



DIABETES MELLITUS AND ITS OCULAR COMPLICATIONS

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Abstract: Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from impaired insulin secretion, insulin action, or both. Prolonged hyperglycemia affects multiple organ systems, including the visual system. Diabetic eye disease is one of the most common and serious chronic complications, potentially leading to visual impairment and blindness if not properly managed. This review discusses the pathophysiology, major ocular manifestations, diagnostic approaches, and current management strategies for diabetic eye complications.

1. Introduction

Diabetes mellitus represents a major global health burden, with its prevalence increasing rapidly due to lifestyle changes, aging populations, and rising obesity rates. Chronic hyperglycemia induces microvascular and macrovascular damage, affecting key tissues such as the retina, lens, optic nerve, and ocular surface. Diabetic eye disease is a leading cause of blindness among adults aged 20–74 years. Early detection and timely treatment are essential to prevent irreversible vision loss.

2. Pathophysiology of Diabetic Eye Disease

Persistent hyperglycemia triggers several biochemical and structural changes:

- Damage to retinal capillaries through basement membrane thickening, pericyte loss, and endothelial dysfunction.
- Accumulation of advanced glycation end-products (AGEs), leading to oxidative stress and inflammation.
- Activation of the polyol pathway, causing osmotic damage within ocular tissues.
- Upregulation of vascular endothelial growth factor (VEGF), promoting pathological neovascularization and vascular permeability.

These mechanisms collectively contribute to the development of diabetic retinopathy, macular edema, and other ocular disorders.

3. Major Ocular Complications of Diabetes

Diabetes affects multiple ocular structures and leads to various complications including diabetic retinopathy, macular edema, cataract, glaucoma, and ocular surface disease.

3.1 Diabetic Retinopathy (DR)

Diabetic retinopathy is the most common microvascular complication of diabetes and progresses through two major stages: Non-Proliferative Diabetic Retinopathy (NPDR) and Proliferative Diabetic Retinopathy (PDR).



3.1.1 Non-Proliferative Diabetic Retinopathy (NPDR)

NPDR is characterized by microaneurysms, dot-and-blot hemorrhages, hard exudates, cotton wool spots, and venous beading. These result from capillary occlusion, leakage, and localized retinal ischemia.

3.1.2 Proliferative Diabetic Retinopathy (PDR)

PDR develops when widespread ischemia stimulates pathological neovascularization. Fragile new vessels can lead to vitreous hemorrhage and tractional retinal detachment, significantly increasing the risk of blindness.

3.2 Diabetic Macular Edema (DME)

DME occurs due to increased vascular permeability mediated by VEGF and inflammatory cytokines. Fluid accumulation in the macula leads to central vision impairment and is the leading cause of visual loss in diabetic patients.

3.3 Diabetic Cataract

Chronic hyperglycemia accelerates cataract formation through sorbitol accumulation in the lens, oxidative stress, and structural protein denaturation. Cataracts occur earlier and progress faster in diabetic patients.

3.4 Glaucoma

Diabetes is associated with an increased risk of primary open-angle glaucoma and neovascular glaucoma. Neovascular glaucoma occurs when new vessels obstruct aqueous humor outflow, causing severe intraocular pressure elevation.

3.5 Ocular Surface Disorders

Diabetes affects the cornea and tear film, leading to dry eye syndrome, recurrent corneal erosions, punctate epithelial keratopathy, and delayed corneal wound healing. Neuropathy reduces corneal sensation, worsening complications.

4. Diagnosis and Screening

Regular screening is essential for early detection. Diagnostic tools include:

- Dilated fundus examination
- Fundus photography
- Optical coherence tomography (OCT)
- Fluorescein angiography
- Intraocular pressure measurement

Annual screening is recommended for all diabetic patients, with more frequent follow-up for those with advanced disease.

5. Management Strategies

Management of diabetic eye disease includes systemic control and ocular-specific treatments.



5.1 Systemic Management

Systemic factors influencing disease progression include blood glucose, blood pressure, and lipid control. Achieving an HbA1c<7% significantly reduces the risk and progression of retinopathy.

5.2 Ocular Treatments

- Anti-VEGF agents (ranibizumab, aflibercept, bevacizumab) reduce macular edema and neovascularization.
- Laser photocoagulation (PRP and focal laser) remains a cornerstone for PDR and DME management.
- Intravitreal corticosteroids are useful for DME unresponsive to anti-VEGF therapy.
- Vitrectomy is indicated for non-clearing vitreous hemorrhage and tractional retinal detachment.

6. Prevention

Preventive strategies include tight metabolic control, routine ophthalmic screening, patient education, maintaining healthy body weight, and smoking cessation. Early prevention significantly reduces vision loss risk.

Conclusion

Diabetes mellitus poses a substantial threat to ocular health, with diabetic retinopathy and macular edema being major causes of preventable blindness. Early screening, strict systemic control, and timely intervention remain essential to minimize the burden of diabetic eye disease.

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