AJLLSE GLOBAL RESEARCH NETWORK

AMERICAN Journal of Language, Literacy and Learning in STEM Education
Volume 3, Issue 1, 2025 ISSN (E): 2993-2769

Treatment of Glaucoma in Modern Medicine

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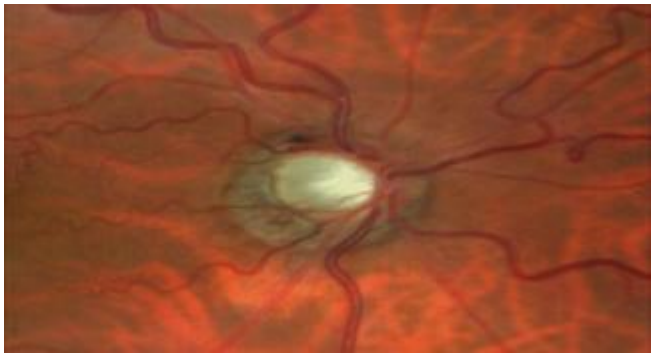
Abstract. *The purpose of this article is to study modern medical treatment methods for glaucoma and evaluate their practical significance and effectiveness. It aims to analyze pharmacological and invasive approaches in diagnosing and treating glaucoma, as well as the role of modern medical technologies and equipment in this process.*

Key words: *Glaucoma, iStent inject® W; MIGS (Minimally Invasive Glaucoma Surgery), implants, SLT (Selective Laser Trabeculoplasty), XEN Gel Stent, ALT (Argon Laser Trabeculoplasty).*

Introduction: The Medical Theory of Glaucoma. Glaucoma is a chronic and progressive ophthalmic disease characterized by the degeneration of the optic nerve and an increase in intraocular pressure. This condition can lead to a narrowing of the visual field and, ultimately, complete blindness. According to the World Health Organization, glaucoma affects over 76 million people worldwide, and this number is expected to rise to 111 million by 2040. The primary causes of this disease include:

1. Increased intraocular pressure (intraocular hypertension)
2. Impaired blood supply to the optic nerve
3. Genetic predisposition



Picture 1. Manifestation of Glaucoma.

Glaucoma brought danger factors :

- Female gender (women are more affected than men)
- Age (the likelihood of developing the disease increases after 40)
- Ethnicity (more common among African and Asian populations)

- Chronic diseases (such as diabetes and hypertension)
- Medication treatments (misuse of certain drugs)
- Genetic predisposition
- Increased intraocular pressure

Glaucoma pathomorphology according to differs:

1. Open-angle glaucoma
2. Closed-angle glaucoma
3. Congenital glaucoma
4. Secondary glaucoma

Materials and Methods: The diagnosis of glaucoma is based on the following criteria:

1. Ophthalmoscopy
2. Optical Coherence Tomography (OCT)
3. Perimetric examination (visual field testing)
4. Gonioscopy

Based on the analysis of examination methods, the following treatment methods are applied to the patient:

1. Minimally Invasive Glaucoma Surgeries (MIGS)
2. AI (Artificial Intelligence)-assisted treatment
3. Intraocular implant placement
4. Laser therapy

Diagnosis: glaucoma clear diagnostic to do methods.

If glaucoma is diagnosed in a patient, treatment is carried out on an individual basis, taking into account the type and stage of the disease, as well as the patient's overall health condition.

Symptoms:

- Narrowing of the Visual Field:

In the early stages of glaucoma, small defects (scotomas) appear in the visual field. These changes are often unnoticed by the patient and can only be detected through specialized examinations.

1. Symptoms of Angle-Closure Glaucoma (Acute Glaucoma Attack)

Angle-closure glaucoma is characterized by a sudden onset and severe symptoms. This condition requires urgent medical attention:

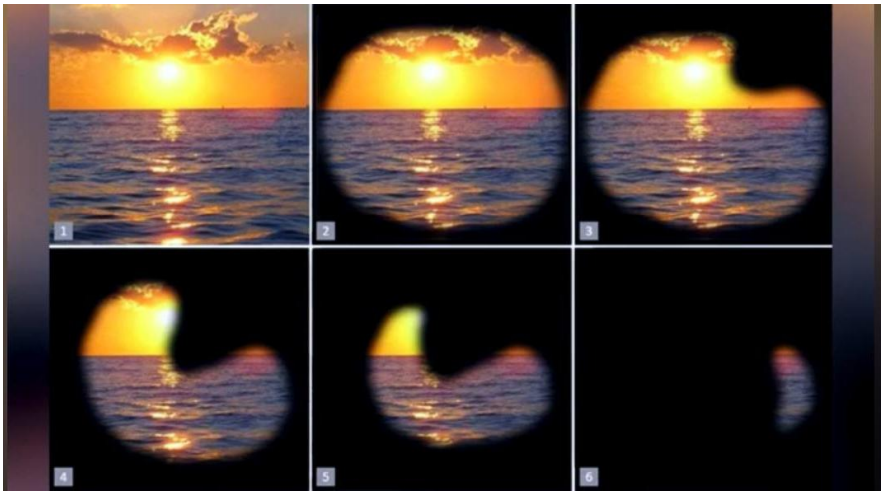
- Severe eye pain: The pain originates inside the eye and spreads to other parts of the head, particularly the temple or forehead areas.

2. Symptoms of Open-Angle Glaucoma

Open-angle glaucoma is often referred to as the "silent thief" because it typically shows almost no symptoms in its early stages. Its main signs include:

1. Gradual narrowing of the visual field – The patient gradually becomes less aware of their surroundings, but central vision remains intact for a long time.

2. Tunnel vision – In the advanced stages of the disease, peripheral vision is almost completely lost.



Picture 2. An image depicting how patients with open-angle glaucoma see.

3. The symptoms of secondary glaucoma.

- Symptoms related to the signs of the underlying disease:

In secondary glaucomas, symptoms often arise due to the underlying condition, such as uveitis, trauma, or tumors.

4. Symptoms of congenital glaucoma.

1. Enlargement of the eye (buphthalmos):

- The anterior segment of the eye enlarges due to increased intraocular pressure.

2. Loss of corneal transparency:

- The cornea may appear swollen and cloudy, and cracks (Haab's striae) can also be observed.

Glaucoma diagnosis for main inspection methods:

1. Ophthalmoscopy

- Purpose: To assess the optic nerve head.
- Description: Evaluate the degree of optic nerve damage (e.g., nerve atrophy or cupping) through a fundus examination.

2. Optical Coherence Tomography (OCT)

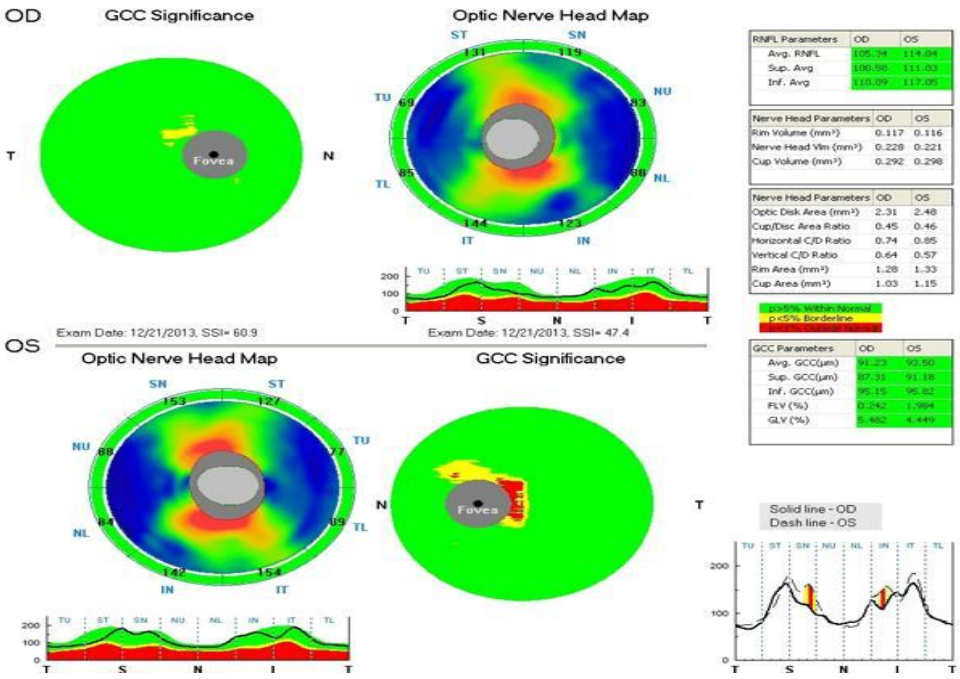
- Purpose: To analyze the thickness of the retinal nerve fiber layer and the macular region.
- Description: Provides high-precision imaging of the optic nerve's condition and nerve fiber loss.

3. Perimetric Examination

- Purpose: To detect visual field defects.
- Description: Measures the extent of the visual field and the degree of peripheral vision loss.

4. Gonioscopy

- Purpose: To evaluate the angle of the anterior chamber.
- Description: Used to determine open-angle or closed-angle glaucoma.



Picture 3. Optical Coherence Tomography (OCT) scan result

Normal pressure glaucoma type: This is a rare type of glaucoma in which the intraocular pressure (IOP) remains within the normal range (10-21 mmHg), yet damage to the optic nerve and narrowing of the visual field are observed.

Glaucoma Treatment Methods:

The primary goal of glaucoma treatment is to lower intraocular pressure (IOP). Increased pressure can damage the optic nerve, so stabilizing this pressure is essential during the treatment process.

1. Minimally Invasive Glaucoma Surgeries (MIGS)

Minimally invasive glaucoma surgeries (MIGS) are performed with less risk and trauma compared to traditional surgeries. This method is an effective treatment for various stages of glaucoma, particularly open-angle glaucoma. MIGS procedures are carried out through small incisions, significantly speeding up the rehabilitation process for patients.

MIGS Technologies:

- iStent inject® W:
- A small titanium stent used to improve fluid flow through the trabecular meshwork.
- It is implanted into the eye using a minimally invasive approach to reduce intraocular pressure.
- The main advantage: low level of trauma and high safety.
- Hydrus Microstent:
- A specialized microstent designed to expand the intraocular drainage system.
- It covers a 90-degree section of the trabecular meshwork, helping restore the natural flow of fluid.

2. Treating Glaucoma with Artificial Intelligence (AI)

The development of artificial intelligence has opened new opportunities in all areas of medicine, including the treatment of glaucoma. With AI, the diagnosis and treatment processes are becoming much more efficient and personalized.

Key Directions for AI-Based Treatment:

1. Monitoring Intraocular Pressure:

- Special devices and programs developed using AI monitor patients' intraocular pressure in real-time.

- These systems analyze the collected data and provide the ability to detect changes in advance.
- For example: "Smart" contact lenses or intraocular sensors that continuously track intraocular pressure.

2. Automating Treatment Plans:

- AI algorithms create individualized treatment plans based on the patient's analysis, medical history, and other factors.
- This technology also helps in adjusting medication dosages, selecting surgical methods, and even determining the optimal approach.

3. Intraocular Implants

In glaucoma treatment, intraocular implants are one of the effective methods for restoring fluid flow and controlling intraocular pressure.

Popular Implants:

1. XEN Gel Stent

- A small tube made from biocompatible material.
- It directly channels fluid from the trabecular meshwork to the subconjunctival space.

4. Laser Therapy

Laser therapy is used in glaucoma treatment as an alternative to surgical interventions. This method targets the trabecular meshwork and helps reduce intraocular pressure.

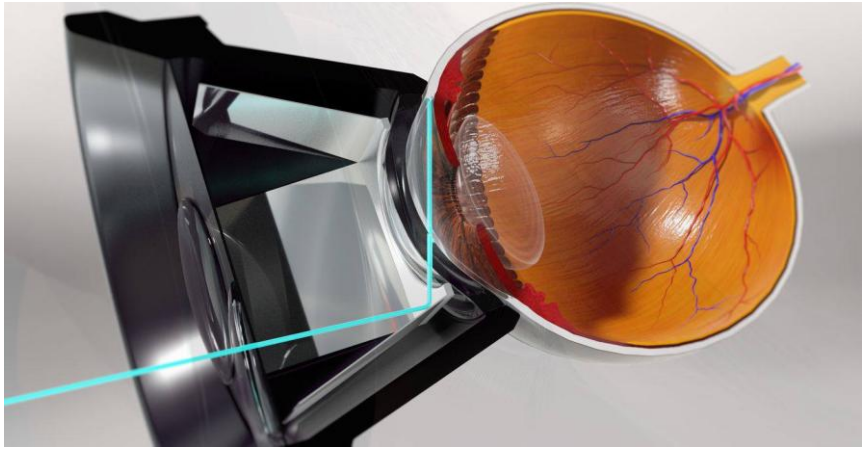
Most Common Laser Methods:

1. Selective Laser Trabeculoplasty (SLT):

- Improves fluid flow by delivering laser pulses to selected areas of the trabecular meshwork.
- Advantages: safe, low risk of complications, and used as a complementary method to other treatments.

2. Argon Laser Trabeculoplasty (ALT):

- Improves fluid flow by targeting larger sections of the trabecular meshwork.
- Used less frequently due to SLT's higher effectiveness and safety.



Picture 4. Selective Laser Trabeculoplasty (SLT)

Conclusion: Modern methods of glaucoma treatment have achieved significant advances in improving both effectiveness and safety. The combination of Minimally Invasive Glaucoma Surgeries (MIGS), laser technologies, and AI (artificial intelligence) interventions plays a crucial role in enhancing patients' vision quality and accelerating post-treatment recovery. The treatment

strategies are primarily focused on reducing intraocular pressure, with the application of the latest methods proving to be highly effective.

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