Disease-Specific Fluorescein Angiography

Recommendations for tailoring retinal fluorescein angiography to diabetic retinopathy, macular degeneration, and cystoid macular edema.

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Fluorescein angiography is a valuable adjunct in the diagnosis and treatment of many retinal diseases. Usually, early and late views of both the posterior pole and peripheral retina are beneficial. Adherence to the same technical procedure for all fluorescein angiograms, however, may not always be the most informative method of documenting certain disease processes. The application of a disease-specific approach to the sequencing of angiography can provide optimal information and procedural efficiency for each individual patient.

The timing of exposures and deliberate inclusion of specific retinal fields are determined by each disease process, in conjunction with the physician’s reason for requesting the procedure. Communication between the physician and ophthalmic photographer is important in order to tailor the angiographic procedure to the informational requirements for each patient. This report offers a guide to angiographic sequencing for three common retinal diseases: diabetic retinopathy, macular degeneration, and cystoid macular edema.

Diabetic Retinopathy—A Panoramic View

The diagnosis and management of diabetic retinopathy depend upon the status of the retinal vasculature in the posterior pole and the midperiphery of each individual diabetic patient. Of concern is capillary leakage and capillary nonperfusion, as well as new blood vessel proliferation. Fluorescein angiography can help determine (a) the extent of capillary closure in the posterior pole and in the retinal midperiphery, (b) the extent of leakage in the macular region, and (c) the presence of neovascularization at the optic disc and elsewhere.

Color photography of the seven standard fields (a standardized protocol for the Diabetic Retinopathy Study) optimally records the clinical status of diabetic retinopathy in most cases (Fig 1).

Prior to fluorescein injection, the angiographic series begins with red-free photographs. Visualization of both background diabetic changes, such as microaneurysms and lipid exudates, and neovascularization is enhanced by monochromatic illumination in the middle wavelengths (500-550 nm) after fluorescein is administered, approximately six sequential photographs of the posterior pole should be taken during the initial dye transit (Fig 3B). Stereo photography is important throughout the session to demonstrate the degree of retinal edema. Thereafter, peripheral views are obtained in all four quadrants: nasal, superior, temporal, and inferior (Figs 3C, D, E, and F). Angioscopy should be performed with the fundus camera to detect capillary closure and neovascularization. Angioscopy provides views of areas for documentation outside the four quadrants. This approach may reveal more information with greater efficiency than is achieved by delimiting angiographic views to the seven standard fields.

After angiographic pictures of the primary eye have been taken, stereo views should be obtained of the macula, optic nerve, and periphery in the fellow eye. Finally, during the recirculation phase, stereo photographs of the posterior pole should be taken of each eye to demonstrate any late leakage into the retina by intraretinal microvascular abnormalities (IRMA) (Fig 3G) or leakage into the vitreous by preretinal neovascularization.

Fig 1: Diagram of seven standard fields as recommended by the Diabetic Retinopathy Study Group. (Wong, D.: Textbook of Ophthalmic Photography. Birmingham, AL: Inter-Optics Publications, 1982, p. 73. Reprinted with permission from Inter-Optics Publications.)
Macular Degeneration—An Early View

Macular degeneration is a general term used to describe several disease processes, such as drusen, geographic pigment epithelial atrophy, subretinal neovascularization membranes, vascularized and nonvascularized pigment epithelial detachments, and pigment epithelial rips. Unlike diabetic retinopathy, the salient findings in macular degeneration usually are confined to the posterior pole, hence, the angiographic sequence (Fig 4), initially should be restricted to the macular area, with special care taken to obtain the early filling phase in stereo.3

Color photographs of the macula and optic nerve are important for the interpretation of these disorders. For example, hypofluorescence occurring during angiography may be due to hemorrhage seen easily with corresponding color photography.

Red-free photographs may accentuate the appearance of serous pigment epithelial detachment and lipid exudates (Fig 5A). After dye injection, it is critical to remain centered on the macula for several frames, taken at half-second intervals, because the appearance of a subretinal neovascular membrane, if present, is demonstrated most clearly in the initial transit phase. Once into the recirculation phase, late pooling of dye may obscure visualization of new vessel formation. Also, nonvascularized pigment epithelial detachments develop a homogeneous accumulation of dye rather early, becoming more prominent over time as the dye diffuses into the subpigment epithelial space (Figs 5B,C, and D). In these cases, late views offer limited information. In other instances, however, when turbid fluid causes an initial obscuration of dye, the visualization of hyperfluorescence slowly develops over time, making the latter phases significantly informative. Continuous stereo views throughout the angiogram facilitate the interpretation of the angiogram because the retinal and choroidal circulation can be viewed in depth.

Extent of photography of the fellow eye is determined on an individual basis, depending upon its condition. If the photographer is uncertain as to how to plan the angiography, it is wise to consult the patient’s ophthalmologist. In some patients, disciform scaring is present, rendering angiography of little value. In other cases, however, the macula of the fellow eye should be photographed immediately following the completion of the early phase on the primary eye (usually approximately one minute after dye injection). If early views of both eyes are required, the fellow eye can be photographed after six early transit photographs taken at one-second intervals are completed on the initial eye. Photography is continued into the recirculation phase to demonstrate leakage and pooling of dye. Late photographs of both eyes should be taken at five and ten minutes after injection.
Fig 3: (A) Visualization of microaneurysms (m), lipid exudates (le), and neovascularization (nv) within the posterior pole of the right eye of a diabetic patient is greatly enhanced with red-free illumination. (B) Initially centered on the macula, fluorescein angiogram documents multiple areas of leakage. (C) Nasal view showing neovascularization and capillary nonperfusion. (D) Temporal view. (E) Superior view. (F) Inferior view. (G) Late phase documents macular edema and leakage into the vitreous from neovascularization.

Fig 5 (Below): (A) The red-free photograph accentuates a serous detachment of the retinal pigment epithelium, drusen, and pigment changes in the left eye of patient with macular degeneration. (B) Early phase demonstrates the outer edges of the retinal pigment epithelial detachment as it begins to fill. (C) The detachment becomes more evident as dye continues to pool. Stereo photographs of this macular view should be taken in frames 13 and 14 to demonstrate serous elevation. (D) A late view shows the serous detachment filled with dye.
**Cystoid Macular Edema—A Late View**

In cystoid macular edema, serous fluid accumulates in cystic spaces within the fovea. This may occur after cataract extraction (Irvine-Gass Syndrome), in age-related macular degeneration, with uveitis, in diabetic retinopathy, and in other conditions associated with chronic macular edema. Like macular degeneration, the areas of interest are usually confined to the posterior pole, however angiographic documentation of this disease entity will be modified in order to emphasize the late phase.

Stereo color photographs of the optic nerve and macula may show elevation and/or a ground-glass appearance in the foveal region.

Red-free photographs usually accentuate the impression of cystic spaces (Fig 6A). Early fluorescein photographs frequently demonstrate dilated parafoveal capillaries that gradually begin to leak fluorescein dye during the arteriovenous phase (Fig 6B). The characteristic "flower petal" pattern of dye accumulation within the cystic spaces occurs in the recirculation phase (Fig 6C). Since diffusion of fluorescein dye into the cystic spaces takes an appreciable amount of time, late views (10 to 20 min after injection) are particularly important to assess the extent of macular dye accumulation and leakage of dye from the optic nerve head (Fig 6D). In severe cystoid edema, the stellate pattern of macular leakage may be blocked in the very late frames by fluorescein in the overlying vitreous and anterior chamber.

**Conclusion**

The importance of emphasizing certain phases of the angiogram and of photographing specific retinal locations has been described for three eye disease groups. Disease-specific photographic sequencing provides pertinent information for each individual patient. Using this approach, fluorescein angiography meaningfully contributes to the evaluation, treatment, and management of several posterior pole diseases.
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