Mini Review
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New approaches in the detection and management of diabetic retinopathy in the near future

Abstract

Diabetes mellitus (DM), a group of metabolic diseases characterized by hyperglycemia, is a major public health problem worldwide. In recent years, the incidence and prevalence of DM has been increasing as a global epidemic. Diabetic retinopathy (DR) is the most common complication of DM and remains the major cause of preventable blindness among working-age people in most developed countries and it has a significant socioeconomic impact and source of morbidity. DR, which has long been recognized as a microvascular disease, has been demonstrated by laboratory and clinical evidence that inflammation and retinal neurodegeneration may also contribute to diabetic retinal damage in the early stages of DR. New diagnostic and treatment modalities in DR management is promising. Further elucidation of the underlying molecular mechanisms may provide new medical approaches for the development of novel therapeutic modalities. Nowadays, novel diagnostic devices such as ultrawide field fundus fluorescein angiography, optic coherence tomography angiography and adaptive optics retinal imaging have improved the detection of DR earlier, faster and more accurately. Subthreshold micropulse laser and other laser photocoagulation applications may be an alternative to conventional retinal photocoagulation with lower complications for DR treatment. In recent years, artificial intelligence, machine learning, and deep learning based diagnosis and treatment applications are developing. In addition, in recent years, unmanned automated-based diagnostic and treatment methods and newly developed intravitreal drugs and implants can offer more diagnostic and treatment options with promising results. This review provides an overview of novel diagnostic and treatment approaches for preventing the progression of diabetic retinopathy.

Keywords: diabetic retinopathy, novel diagnostic methods, new therapeutic modalities, visual loss

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Introduction

Diabetes mellitus (DM) is a major public health problem worldwide. It is one of the most frequent chronic diseases affecting children and adolescents and the prevalence and incidence of its is progressively increasing. Diabetic retinopathy (DR) is the most common complication of DM and remains the major cause of preventable blindness among working-age people in most developed countries.[1–6] DR can be classified as non-proliferative (NPDR) and proliferative diabetic retinopathy (PDR). Microaneurysms and retinal hemorrhages in the fundus are the earliest symptoms of NPDR. In moderate or severe NPDR is ischaemia, cotton wool spots, venous beading, and intraretinal microvascular abnormalities. In PDR is abnormal new retinal vessels, retinal and vitreus haemorrhage, fibrosis, traction, and retinal detachment, leading to visual loss. Blood retinal barrier (BRB) breakdown increases vascular permeability and accumulates fluid in the macula, leading to macular swelling or thickening and visual impairment.[7] There are four main DR treatment methods, including conventional laser photocoagulation, intravitreal anti-VEGF or corticosteroid injections, and vitreoretinal surgery. However, many of these treatments are invasive and have serious complications, at the same time expensive and used for advanced stages of DR. Therefore, Early detection through regular eye examination is the only way to prevent or reduce visual impairment and medical costs. In order to reduce the incidence and progression of visual loss in DR, DR should be detected and treated at early stages. Therefore, in addition to the conventional methods, new and effective prevention strategies and multidisciplinary approaches are required.[3]

In recent years, artificial intelligence, machine learning, and deep learning based diagnosis and treatment applications are developing. In addition, in recent years, unmanned automated-based diagnostic and treatment methods and newly developed intravitreal drugs and implants can offer more diagnostic and treatment options with promising results.[6] This review provides an overview of novel diagnostic and treatment approaches for preventing the progression of diabetic retinopathy.

Discussion

In the last decade, intravitreal anti-VEGF drugs have been the first treatment option for DME and PDR. However, in clinical practice, the use of anti-VEGF drugs is limited due to the requirement of frequent injections, endophthalmitis, financial burden and poor compliance of patients. Laser photocoagulation application has not lost its importance in the treatment of DR as adjuvant therapy. However, in daily clinical practice, laser photocoagulation application is limited due to side effects such as peripheral visual field defect and reduced night vision. Intravitreal corticosteroids have demonstrated clinical benefits in the treatment of refractory diabetic macular edema (DME) or in cases that do not respond to anti-VEGF drugs treatment. However, the use of intravitreal corticosteroids is limited due to the high risks of serious adverse ocular events such as endophthalmitis, elevated intraocular pressure and cataract formation. Vitreoretinal surgery has an important role in advanced cases of proliferative DR. Because of postoperative serious complications, such as rhegmatogenous retinal detachment, vitreous hemorrhage, cataract formation and neovascular glaucoma, vitrectomy procedure was sometimes controversial.[7]

As previously mentioned, vision loss due to DR can be prevented and treated with early diagnosis and treatment. New diagnostic and treatment modalities in DR management is promising. Nowadays, novel diagnostic devices such as ultrawide field fundus fluorescein

angiography, optic coherence tomography angiography and adaptive optics retinal imaging have improved the detection of DR earlier, faster and more accurately. Subthreshold micropulse laser and other laser photocoagulation applications may be an alternative to conventional retinal photocoagulation with lower complications for DR treatment. In addition, in recent years, unmanned automated-based diagnostic and treatment methods and newly developed intravitreal drugs and implants can offer more diagnostic and treatment options with promising results.[1–8]

Ophthalmology is a branch of science that is highly dependent on technological development compared to other medical sciences. The applications of artificial intelligence (AI), machine learning (ML), and deep learning (DL) technologies in the field of health services has developed rapidly.[9] In short, deep integration of AI, ML and DL into ophthalmology has the potential to revolutionize the existing disease diagnosis system and create a significant clinical effect in ophthalmic health care service.[6,10] Therefore, in addition to existing technologies in the diagnosis and management of DR, alternative emerging technologies such as AI, ML and DL technologies are needed. The economic, social and life satisfaction impact of visual loss is also important. Vision loss imposes a significant burden on the society, both economically and socially in terms of medical costs and nonmedical costs. Vision loss results in reduced quality of life, decreased productivity, increased medical expenses and increased other direct and indirect costs.[11] However, in this context, the visual impairment, blindness, life dissatisfaction, medical expenses and other direct and indirect costs caused by DR may be reduced with early detection and treatment of DR.

Conclusion

In conclusion, in recent years, with the advances in new diagnostic methods, pharmacotherapy and vitroretinal surgery techniques, there have been significant improvements in both the diagnosis and treatment of DR. With novel and more efficient preventive and interventional strategies based on better understanding of pathogenesis early stages of the disease, visual loss from late-stage of DR may be prevented and treated in early periods. In short, both the incidence and progression of DR can only be reduced by more effective and consistent preventative medical and interventional methods.

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Conflicts of interest

The author has declared that no conflicts of interest exist.

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