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DEFINITION AND CLASSIFICATION OF RETINAL ANGIOPATHY

Abstract

Retinal angiopathy is a pathological condition characterized by structural and functional changes in retinal blood vessels due to systemic or local disorders. It often develops as a complication of diseases such as diabetes mellitus, arterial hypertension, trauma, and endocrine disorders. The purpose of this review is to analyze current scientific literature on the definition, pathophysiology, and classification of retinal angiopathy. The study is based on the analysis of modern ophthalmological and medical publications. The review highlights the main types of retinal angiopathy, including diabetic, hypertensive, hypotonic, traumatic, and juvenile forms. Understanding the mechanisms and classification of retinal angiopathy is essential for early diagnosis and prevention of severe visual impairment.

Keywords

retinal angiopathy, retina, vascular pathology, diabetic angiopathy, hypertensive angiopathy, retinal circulation.

Introduction. The retina is one of the most metabolically active and structurally complex tissues in the human body. Its proper functioning depends on a continuous and well-regulated blood supply delivered through a highly specialized microvascular network. Any disturbance in retinal circulation can lead to significant structural damage, metabolic imbalance, and progressive impairment of visual function. Because the retinal vasculature can be directly visualized using modern ophthalmological techniques, it provides a unique opportunity to assess microvascular changes occurring throughout the body (Wong & Mitchell, 2004).

Retinal angiopathy represents a group of pathological vascular alterations affecting the retinal arteries, veins, and capillaries. These changes usually occur as secondary manifestations of systemic diseases rather than as independent ocular disorders. In many cases, retinal vascular abnormalities are among the earliest detectable signs of systemic vascular dysfunction (Cheung et al., 2010). Therefore, retinal angiopathy has gained significant attention in modern ophthalmology and internal medicine as an important diagnostic indicator of systemic pathology.

A wide range of systemic conditions can lead to the development of retinal angiopathy. Among the most common causes are diabetes mellitus, arterial hypertension, metabolic syndrome, traumatic injuries, and endocrine disorders. These conditions may disrupt vascular autoregulation, alter endothelial function, and impair microcirculatory blood flow within retinal tissues (Antonetti et al., 2012). As a result, pathological changes such as vascular narrowing, dilation, microaneurysm formation, hemorrhages, and retinal edema may develop.

The global prevalence of chronic diseases associated with retinal angiopathy continues to increase. According to epidemiological studies, the incidence of diabetes and hypertension is rising rapidly worldwide, which significantly contributes to the growing burden of retinal vascular disorders (Yau et al., 2012). These diseases not only affect systemic circulation but also lead to progressive damage of the retinal microvasculature, ultimately increasing the risk of visual impairment and blindness.

In recent decades, significant advances have been made in the understanding of retinal vascular pathology. Modern diagnostic techniques such as optical coherence tomography, fundus photography, and fluorescein angiography allow early detection of microvascular abnormalities and help clinicians assess the severity and progression of retinal angiopathy. Early identification of these changes is essential for preventing irreversible retinal damage and maintaining visual function.

From a clinical perspective, classification of retinal angiopathy plays a crucial role in understanding the underlying mechanisms of the disease and selecting appropriate therapeutic strategies. Different forms of angiopathy—such as diabetic, hypertensive, hypotonic, traumatic, and juvenile—are associated with distinct pathogenetic mechanisms and clinical manifestations. Therefore, accurate classification helps improve diagnostic accuracy and optimize treatment approaches.

Moreover, retinal vascular changes often reflect systemic microvascular pathology occurring in other organs, including the brain, kidneys, and heart. For this reason, the retina is sometimes referred to as a “window to the vascular system,” providing valuable information about the state of the entire circulatory system (Patton et al., 2005). Studying retinal angiopathy not only contributes to ophthalmology but also plays an important role in cardiovascular and metabolic research.

Aim of the Study. The aim of this study is to analyze the concept, definition, and modern classification of retinal angiopathy based on a comprehensive review of contemporary scientific literature, as well as to identify the main clinical and pathogenetic characteristics of different forms of retinal vascular disorders.

Definition of Retinal Angiopathy. Retinal angiopathy refers to pathological changes in retinal blood vessels caused by systemic vascular dysfunction. These changes may include vasoconstriction, vessel dilation, endothelial damage, increased vascular permeability, and impaired blood flow (Aiello et al., 1998).

According to ophthalmological studies, the retina provides a unique opportunity to observe microvascular pathology directly, making retinal angiopathy an important diagnostic marker for systemic diseases (Patton et al., 2005).

Retinal vascular alterations often reflect systemic microangiopathy processes occurring in conditions such as diabetes mellitus, hypertension, and autoimmune diseases (Simo et al., 2014). Structural changes in retinal vessels may include:

- thickening of vascular walls
- narrowing or dilation of vessels
- microaneurysm formation
- hemorrhages and exudates

These alterations can disrupt retinal metabolism and lead to progressive vision loss (Frank, 2004).

Classification of Retinal Angiopathy. Modern ophthalmology distinguishes several major types of retinal angiopathy based on etiology.

Diabetic retinal angiopathy. Diabetic angiopathy is the most common form and develops as a complication of chronic hyperglycemia. Persistent high glucose levels cause endothelial dysfunction, basement membrane thickening, and capillary occlusion (Antonetti et al., 2012). These changes lead to retinal ischemia and eventually diabetic retinopathy.

Hypertensive retinal angiopathy. Hypertensive angiopathy occurs due to prolonged arterial hypertension. Increased blood pressure leads to vasospasm, arteriosclerosis, and narrowing of retinal arteries (Wong & Mitchell, 2004). In severe cases, hemorrhages, cotton-wool spots, and optic disc edema may occur.

Hypotonic retinal angiopathy. Hypotonic angiopathy is associated with decreased vascular tone and systemic hypotension. Reduced blood pressure causes dilation of retinal veins and impaired blood flow regulation (Cheung et al., 2010).

Traumatic retinal angiopathy. Traumatic angiopathy develops after mechanical injuries, especially head or chest trauma. Sudden pressure changes may damage retinal vessels and cause hemorrhages or edema (Kuhn et al., 2014).

Juvenile angiopathy (Eales disease). Juvenile angiopathy is a rare inflammatory condition affecting young individuals. It is characterized by retinal vasculitis, recurrent hemorrhages, and neovascularization (Biswas et al., 2013).

Discussion. The classification of retinal angiopathy reflects the underlying systemic pathology affecting vascular regulation. Several studies emphasize that retinal vascular abnormalities often appear before clinical symptoms of systemic disease (Yau et al., 2012).

For example, retinal microvascular changes may serve as early markers of cardiovascular disorders and metabolic syndrome (Cheung et al., 2010). Advances in imaging techniques such as optical coherence tomography and retinal angiography have improved the ability to detect early vascular abnormalities.

Early identification of retinal angiopathy allows clinicians to initiate preventive treatment and control systemic risk factors, reducing the risk of severe complications.

Conclusion. Retinal angiopathy represents a group of vascular disorders affecting the retinal microcirculation and is commonly associated with systemic diseases. The condition reflects structural and functional changes in retinal blood vessels that may lead to visual impairment.

The main types of retinal angiopathy include diabetic, hypertensive, hypotonic, traumatic, and juvenile forms. Understanding their classification and underlying mechanisms is essential for early diagnosis, prevention, and effective treatment.

Further research is necessary to improve diagnostic methods and develop targeted therapeutic strategies aimed at protecting retinal microcirculation.

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