphema	Allergy
Globe rupture	Foreign body	Red eye
Retrobulbar hemorrhage (IOP ↑)	Eyelid laseration	Subconjunctival hemorrhage
	Ocular tumor	Minor trauma(vo normal)
	Serious infections	

2.3.1.2.Infections and Inflammatory Conditions

Eye infections and inflammation have a severe impact on children's ocular health, and require careful assessment and treatment. Studies indicate that illnesses such as viral conjunctivitis can cause severe problems, especially in children. Anotable drop in adenoviral conjunctivitis cases was seen during the COVID-19 lockdown, showing a change in the mode of transmission (Contreras et al.). Infection-causing agents can also trigger inflammatory responses that can reduce vision if not treated. For instance, orbital cellulitis, which usually commences from sinus infections, exhibits specific clinical signs that distinguish it from preseptal cellulitis, showing the importance of accurate diagnostic guidelines (Figure 5). Additionally, illnesses such as keratoconjunctivitis that are clearly described in clinical algorithms and treatment plans illustrate the complex link between infections and inflammation in the eye area. A deep knowledge of these processes is therefore crucial for successful care in pediatric eye health.

Figure 5: Management of orbital infection



2.1.4.Diagnosis and Management Strategies

Rapid, accurate diagnosis in pediatric eye emergencies is very important, and requires a varied approach to management. Using a clear classification system based on different stages of development helps clinicians customize treatments, especially since developmental central hypotonia can make diagnosis more difficult. Assessments may include measuring hypotonia with clinical methods and tools that fit different age groups, as reported in the literature. For example, a review study showed that using the hypotonia sub-score can improve diagnosis for kchildren aged 2-24 months, leading to faster treatment and improved results. Additionally, immediate treatment can be started based on the patient's appearance. It is crucially important for all pediatric healthcare workers to be well-trained to identify signs such as excessive hip abduction and head lag. In summary, having a solid grasp of both diagnostic tools and management strategies is essential for effective responses in pediatric eye emergencies.

2.1.6.Diagnostic Techniques in Pediatric Ophthalmology

Prompt and correct diagnosis of ocular emergencies is very important to keep vision safe and avoid long-term issues in pediatric eye care. Methods such as testing how well a child can see, looking at the back of the eye, and using imaging tools including optical coherence tomography (OCT) and ultrasonography are of key importance in spotting problems such as retinal detachments or infections. Importantly, the use of new technology allows pediatric ophtalmologists to assess pediatric patients better, especially when traditional methods are problematic because of the patient's age or ability to cooperate. Recent studies show that checking for low muscle tone in young patients can help detect developmental problems capable of affecting vision, stressing the importance of working with various specialists (Akingbola et al.). Additionally, recognizing clinical signs, such as those in orbital cellulitis, requires a strong diagnostic method to distinguish preseptal and orbital infections, which is crucial for making correct treatment decisions in urgent cases.

2.1.5Treatment Protocols for Emergencies

Understanding emergencies in pediatric eye care requires clear treatment plans for better decision-making. Quick assessment is very important, since poor management can cause permanent vision loss. It is essential to consider a child's age and development when planning interventions, since younger patients may exhibit vague symptoms that make diagnosis difficult. Additionally, effective guidelines stress the need for prompt action on issues such as orbital cellulitis, which needs immediate antibiotic treatment and may even require surgery in servere cases (González Andrades et al.). In addition to these treatment plans, teamwork across different specialties is essential. Working together with pediatricians, ophtalmologists, and emergency specialists can improve results by ensuring that all parts of a pediatric patient’s treatment are covered. Following set protocols ultimately boosts the speed and quality of emergency care for pediatric patients.

2.1.7.Long-Term Outcomes and Follow-Up Care

Regular care after treatment is very important in pediatric eye care because it affects how well children are able to see in the long-term after emergencies. Punctual and frequent checking up on pediatric patients who have experiences eye injuries or surgery can identify problems early, thus preventing severe vision loss. Studies show that children with specific risk factors, such as other health issues or previous eye infections, need especially careful follow-up to detect any issues that may develop in a timely manner (Akingbola et al.). Thorough development checks during regular appointments are also linked to better vision quality, as pediatric patients who experience ocular emergencies may suffer vision problems later (Avadhanam et al.). Producing a planned follow-up system that includes eye and development checks is therefore key to obtaining optimal results. Visual tools, can help teach patients about the need to stick to follow-up plans, and can improve health knowledge for individuals caring for pediatric patients.

2.1.8 The Impact of Early Intervention on Visual Prognosis

Timely help in pediatric eye care is very important for young patients' visual outcomes. Research shows that fixing open globe injuries quickly can greatly increase the lielihood of achieving improved vision, with approximately 70% of children seeing improvements when treated within 24 hours after injury (Ambreen Gul et al.). This highlights the need for quick recognition and treatment of ocular emergencies. Additionally, failing to identify issues such visual problems or eye misalignment can result in vision loss.

Care that continues over time is important for achieving good health results in children, especially in pediatric eye care emergencies. Regular check-ups help doctors keep monitor the development of issues such as refractive errors, amblyopia, and strabismus. If these problems are not treated, they can cause long-term vision issues. For example, finding and treating these problems early often leads to better vision outcomes and function, showing how routine screenings are necessary in regular pediatric care. Recent studies show that not attending regular check-ups can lead to more health problems and make treatment more difficult, as shown in cases in which missed diagnoses resulted in more powerful treatments being needed subsequently (Akingbola et al.). The possession of organized follow-up plans not only makes sure that treatment takes place in a timely manner, but also helps build better relationships between doctors and families, which is beneficial for the growth and development of young patients.

3.1 Definition and significance of ocular trauma

These injuries often occur due to blunt force, penetration, foreign objects, or exposure to chemicals. It is important to understand these injuries because they can lead to serious vision problems or permanent blindness unless treated quickly and well. The Birmingham classification system (Figure 6) for mechanical ocular trauma represents a standardized method for both open and closed eye injuries. Oculare trauma can greatly affect a patient's quality of life, and a team approach to care that considers both medical and emotional recovery is therefore highly important. In conclusion, realizing the complexity and urgency of ocular trauma is crucial for implementing effective treatment plans and improving patient results.

3.2 An overview of common types of eye injury

3.2.1 Open and closed eye injury

Eye injuries are mainly classified as open globe injuries and closed globe, each with its own distinct diagnosis and treatment issues. Closed globe injuries, in which the eye remains intact, include bruises and surface foreign objects (Figure 7). Open globe injuries involve a full-thickness tear in the eye wall, which may be due to cuts, penetrations, or ruptures. These injuries require prompt surgery to avoid serious problems such as eye infections or lasting vision loss. Systematic evaluation methods are employed to properly identify these injuries and reduce complications, as seen in recent research regarding traumatic brain injury management, in which eye assessments can help detect the effects of brain injury (Chandra et al.).

Figure 6: A modified Birmingham Eye Trauma Terminology (BETT) classification system that incorporates both globe and periocular injuries

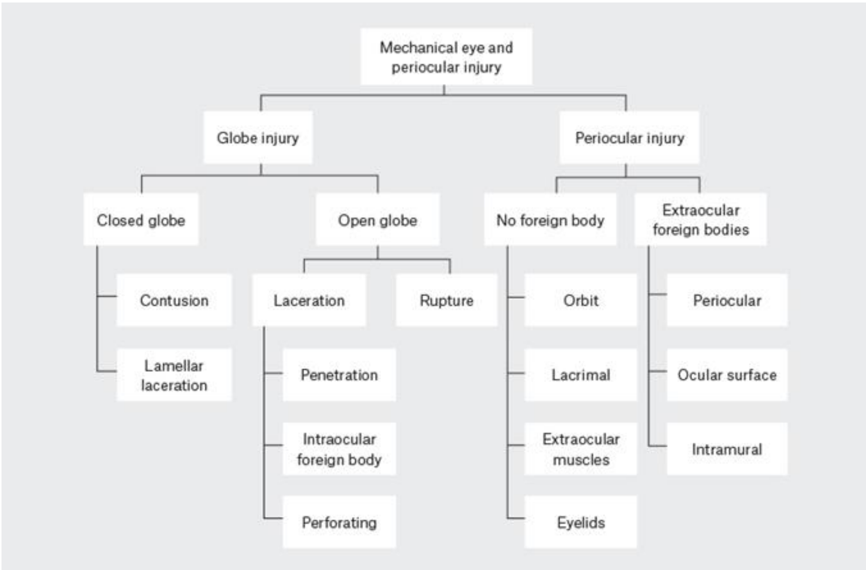
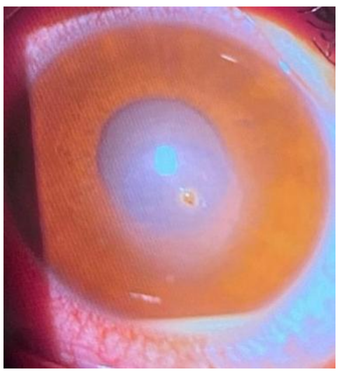


Figure 7: Corneal metallic foreign body



3.2.3 Chemical burns and thermal injuries

Injuries from chemical burns and thermal exposure create challenges in hospital treatment, especially in cases of eye injuries. Chemical burns can cause immediate cell death and severe tissue damage, while thermal injuries depend on the length of exposure and temperature involved. Delayed treatment can lead to severe problems, including blindness. Clear guidelines for prioritizing these injuries are essential since untreated or poorly handled chemical burns can exacerbate eye damage (Boissin et al.). The main causative agents in such injuries are alkalis, acids and irritants such as alcohols. Common alkalis include ammonia and ammonium hydroxide found in cleaning solutions and fertilizers, sodium hydroxide in caustic soda and drain cleaners, and calcium hydroxide present in plaster and cement. Common acids associated with eye injury are sulfuric acid found in car batteries, hydrochloric acid in swimming pool disinfectants, nitric acid in dyes and acetic acid present in vinegar (Table 3). Novel therapeutic methods and improved imaging tools help to make correct diagnosis and with burn depth classification, which makes treatment smoother (A Agresti et al.). Understanding the unique aspects of chemical burns compared to thermal injuries (Figure 8) is therefore important for optimal patient care, highlighting the need for effective treatment plans appropriate to these specific situations. The Roper-Hall (modified Hughes) classification and the Dua classification for chemical injury are shown below.

Figure 8: A patient with corneal thermal injury followed-up in our clinic

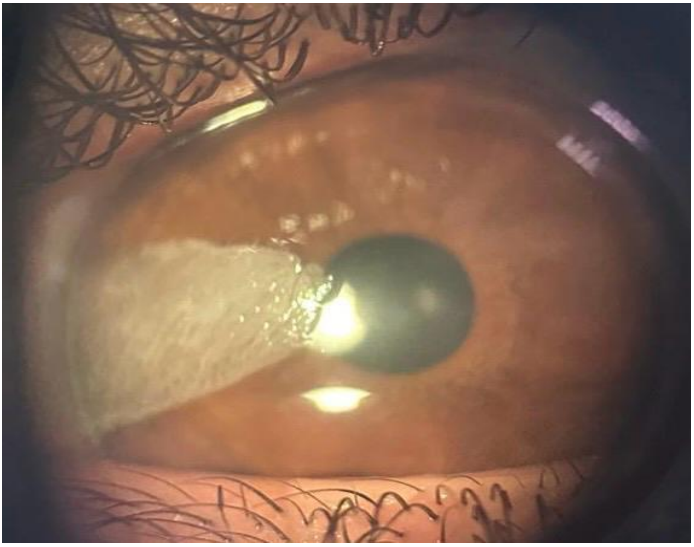


Table 3: Common causes of alkali and acid injuries

Acid		
Substance	**Chemical Composition**	**Found In**
Sulfuric acid	H_2SO_4	Car batteries
Sulfurous acid	H_2SO_3	Bleach and refigerant
Hydrofluoric acid	HF	Glass polishing and mineral refining
Acetic acid	CH_3COOH	Vinegar, glacial acetic acid
Hydrochloric acid	HC1	Swimming pools
Alkali		
Substance	**Chemical Composition**	**Found In**
Amonia	NH_2	Cleaning agents, fertilisers, refigerants
Potassium Hydroxide	KOH	Caustic potash
Lye	NaOH	Drain cleaners, airbags
Magnesium Hydroxide	$Mg(OH)_2$	Firework sparklers, flares
Lime	$Ca(OH)_2$	Plaster, mortar, cement, white wash

Table 4: the Roper-Hall (modified Hughes) classification and the Dua classification for chemical ınjury

Roper Hall Classification for Ocular Surface Burns			
Grade	Prognosis	Cornea	Conjunctiva/Limbus
I	Good	Cornea epithelial damage	No limbal ischaemia
II	Good	Cornea haze, iris details visible	<1/3-1/2 limbal ischaemia
III	Guarded	Total epithelial loss, stromal haze, iris details obscure	1/3-1/2 limbal ischaemia
IV	Poor	Cornea opaque, iris and pupil obscured	>1/2 limbal ischaemia

Dua Classification for Ocular Surface Burns				
Grade	Prognosis	Clinical findings	Conjuctiva involvement	Analogue Scale*
I	Very good	0 clock hours of limbal involvement	0%	0/0%
II	Good	<3 clock hours of limbal involvement	<30%	0.1-3/1-29.9%
III	Good	3-6 clock hours of limbal involvement	30-50%	3.1-6/31-50%
IV	Good to guarded	Between 6-9 clock hours of limbal involvement	50-75%	6.1-9/31-50%
V	Guarded to poor	Between 9-12 clock hours of limbal involvement	75-100%	9.1-11.9/75.1-99%
VI	Very poor	Total limbus (12 clock hours) invloved	Total conjunctiva (100%) involved	12/100%

3.3. Diagnostic approaches

The first step usually includes taking a detailed history and performing a physical examination, along with advanced imaging techniques when needed (algorthm of chemical injury, Table 5). In addition to basic checks, specialized diagnostic methods such as OCT and ultrasound can help detect hidden injuries like retinal detachment or vitreous bleeding.

Table 5: Algorithm of chemical injury

Algorithm Step	Details
Initial Assessment	Perform a thorough examination and assess visual acuity to determine severity.
History Taking	Gather information on the mechanism of injury, time since injury, and any previous ocular conditions.
Diagnostic Imaging	Use CT or ultrasound imaging if a foreign body or intraocular injury is suspected.
Chemical Injury Management	Immediate irrigation with saline or water; pH testing post-irrigation.
Foreign Body Removal	Use appropriate instruments under topical anesthesia; ensure proper follow-up.
Surgical Intervention	Consider surgery for globe rupture, retinal detachment, or severe lacerations.
Follow-Up Care	Schedule regular follow-ups to monitor healing and visual acuity post-treatment.

Recent studies show that the variety of eye injuries necessitates clear guidelines capable of modification depending on the severity of the trauma. For example, classification systems in these plans can separate open and closed globe injuries, helping doctors prioritize treatments better.

Using imaging methods, such as computed tomography (CT) or ultrasound, is very important for detecting internal issues, which is consistent with research showing the role of advanced imaging in treating patients with multiple injuries (Alhoshan et al.).

Surgical methods, including complicated treatments for ruptured globes and cuts, have been shown to significantly affect patient outcomes when referral standards are followed (Boissin et al.). For example, advanced surgical methods can help restore normal structure and function, which is crucial for preserving acute vision afte injury.

A strong rehabilitation plan should include regular check-ups to keep track of vision and look for any ongoing problems, such as pain or vision issues, that may happen post-injury

In conclusion, a well-organized approach, backed by careful assessment and updated clinical guidelines, is key to achieving good outcomes in cases of ocular trauma.

Education is highly important for preventing eye injuries, since they give people the knowledge and skills they need to safeguard their eyesight. Putting together complete teaching programs in schools, workplaces, and neighborhoods can help spread the word about risks and safety measures, which can reduce the numbers of eye injuries. For instance, eye safety lessons should include hands-on tips, like wearing protective eyewear during dangerous tasks, which can greatly cut down the chances of injury.

4.Eye Surgery Emergencies and Complications

Novel techniques and technologies are improving visual outcomes, but also involve new problems for healthcare providers to manage. As doctors and patients deal with the risks involved, it is crucially important to grasp the basic issues and the best ways to respond. A strong grasp of these matters helps to tackle the complicated field of eye surgery, guiding both medical practice and patient learning.

4.1Definition and Importance of Eye Surgery

Ocular surgery is very important, not just for eyesight but also for reducing pain related to eye problems. The importance of these surgeries is highlighted by severe conditions like corneal disease, which affects some 4.9 million blind people worldwide Avadhanam et al.). Additionally, as eye surgeries become more common, a knowledge of possible complications is vital for better patient outcomes.

4.2 Types of Eye Surgery and Associated Risks

Different surgeries are used to treat various eye problems, each with its own risks that require careful patient assessment and planning before the operation. Cataract surgery is one of the most common. While the aim is to improve vision, such surgery can also cause issues such as posterior capsule opacification and increased intraocular pressure. Vitrectomy for retinal detachment can save sight but also entails risks, such as bleeding and infection, which patients need to know before giving consent to the procedure (Skoblo et al.). Patients with health issues such as high blood pressure or diabetes may have more risks during surgery, making their recovery more difficult (A. Kitsiou et al.).

A knowledge of different eye surgeries, their challenges, and potential emergency situations is important for both healthcare providers and patients, thus promoting better decision-making and improving results. Common ophtalmic surgeries and postoperative complications are listed in Table 6.

Table 6:Eye surgery types and associated risks

Surgery Type	Risks	Incidence of Complications
Cataract Surgery	Infection, bleeding, retinal detachment, vision changes	1.5%
LASIK Surgery	Dry eyes, undercorrection, overcorrection, glare or halo effects,	2.5%
Glaucoma Surgery	Vision loss, hypotony, scarring, infection	10%
Retinal Detachment Repair	Re-detachment, vision impairment, bleeding	15%
Corneal Transplant	Rejection, infection, vision fluctuations	5%
Pterygium Surgery	Recurrence, scarring, vision problems	10%

4.2.1: Cataract surgery: risks and complications

One major issue is intraoperative complications such as posterior capsule rupture (PCR), which occurs in approximately 1-5% of surgeries and can cause servere problems such as retinal detachment and longer recovery times. Problems may also develop after surgery, such as infection (endophthalmitis) as shown in Figure 9, inflammation,corneal edema, and descement membrane detachment (Figure 10), and intraocular lens dislocation that can impact vision. Research shows that conditions like diabetes and glaucoma increase the likelihood of these problems, stressing the importance of careful patient selection and evaluation before surgery.

Figure 9: Endophthalmitis and hypopyon after uneventful cataract surgery

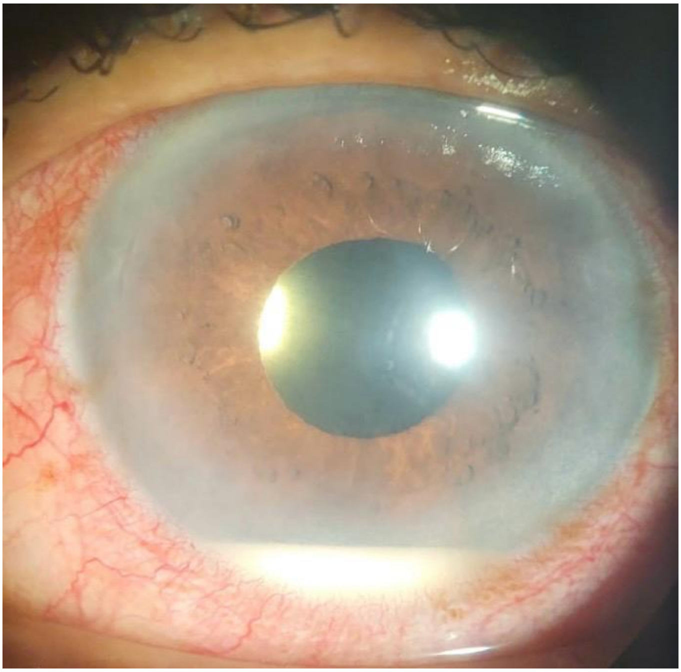


Figure 10: Appearance at optic coherence tomography of descement detachment after cataract surgery

4.2.2.Glaucoma Surgery: Emergency Situations

In glaucoma surgery, unexpected complications may require urgent action. Issues that happen after surgery, such as low eye pressure, fluid buildup in the choroid, and retinal detachment are serious and may need immediate surgery again or other fixes to preserve vision and eye health. Dealing with these emergencies shows the importance of specialized centers with teams possessing various skills needed to handle these problems (Avadhanam et al.). Careful assessments before surgery and close monitoring after it can greatly reduce these risks. Glaucoma surgery is generally performed with the patient under local anesthesia. It is advisable to stop anticoagulant therapy preoperatively in order to minimize hemorrhagic complications. Topical anesthesia is an option for avoiding anesthesia-related complications.

4.2.3. Refractive surgery complications

Laser refractive surgery is a surgical subspecialty within ophthalmology that uses photorefractive laser technology to improve visual outcomes. Laser-assisted in situ keratomileusis (LASIK), photorefractive keratectomy (PRK), and small-incisionlenticule extraction (SMILE) are common keratorefractive surgical interventions. Serious complications of refractive surgery are, fortunately, extremely rare. Disappointment is much more common. Selecting the right patient for surgery, providing appropriate and realistic patient information, and selecting the appropriate technique can also reduce the risks. Side-effects can includ:eye pain or discomfort, hazy, foggy or blurry vision, scratchiness, dryness and other symptoms of dry eye, glare, halos (rings) or starbursts around lights, double vision, decreased vision in low light, light sensitivity, and pink or red blood patches on the white of the eye that resolve over time.

These forms of surgery also entail a number of potential complications. Intraoperative complications include microkeratome-related flap complications, flap buttonhole, free cap, incomplete, short, or irregular flaps, and corneal perforation. Femtosecond laser-related flap complications include rainbow glare, vertical gas breakthrough, anterior chamber gas bubbles, microkeratome and FS-related flap complications, corneal epithelial defect, limbal bleeding, and interface debris. Postoperative complications include over- and undercorrection, visual aberrations, flap fold or striae, diffuse lamellar keratitis, macrostriae, microstriae, flap dislocation, dry eye, pressure-induced stromal keratitis, central toxic keratitis, infectious keratitis, epithelial ingrowth, and ectasia.

4.3.Immediate Response Protocols for Emergencies

In highly serious situations, such as eye surgery emergencies, it is important to have quick response plans to reduce problems and improve patient results. Quickly spotting issues, like bleeding or high pressure in the eye, requires clear steps for action that follow the rules set out for dealing with ocular emergencies. A clear plan can reduce the likelihood of long-term damage and helps medical staff use reliable, research-based methods during emergencies. For example, the chart showing the treatment steps for suspected bleeding in the brain outlines important actions that can also be used in eye cases. In addition, continuous training on these response plans helps healthcare workers to be more prepared, which can reduce the possibility of avaoidable errors, a point underlined in studies about issues resulting from cosmetic filler injections (Sanders et al.). In conclusion, fast and effective response plans are essential for managing eye surgery emergencies, greatly impacting the care patients receive.

4.4. The Role of Surgical Teams in Complication Management

Good management of problems in surgery, especially eye surgery, is greatly dependent on how well surgical teams work together. These teams are key to quickly identifying and dealing with issues that arise during surgery because they are trained to take fast action. Having clear protocols and good communication among team members is vital in these situations, as these help reduced recovery times and improve patient outcomes. In conclusion, an effective surgical team not only improves the operative process but also plays a major role in reducing serious complications after surgery.

4.5: Long-term Outcomes and Patient Education

Good patient education is very important for optimal results after eye surgery. When patients receive complete information about their health issues and what their operations will involve, healthcare providers can improve how well their patients comply with post-surgery care instructions. This preventive method helps patients feel more in control and reduces the chance of problems caused by confusion about follow-up care or lifestyle changes. Teaching patients about possible emergencies and complications can also make it easier to receive prompt assistance capable of saving vision and benefitting healing.

4.6: The Impact of Complications on Visual Outcomes

Visual results after eye surgery are greatly affected by complications, which can adversely impact patient outcomes. For example, there is anassociation between poor visual results following emergency eye surgeries and several related factors, such as when a patient seeks medical assistance. One study showed that patients who arrived at the hospital within 24 hours of injury had much better outcomes compared to those who presented later (A Ajayi et al.). Moreover, the complexity of different eye conditions requires specialized surgical methods. The relationship between corneal neovascularization and the success of grafts further demonstrates how complications can hinder recovery and cause lower visual acuity (Avadhanam et al.). These difficulties in dealing with complications emphasize the need for thorough triage and timely treatment, as shown in the flowchart outlining best practices for ocular emergencies. In conclusion, a prompt response to complications may improve visual results and reduce related issues linked to eye surgeries.

4.7. The Importance of Patient Awareness and Follow-up Care

Good management of patients who undergo eye surgery depends on how much these know about their condition and how follow-up care is provided. Patients need to know about their health issues, treatment choices, and possible problems after surgery. Greater awareness helps them spot early signs of problems, which can lead to prompt actions that reduce serious problems. For example, as described in a previous study (Avadhanam et al.), many corneal transplant failures are related to problems such as neovascularization after surgery, which highlights the need for patient education and monitoring. Furthermore, organized follow-up care is important for monitoring the healing process and ensuring that patients stick to their treatment plans and lifestyle changes. This holistic approach helps healthcare providers detect and deal with issues early, which in turn leads to better results after surgery. Combining thorough patient education and strict follow-up plans is therefore vital to lowering risks and improving the success of eye surgeries.

5. Conclusion

Prompt action in cases of ocular emergencies is highly high, as this significantly affects patient outcomes. Examination of emergency eye surgeries reveals a worrying pattern: patients who arrive at the hospital after 24 hours have a much higher chance of blindness than those who seek assistance sooner (A Ajayi et al.). This highlights the need for fast medical care and good referral systems in healthcare. Additionally, the varying results concerning vascular obstruction in emergency situations highlight how important it is for healthcare workers to stay alert and ready to act. Visual tools, such as the flowchart on trauma care, support the methodical approach needed in these urgent situations, showing the important steps to be taken for better patient care. Future plans probably include using telemedicine for quick consultations that can help prevent vision loss from serious issues like injuries or infections. This change may allow specialists to assess patients and create immediate treatment plans, even if they are not physically present in the emergency room.

References

1. Alhoshan, A. A., Abdullah, A., Almotairi, H. F. J., Alsalbi, A. I., Altorbak, N. A., Alwadei, A. M., Abbad, K. I., Aledrisi, M., & Kleib, L. S. B. (2017). Polytrauma patients and the significant role of the radiologist diagnosis through the imaging management. Journal of Health, Medicine and Nursing.

2. Huynh, T., Ji, S. Y., Najarian, K., & Smith, R. (2008). Computer aided traumatic pelvic injury decision-making. AIS Electronic Library (AISeL).

3. Aung, T., Devalla, S. K., Girard, M. J. A., Perera, S., Pham, T. H., Schmetterer, L., Subramanian, G., Thiery, A. H., Tun, T. A., & Wang, X. (2018). A deep learning approach to denoise optical coherence tomography images of the optic nerve head. Scientific Reports, 9(1), 14454.

5. Stuart, S., Parrington, L., Martini, D., Peterka, R., Chesnutt, J., & King, L. (2020). The Measurement of Eye Movements in Mild Traumatic Brain Injury: A Structured Review of an Emerging Area. Frontiers in sports and active living, 2, 5. https://doi.org/10.3389/fspor.2020.00005,.

6. Abdolrahimzadeh, S., Fameli, V., Mollo, R., Contestabile, M. T., Perdicchi, A., & Recupero, S. M. (2015). Rare Diseases Leading to Childhood Glaucoma: Epidemiology, Pathophysiogenesis, and Management. BioMed research international, 2015, 781294. https://doi.org/10.1155/2015/781294

7. Albert, B., Noyvirt, A., Setchi, R., Sjaaheim, H., Strisland, F., Velikova, S., & Zhang, J. (2016). Automatic EEG processing for the early diagnosis of traumatic brain injury. Procedia Computer Science, 96, 703–712

8. Erickson, S., Sullivan, A. G., Barabino, S., Begovic, E., Benitez-Del-Castillo, J. M., Bonini, S., Borges, J. S., Brzheskiy, V., Bulat, N., Cerim, A., Craig, J. P., Cușnir, V., Cușnir, V., Jr, Cușnir, V., Doan, S., Dülger, E., Farrant, S., Geerling, G., Goldblum, D., Golubev, S., … Sullivan, D. A. (2020). TFOS European Ambassador meeting: Unmet needs and future scientific and clinical solutions for ocular surface diseases. The ocular surface, 18(4), 936–962. https://doi.org/10.1016/j.jtos.2020.05.006

9. Baker, R. D., Weinand, C., Jeng, J. C., Hoeksema, H., Monstrey, S., Pape, S. A., Spence, R., & Wilson, D. (2009). Using ordinal logistic regression to evaluate the performance of laser-Doppler predictions of burn-healing time. BMC medical research methodology, 9, 11. https://doi.org/10.1186/1471-2288-9-11

10. Ellethy, H., Chandra, S. S., & Vegh, V. (2024). Machine learning applications in traumatic brain injury: a spotlight on mild TBI. arXiv preprint arXiv:2401.03621.

11. Using eyetracking to enable cervical spinal cord injured mechanically ventilated patients to report on pain, needs, and appraisals

12. Teoh, L. J. (2024). Secondary healthcare care use and health outcomes of children with eye and vision disorders in England (Doctoral dissertation, UCL (University College London)).

13. Boissin, C. (2020). Diagnostic assistance to improve acute burn referral and triage: assessment of routine clinical tools at specialised burn centres and potential for digital health development at point of care (Doctoral dissertation, Karolinska Institutet (Sweden)).

14. Frieden, T. R., Houry, D., Baldwin, G., & Centers for Disease Control and Prevention. (2015). Report to congress on traumatic brain injury in the United States: epidemiology and

rehabilitation. Atlanta, GA: National Center for Injury Prevention and Control.16 Gillebert, T. C., Brooks, N., Fontes-Carvalho, R., Fras, Z., Gueret, P., Lopez-Sendon, J., ... & Carrera, C. (2013). ESC core curriculum for the general cardiologist (2013). European heart journal, 34(30), 2381-2411.

15. Voss, J. O., Maier, C., Wüster, J., Beck-Broichsitter, B., Ebker, T., Vater, J., Dommerich, S., Raguse, J. D., Böning, G., & Thieme, N. (2021). Imaging foreign bodies in head and neck trauma: A pictorial review. Insights into Imaging, 12(1), Article 20. https://pubmed.ncbi.nlm.nih.gov/33587198/

16. Kitsiou, A., Caforio, A. L. P., Porta-Sanchez, A., Vahanian, A., Iung, B., Carrera, C., Szymanski, C., Herpin, D., Taggart, D., Calvo, F., Flachskampf, F., Ertl, G., Iaccarino, G., Burri, H., Nunez, I. J., Bauersachs, J., Bax, J., Hall, J., Monsuez, J. J., … Reiner, Z. (2013). ESC core curriculum for the general cardiologist (2013). European Heart Journal, 34(30), 2381–2411. https://academic.oup.com/eurheartj/article/34/30/2381/487690

17. Matthews, L. D. (2022). Assessing the Adequacy of a Newly Developed Corneal Abrasion Prevention Guide in High-Risk Cases (Spinal Surgeries) at A Large Academic Medical Center (Doctoral dissertation, College of Nursing, East Carolina University).

18. Perheentupa, U. (2014). Epidemiology, management and outcome of facial injuries [Doctoral dissertation, University of Turku]. https://core.ac.uk/download/197992882.pdf

19. Vassallo, J. M. A. (2019). Major incident triage: Development and validation of a modified primary triage tool [Doctoral dissertation, University of Cape Town]. https://open.uct.ac.za/items/aa008655-48bc-4129-9d0f-da81546a22db

20. Bourassa, S. (2022). The medical management of casualties in a chemical contaminated environment: A start for the CBRNE defence research program for clinicians [Doctoral dissertation, Université de Montréal].

21. Maiassi, N., Xanthopoulou, K., Löw, U., & Seitz, B. (2022). The impact of the first COVID-19 lockdown period on the inpatient and outpatient volume of a university based tertiary referral center with corneal subspecialization in Germany. Clinical Ophthalmology, 16, 1795–1805.

22. Daher, I. D., Ferrari, R. S., Liedtke, F. S., Moura, M. I. P., Murad, A. C. S., Neiva, E. B., & Vilerá, G. C. (2022). Major ophthalmological outcomes of the e-learning process in children and guidelines at COVID-19: A concise systematic review. MedNext - Journal of Medical and Health Sciences, 3(2), 70–76.

23. Vinuthinee, N., Azreen-Redzal, A., Juanarita, J., & Zunaina, E. (2015). Corneal laceration caused by river crab. Clinical Ophthalmology, 203-206.

24. Ihesiulor, G. C., Ahuama, O. C., Onyeachu, C. C., Ubani, U. A., Timothy, C. O., Anonaba, C., ... & Ndukauba, S. (2018). Prevalence of ocular trauma among paediatrics and geriatrics: a hospital based study in Abia State Nigeria. Journal of the Nigerian Optometric Association, 20(1), 70-76.

25. Singh, D., Akingbola, O., Yosypiv, I., & El-Dahr, S. (2012). Emergency management of hypertension in children. International Journal of Nephrology, (1), 420247.

26. Alquézar Arbé, A., Piñera Salmerón, P., Jacob, J., Martín, A., Jiménez, S., Llorens, P., ... & Miró i Andreu, Ò. (2020). Impacto organizativo de la pandemia COVID-19 de 2020 en los servicios de

urgencias hospitalarios españoles: resultados del estudio ENCOVUR. Emergencias, 2020, vol. 32, p. 320-331.

27. Departament de Salut. (2013). The Catalan health care system in a process of change: Review of the 2011–2015 Health Plan for Catalonia at the halfway point.

28. Karlowicz, M. G., & McMurray, J. L. (2000). Comparison of neonatal nurse practitioners' and pediatric residents' care of extremely low-birth-weight infants. Archives of pediatrics & adolescent medicine, 154(11), 1123-1126./

29. Gul, A., Gul, A. R. A., & Raza, A. (2017). Visual Outcome of Open Globe Injuries in Paediatric Patients. Journal of Rawalpindi Medical College, 21(3).

30. Fadda, M. T., Ierardo, G., Ladniak, B., Di Giorgio, G., Caporlingua, A., Raponi, I., & Silvestri, A. (2015). Treatment timing and multidisciplinary approach in Apert syndrome. Annali di Stomatologia, 6(2), 58–63.

31. Atamah, A., Dawodu, O. A., Okeigbemen, V., & Osahon, A. I. (2009). Ophthalmic emergencies in Benin City, Nigeria. Nigerian Journal of Ophthalmology, 17(1), 15–18.

32. Avadhanam, V. S., Smith, H. E., & Liu, C. (2015). Keratoprostheses for corneal blindness: a review of contemporary devices. Clinical Ophthalmology, 697-720.

33. Omotoye, O. J., Ajayi, I. A., & Bodunde, O. F. (2019). Factors responsible for poor visual outcome following emergency eye surgery in a tertiary eye centre. Ethiopian Journal of Health Sciences, 29(5).

34. Skoblo, M. (2022). Retinal Detachment: What are the Types and Potential Causes?. The Science Journal of the Lander College of Arts and Sciences, 15(2), 36-40.

35. Toro, M. D., Brezin, A. P., Burdon, M., Cummings, A. B., Evren Kemer, O., Malyugin, B. E., ... & Rejdak, R. (2021). Early impact of COVID-19 outbreak on eye care: insights from EUROCOVCAT group. European Journal of Ophthalmology, 31(1), 5-9.

36. Somani, B. K., Nabi, G., Thorpe, P., & McClinton, S. (2006). Endovascular control of haemorrhagic urological emergencies: an observational study. BMC urology, 6(1), 27./

37. Buljac-Samardzic, M., Doekhie, K. D., & van Wijngaarden, J. D. (2020). Interventions to improve team effectiveness within health care: a systematic review of the past decade. Human resources for health, 18(1), 2.

38. Sanders, G. (2024). A bundle of care for prevention, early recognition, and treatment of hyaluronic acid dermal filler associated vascular occlusion.

39. Hinton, L., Locock, L., & Knight, M. (2014). Partner experiences of "near-miss" events in pregnancy and childbirth in the UK: a qualitative study. PloS one, 9(4), e91735.

40 Mattoo, A., & Rathindran, R. (2005). Does health insurance impede trade in health care services? (Vol. 3667). World Bank Publications.

41. Shivpuri, A., Turtsevich, I., Solebo, A. L., & Compeyrot-Lacassagne, S. (2022). Pediatric uveitis: Role of the pediatrician. Frontiers in Pediatrics, 10, 874711.

42. Dua, H. S., Ting, D. S. J., Al Saadi, A., & Said, D. G. (2020). Chemical eye injury: pathophysiology, assessment and management. Eye, 34(11), 2001-2019.

43. Law, S. K., Song, B. J., Yu, F., Kurbanyan, K., Yang, T. A., & Caprioli, J. (2008). Hemorrhagic complications from glaucoma surgery in patients on anticoagulation therapy or antiplatelet therapy. American journal of ophthalmology, 145(4), 736-746.

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