Understanding the Pathophysiology of Diabetic Retinopathy for Early Screening.

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ABSTRACT

Diabetic retinopathy (DR) is a microangiopathy resulting from the chronic effects of diabetes mellitus (DM), with an estimated prevalence of 24 to 39% in diabetic patients in Brazil. DR is one of the leading causes of vision loss in individuals between the ages of 20 and 75, which may be aggravated by associated complications such as dyslipidemia, hyperglycemia, and hypertension. The aim of this study was to understand the pathophysiology of DR and the importance of early screening. The study used data from articles published in the last five years, selected from the PubMed, SCIELO, and LILACS databases, which addressed the relationship between the pathophysiology of DR and the need for early screening. After a literature review, four relevant articles were included in the analysis. The results highlight that DR progresses from increased vascular permeability, which causes microaneurysms, to retinal ischemia, with signs such as cotton wool spots and neovascularization in advanced stages. The current classification of DR includes Non-Proliferative Diabetic Retinopathy (NPDR), subdivided into mild, moderate, and severe, and Proliferative Diabetic Retinopathy (PDR). Diabetic macular edema (DME) may occur at any stage of DR. The conclusion emphasizes the severity of DR, its pathophysiological complications, and the importance of early screening and treatment to reduce its consequences. Management of risk factors, such as dyslipidemia and hypertension, is essential to prevent disease progression and its implications for patients' quality of life.

Keywords: diabetic retinopathy; physiopathology; diabetes complications

INTRODUCTION

Diabetic retinopathy (DR) is a microangiopathy resulting from the chronic effects of diabetes mellitus (DM), whose diagnosis may also indicate other pathologies such as kidney disease, stroke, and cardiovascular diseases (FUNG; PATEL; WILMOT; AMOAKU, 2022). It is estimated that in Brazil, between 24% and 39% of diabetic patients will be diagnosed with DR at some stage, and its incidence rises after 20 years of the disease progression, reaching 90% for type 1 DM and 60% for type 2 DM (BRASIL, 2021).

The most serious consequence of DR is total loss of vision, which makes it one of the leading causes of blindness in people aged 20-75 (BRAZIL, 2021). This complication involves a high expenditure of resources for the management and treatment of the affected population, a factor that could be mitigated by screening and early treatment (CAPPELANI; REGILLO; HALLER; GAGLIANO; PULIDO, 2024).

The categorized stages of the disease are summarized as a classification between retinal microangiopathy and hyperpermeability, retinal ischemia and capillary loss, Non-Proliferative Diabetic Retinopathy (NPDR), Proliferative Diabetic Retinopathy (PDR), and Diabetic Macular Edema (DME), noting that DME can occur at any stage of DR.

Therefore, effective screening, combined with understanding, control, and improvement of the aggravating factors of DR, can reduce the incidence of this pathology. The objective of this study is to understand the nuances of the pathophysiology of DR, for the initiation of early and quality screening.

METHODOLOGY

This expanded abstract was based on a search of the *PubMed*, *SCIELO*, and *LILACS* databases. The inclusion criteria consisted of articles published in the last 5 years that corresponded to the *Decs/Mesh* descriptors*:* diabetic retinopathy; physiopathology; diabetes complications, full-text and freely available, and answered the guiding question: *What is the pathophysiology of diabetic retinopathy and its influence on early screening?* From the 7,903 initial articles, 469 met the inclusion criteria, and four articles that met the criteria for this discussion were selected.

RESULTS

The stages of DR were analyzed according to the disease progression classification. The aggravating factors of the disease were presented more clearly and comprehensively, such as dyslipidemia, hyperglycemia, and hypertension, factors that alter the physiology of the biochemical cascade, leading to microvascular abnormalities, retinal ischemia, and other consequences. The most modern and widely used classification in clinical practice is an adaptation of an old 14-level scale to 5 levels, known as the Diabetic Retinopathy Disease Severity Scale (YANG; TAN; SHAO; WONG; LI, 2022), Figure 1.

Figure 1. Diabetic Retinopathy Disease Severity Scale

Nível de gravidade da retinopatia	Alterações observáveis à fundoscopia dilatada
Sem retinopatia aparente	Sem alterações.
RDNP leve	Apenas microaneurismas.
RDNP moderada	Presença de microaneurismas, mas que ainda não caracterize RDNP grave.
RDNP grave com um dos critérios ao lado RDNP muito grave com dois critérios	Hemorragias intra-retinianas nos 4 quadrantes ou
	Alterações venosas em conta em 2 ou mais quadrantes ou
	IRMA moderada em 1 ou mais quadrantes.
RDP	Neovascularização de disco ou de retina ou
	Hemorragia vítrea ou pré-retiniana.

RDNP = Retinopatia Diabética não Proliferativa; IRMA = Alterações Microvasculares Intra-Retinianas; RDP = Retinopatia Diabética Proliferativa.

Source: Ministry of Health, Clinical Protocol and Therapeutic Guidelines for Diabetic Retinopathy, 2021.

The progression of DR begins with vascular hyperpermeability, when blood vessels become more permeable as a result of chronic hyperglycemia-induced damage, leading to fluid leakage and, consequently, exudate and edema, which cause the appearance of microaneurysms.

Without adequate and quality treatment, the disease progresses with loss of retinal capillaries, causing tissue ischemia, characterized by "cotton wool" spots suggestive of ischemic necrosis of the nerve layers of the retina (FUNG; PATEL; WILMOT; AMOAKU, 2022).

NPDR presents with an accumulation of intra-retinal changes, microaneurysms, hard exudates, and intra-retinal hemorrhages. This stage of DR is subdivided into mild, moderate, or severe, depending on the extent of vascular damage, with the severe stage characterized by significant ischemia with Intra-Retinal Microvascular Abnormalities (IRMA) (YANG; TAN; SHAO; WONG; LI, 2022).

In PDR, neovascularization occurs in response to ischemia, but abnormal fragile vessels are prone to rupture, leading to vitreous hemorrhage (ANTONETTI; SILVA; STITT, 2021).

As for DME, it can occur at any stage, causing thickening of the retina in the macula and blurred vision due to fluid leakage from abnormal vessels into the central retinal tissue, affecting central vision.

CONCLUSION

DR is a disease with serious consequences, aggravated by common comorbidities in both global and Brazilian populations, such as hypertension, dyslipidemia, and hyperglycemia. These complications damage the retinal endothelium, leading to microangiopathies, hemorrhages, neovascularization, edema, and exudates.

Regular and frequent screening, beginning with the detection of increased vascular permeability or at any stage of DR, could provide better protection for diabetic patients through early management, thereby controlling the rapid progression of DR signs and symptoms despite its high complexity.

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