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Brief Communication on Laser Treatment for Diabetic Retinopathy

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ABSTRACT

Diabetic retinopathy is a growing global health issue affecting 5% of the global population. With over 60,000 new cases reported annually, over 1 million individuals with diabetes are at risk of lower limb amputation. Diabetic retinopathy is diagnosed in 20% of patients with diabetes mellitus. Factors contributing to its prevalence include modern technology, sedentary lifestyles, and poor adherence to healthy practices. This article examines the negative effects of diabetic retinopathy and the need for comprehensive measures to reduce its impact. It provides insights into managing diabetic retinopathy and its impact on global health systems through research and advancements in diagnostic and treatment methods

INTRODUCTION

Diabetic retinopathy is a chronic disease characterized by damage to the blood vessels in the retina. The disease results from insulin deficiency, which triggers an increase in intracellular sorbitol and fructose concentrations. This increase in osmotic pressure causes the endothelial cells in capillary blood vessels to swell and constrict the available space. At the same time, the accumulation of proteins in plasma inhibits erythrocyte aggregation and fibrinolysis, leading to the formation of microthrombosis. The appearance of microthrombosis in capillary endothelial cells and pericytes leads to their death. As a result, the permeability of the capillary wall increases, causing intercellular swelling, constriction of capillary blood vessels, and retinal ischemia. These conditions eventually lead to the growth of new blood vessels, called neovascularization, in the retina. The above pathophysiologic mechanisms associated with diabetic retinopathy underscore the importance of exploring effective treatment approaches to mitigate disease progression. Understanding the theories and concepts is crucial for improving patient outcomes and preserving visual function. In this article, we focus on one theory and explore its potential implications for ophthalmic surgery. By examining the relationship between this theory and diabetic retinopathy, we can understand its significance and explore the potential it holds for improving surgical interventions.

LITERATURE REVIEW

The development and severity of diabetic retinopathy are influenced by several factors, including the level and duration of blood glucose levels. Recent studies have shown that individuals with fasting blood glucose levels greater than 11 mmol/L are at a significantly higher risk of developing diabetic retinopathy than those with levels of approximately 7 mmol/L (Wang et al., 2009). Disorders of lipid metabolism, including elevated triglyceride levels and decreased high-density lipoprotein (HDL) cholesterol, play a role in the development of the disease (Su & Peng, 2020; Kosmas et al., 2023). Impaired renal function, indicated by elevated albuminuria levels and reduced glomerular filtration rate, further heightens the risk of diabetic retinopathy (Wang et al., 2023). Uncontrolled hypertension and chronic constipation have been identified as independent risk factors for the development and progression of the disease (Lin et al., 2014; Liu et al., 2021).

Diabetic retinopathy can be divided into different stages reflecting the underlying pathological changes in the retina:

In the nonproliferative stage of diabetic retinopathy, microaneurysms are present as small dilations of the retinal capillaries. Retinal hemorrhage can occur when blood vessels become weakened and rupture. Accumulation of lipoprotein-containing material, known as hard exudate, may be present, along with absorbent cotton spots that indicate localized ischemic infarcts (Fiorelli et al., 2021).

METHODOLOGY

In the preproliferative stage, the disease progresses with the development of intraretinal microvascular abnormalities (IRMAs) and venous abnormalities (Amrelia, 2020; Wang et al., 2021). IRMAs are dilated capillaries that deviate from their normal anatomical course, while venous abnormalities include bulges and loops that indicate impaired blood flow (Lumbroso et al., 2015; Stewart, 2017; Balaratnasingam et al., 2022). The retina becomes more vulnerable to ischemia as microcirculation is impaired, which raises the risk of complications that can threaten vision.

The proliferative stage is characterized by the growth of abnormal new blood vessels (neovascularization) on the surface of the retina or optic disk (Al Shalchi & Rahebi, 2022). These delicate vessels, which are susceptible to leakage and bleeding, can lead to the development of vitreous hemorrhages and tractional retinal detachment. If left untreated, these complications can result in severe visual impairment and blindness (Kovoor et al., 2022).

RESULTS AND DISCUSSION

Laser coagulation is a critical method for preventing blindness and treating diabetic retinopathy. Practical experience has shown that while it does not cure the disease, it preserves vision and mitigates the complications associated with diabetes. Laser coagulation has been proven to maintain visual acuity in approximately 60% of patients in advanced stages over a 10- to 12-year timeframe. Early intervention can preserve 90% of visual acuity over a long period, particularly when there are no risk factors present (Wang et al., 2022).

There Are Three Main Types of Retinal Laser Coagulation Techniques Used Globally:

Laser coagulation is a method used to target areas of retinal ischemia and stop the growth of neovascularization. By selectively using laser energy on ischemic areas, the permeability of abnormal blood vessels can be reduced, preventing additional complications.

Focal laser coagulation is a treatment method used to target specific areas of retinal leakage or microaneurysms. Laser energy is precisely directed at these localized abnormalities, occluding the leaking blood vessels and reducing the risk of macular edema and associated vision loss.

Panretinal laser coagulation (PRP): PRP is a comprehensive laser treatment approach that applies laser energy to the peripheral retina. This technique aims to regress abnormal blood vessels, especially in cases of proliferative diabetic retinopathy. Targeting the peripheral retina suppresses the growth of neovascularization and minimizes the risk of vitreous hemorrhage and tractional retinal detachment (Sastry et al. 2022).

The Mechanisms Underlying the Therapeutic Effect of Laser Coagulation Are Complex:

Inhibition of neovascular growth: laser coagulation interrupts the development of abnormal blood vessels with increased permeability. Selectively removing these vessels reduces the risk of leakage and complications.

Laser treatment can improve blood flow to the central regions of the retina by mitigating ischemic zones. This helps alleviate the oxygen and nutrient deficiency linked to diabetic retinopathy and promotes retinal health and function.

Laser coagulation leads to the regression of neovascularization, which is a major source of pathological growth factors, resulting in a reduction in their production. The removal of these abnormal vessels reduces the production of growth factors, which decreases the motivation for additional neovascularization.

Laser coagulation promotes tissue remodeling and preservation by replacing aging and dysfunctional retinal cells with new functional cells. Strengthening the retina through laser treatment helps maintain its structural integrity and lowers the risk of retinal detachment (Sheng et al., 2022).

Laser Coagulation Has Several Advantages as A Treatment Method

Laser treatment is a noninvasive approach that ensures patient safety and eliminates the need for surgical incisions.

The procedure is minimally invasive, meaning it can be performed seamlessly without the need for sutures or major tissue incisions.

Laser coagulation is generally well tolerated by patients and can be completed within 20 to 30 minutes, making it a relatively painless procedure. The use of local anesthesia reduces complications related to general anesthesia.

Outpatient procedures are convenient and efficient for patients of all age groups, as they do not require a prolonged hospital stay (Elsharkawy et al., 2022).

CONCLUSIONS AND RECOMMENDATIONS

Diabetic retinopathy is a major global health issue that impacts millions of individuals. To alleviate this increasing burden, it is crucial to highlight the significance of regular eye exams conducted by qualified eye care professionals. These comprehensive examinations enable early detection of retinal changes, allowing for timely intervention. The use of advanced imaging techniques, such as optical coherence tomography (OCT) and fundus photography, improves precision and enables the detection of subtle abnormalities that may require immediate treatment. Adjusting the frequency of fundus examinations based on the severity of the disease is crucial for personalized treatment. Annual examinations are recommended for individuals without any changes in retinopathy, while semiannual examinations are necessary for those with mild or moderate retinopathy. Patients starting insulin therapy, pregnant women, and those with preexisting retinal changes require more frequent examinations every three months. This personalized approach ensures timely interventions and maximizes clinical outcomes.

While laser coagulation is still a key treatment for diabetic retinopathy, promising new therapeutic options are emerging. Pharmacologic interventions that target vascular endothelial growth factor (VEGF) have been successful in stopping the progression of the disease and improving visual outcomes. Gene therapies and stem cell-based approaches have the potential to regenerate retinal tissue and restore visual function. These advancements mark a new era in the treatment of diabetic retinopathy, offering customized and effective options. To improve treatment outcomes, it is crucial to incorporate research advancements into clinical practice. By integrating regular eye exams, advanced imaging technologies, personalized frequency of fundus exams, and exploration of new treatments, we can enhance the effectiveness, originality, and innovative aspects of diabetic retinopathy treatment. This comprehensive approach aims to improve patient outcomes and reduce the global burden of this vision-threatening disease.

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