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Recent Advances in Ocular Imaging in Management of Uveitis and Related Intraocular Inflammations

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Keywords

• Uveitis • Ocular inflammation • Imaging • Optical coherence tomography • OCT • Optical coherence tomography angiography • OCTA • Fundus autofluorescence

Key points

- Multimodal imaging studies with multiple, coregistered, complementary image acquisitions are often essential for diagnosis of uveitis, differentiating it from its masqueraders and monitoring response to treatment.
- Quantitative analysis and automated image processing algorithms provide objective measures of ocular inflammation severity.
- New generations of optical coherence tomography provide detailed retinal imaging to the level of visualizing individual photoreceptors.
- Optical coherence tomography angiography is a novel noninvasive technology to image retinal and choroidal vasculature.

INTRODUCTION

Intraocular inflammation, also known as uveitis, is a major cause of visual impairment. About 10% to 15% of blindness in the United States is attributable to uveitis [1,2]. It is estimated that 25 to 52 new cases of uveitis occur per

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100,000 Americans every year, and the overall prevalence of uveitis is close to 60 patients per 100,000 people in western countries [1,3,4]. The incidence of uveitis is probably higher worldwide. In some developing countries, uveitis is responsible for 1 in every 4 cases of blindness [1].

Uveitis is typically classified based on the anatomic site of inflammation as anterior, intermediate, posterior, or panuveitis. A multitude of pathologic conditions, including infection, trauma, autoimmunity, and malignancy, are known causes of uveitis. Most of these underlying causes are more common in younger populations. Most cases of uveitis are bilateral, chronic, and associated with a high rate of complications. Major sequelae that contribute to visual impairment in uveitis are cataract, glaucoma, band keratopathy, vitreous opacities, macular edema (ME) and degeneration, retinal detachment, and optic nerve atrophy. Prompt diagnosis and appropriate treatment can prevent or minimize these complications.

Recent advances in imaging techniques, along with new treatment modalities, have revolutionized the management and prognosis of uveitis. Advances in ocular imaging modalities are in part due to unique ocular physics, which allow visualization of most ocular tissues with a wide range of modalities, such as fluorescein and indocyanine green angiography (ICGA), optical coherence tomography (OCT), OCT angiography (OCTA), fundus autofluorescence (FAF) imaging, scanning laser ophthalmoscopy, adaptive optics, hyperspectral imaging, and retinal oximetry. A brief synopsis of ocular imaging modalities and new developments is provided in Table 1. The clinical diagnosis and management of uveitis is undergoing significant change as a result of these developments. This article reviews some of the conventional and advanced imaging modalities used in uveitis, as well as emerging trends in retinal and choroidal imaging.

COLOR FUNDUS PHOTOGRAPHY

Conventional color fundus photography remains the main method for documentation of posterior pole and midperipheral retinal changes. Conventional fundus cameras can capture a field of view between 30° and 55° (Fig. 1). Composite images can increase the field of view to 75° to 80°. However, composite images are significantly limited by their inability to image the retinal periphery and by a tendency toward shadows and artifacts at the boundaries where images overlap. Fundus photography cameras date back to 1950s, but the method continues to evolve with more recent optimizations, including nonmydriatic fundus cameras, stereoscopic image acquisition, and digital image acquisitions [5]. Multiple commercially available adaptors are now available to allow smartphone fundus image capturing (www.peekvision.org). Smartphone photography of the fundus has the potential to change fundus image documentation in the developing countries and telemedicine consultation for posterior and panuveitis (Fig. 2); however, this potential remains somewhat constrained by limited image resolution and field of view [6].