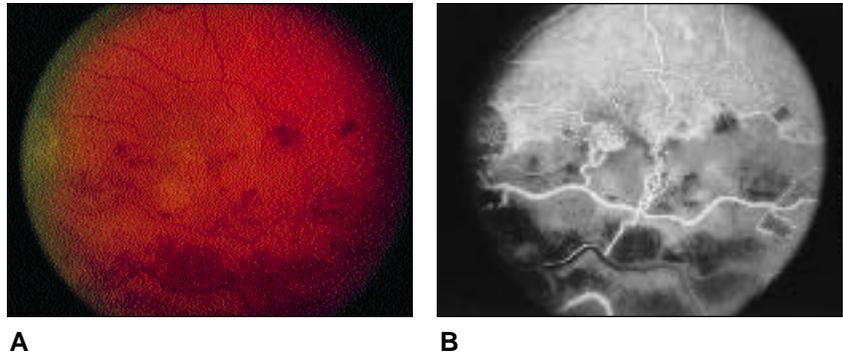


FIGURE 5-1

Both fundus photography (A) and fluorescein angiography (B) use a fundus camera to obtain retinal images. However, each reveals very different visual information.



This chapter describes the instrumentation and procedure for fluorescein angiography. It includes practical advice about common problems and advanced techniques.

The following essential topics are discussed elsewhere in this book:

- Fundus photography technique (Chapter 2)
- Preparation for a sodium fluorescein injection (Chapter 4)
- Normal side effects and potential complications associated with the injection of sodium fluorescein (Chapter 4)

Fundus photography and fluorescein angiography are both similar and, at the same time, quite different procedures (Figure 5-1). Both use a fundus camera and its requisite alignment and focusing techniques. Fluorescein angiography adds the requirements of an exciter/barrier filter set and specific timing.

Time is an important aspect of both procedures, but for different reasons. Fundus photography documents the retina at a specific moment in time. Retinal changes are followed over days, weeks, months, or years. Fluorescein angiography records, usually in still pictures, the dynamic process of dye flowing through and leaking from retinal blood vessels. Significant changes occur over fractions of seconds. During fluorescein angiography, the pace of photography is faster and the timing of the photographs is more critical.

Successful fluorescein angiography is contingent upon your mastery of fundus photography. If you are comfortable taking color photographs of the retina, then fluorescein angiography will be simple to learn. One way to think of fluorescein angiography is as rapid-sequence fundus photography using colored filters.

Instrumentation

Almost any type of mydriatic fundus camera may be adapted for fluorescein angiography: narrow-angle, wide-angle, handheld, film-based, or digital. Most modern fundus cameras are supplied as ready for angiography by the manufacturer, although a few are not.

Use separate 35-mm camera bodies for color and black and white to reduce both film waste and barrier filter mishandling. This arrangement also adds a measure of security to the fundus photography system: A spare film back should always be available in the event of a breakdown. The camera bodies should be motorized and capable of triggering an electronic flash sequentially for at least 30 seconds at a rate of at least one frame per second.

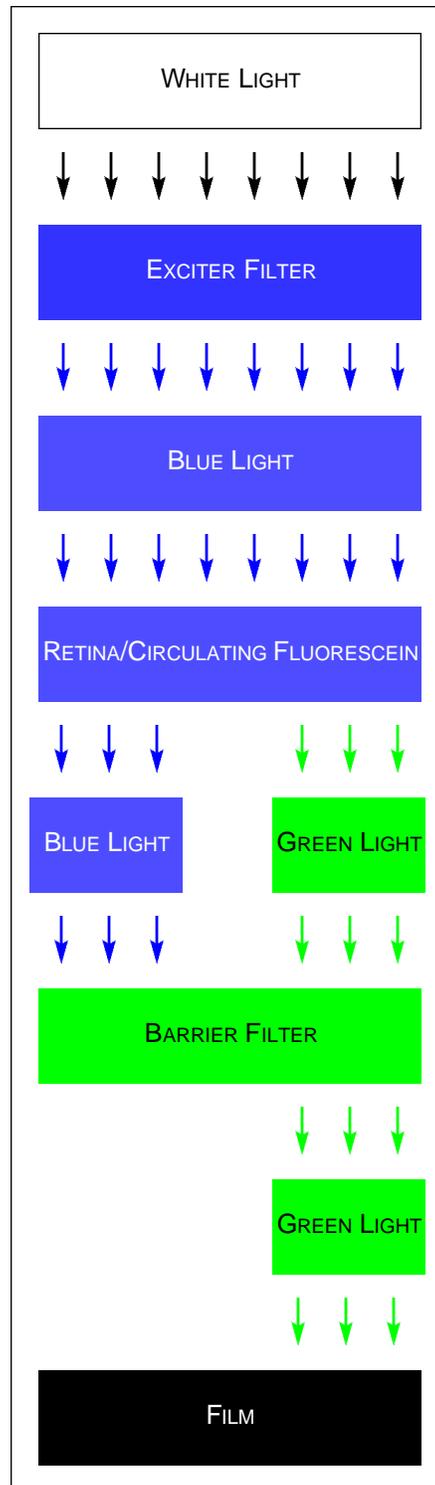


FIGURE 5-4

The exciter and barrier filter. White light enters the exciter filter, which transmits only the blue portion of the light. The blue light enters the eye where it is either absorbed by the fluorescein or reflected by the retina. The light absorbed by the fluorescein is emitted as green light. The green excited light and the reflected blue light leave the eye. The blue light is rejected by the barrier filter, while the green light passes through the barrier filter and is recorded on film.

Like all colored objects, fluorescein filters will eventually degrade (Figure 5-6). Age, exposure to light, and high humidity are some of the factors that contribute to filter failure. Increased pseudofluorescence (see the section on Pseudofluorescence and Autofluorescence) is a sign of worn out filters.

Fluorescein filters should always be replaced as a matched pair to ensure efficiency. In busy offices in warm, humid climates, filters may

Table 5-1. Fluorescein Angiography: Step by Step*

Prepare and position	Prepare the room Plan the procedure
Patient contact time →	Perform color fundus photography Switch cameras and filter Photograph name tag and green filter Expose a control photograph Re-educate your patient Double-check everything Solicit injection
Expose	Signal injector Begin series—shoot “earlies” Shoot pictures at 1, 3, 5, 10 minutes Close the session
Follow-up	Process and edit the images Deliver the finished product Review your work

*Review these steps before or during the procedure to help establish your routine. Post a copy of these steps near your fundus camera for reference.

Table 5-2. Fluorescein Angiography Supply Checklist

Filled syringe	10-cc syringe with 5 cc 10% sodium fluorescein 5-cc syringe with 2.5 cc 25% sodium fluorescein
Needle	20-gauge straight needle 23-gauge butterfly, 12-inch tube, 3/4-inch needle 23-gauge catheter
Wound cover	Adhesive bandage Gauze or cotton ball with tape
Tourniquet	3/4-inch tubing
Cleansing aid	Alcohol pads
Personal protection	Gloves, mask, and safety clothing as needed Syringe disposal unit
Miscellaneous	Emergency supplies Emesis basin

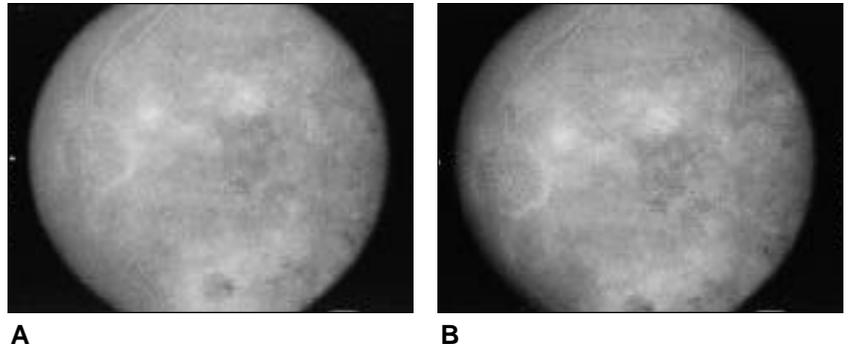
different brands of cameras or different recording media (film vs. electronic) pose few difficulties for the experienced angiographer.

Prepare and Position

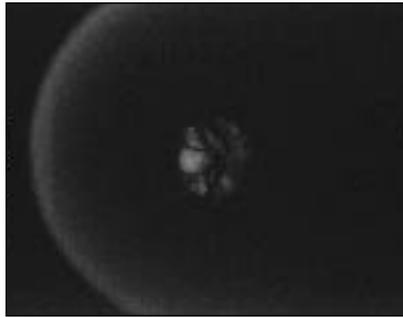
1. *Prepare the room.* Tidy the room. Complete all billing and paperwork. Adjust the stool height and the fundus camera's mechanical controls to their approximate midpoints. Load both camera backs with film—one with color slide film and one with fast black and white negative film. Confirm that the illumination and flash settings, the filter wheel, and the diopter compensation control are in their standard positions. Set your reticle. Prepare the sodium fluorescein injection and injection supplies (Table 5-2).
2. *Plan the procedure.* Have a photographic plan in mind before you escort the patient into the room. Review the photo request form and examine any prior photographs. Note the patient's visual acuity and working diagnosis. Determine the fields to photograph. Select your camera and angle of view, the areas of the patient's retina you intend to document (Table 5-3), and the timing of your photographs (Figure 5-7). If multiple angles of view are selected, be certain that each variation is shot both in color and as an angiographic frame. Ask pertinent questions: On which retinal level should you focus?

FIGURE 5-11

An efficient fluorescein filter set (A) is compared with a mismatched set (B). Pseudofluorescence masks fine details by effectively overexposing the highlights.

**FIGURE 5-12**

Using both a barrier and exciter filter—but no sodium fluorescein—when photographing these optic nerve head drusen and astrocytic hamatoma illustrates autofluorescence. You would expect no retinal details in a normal patient's control photograph with a well-matched set of filters.



documenting usually occur between visits, allowing images to be exposed at a more leisurely pace. Alternately, the “earlies” are a very important phase of fluorescein angiography that come and go within 30 seconds. Timing is clearly of the essence.

Begin shooting before you see any dye within the blood vessels. Once the dye has filled the blood vessels, sodium fluorescein's rate of visual change is measured in minutes rather than seconds. Inexperienced photographers may get caught up in the moment and continue to shoot rapidly after the dye has progressed through its initial changes. Remember that the most important images occur as the dye is filling the blood vessels. If you have missed these pictures for some reason (perhaps the patient moved or you forgot to insert the barrier filter), taking a rapid sequence of photos after the dye has filled the blood vessels is of little consequence.

Consistent timing is important during the late phases of the angiogram. Leaking sodium fluorescein is an important clinical finding. Similar timing of late photographs in two fluorescein tests from different dates allows better comparison of the relative activity of a lesion.

When You Can't See the Dye

Particularly unsettling to the inexperienced angiographer are the instances when no fluorescein dye can be seen in the blood vessels after the dye injection. Keep your head and remember that this can be the result of a number of circumstances. Check first with the person injecting: Was there infiltration, extravasation, or an arterial injection?

The patient may have circulation problems. If you don't see dye by 20 seconds after the injection, continue to shoot—but shoot more slowly (1 frame every 2–3 seconds). Admittedly unusual, I have performed angiograms in which the earlies have begun as late as 90 seconds after

If a patient becomes nauseated, remain calm, ask him or her to sit back and take slow deep breaths through the mouth with eyes open. A reassuring attitude is important. We suggest to the patient that “the nausea usually passes as quickly as it comes” in low, calming tones. Try humor (“Not many people react to this dye—you are one of the lucky 2%”) or distraction (“The pictures are timed—do you think we can take some more now?”). Nausea does not always lead to vomiting. If it does, offer your patient an appropriate container. A plastic lined wastebasket is more useful than the often too small emesis basin.

Most minor reactions do not need medical intervention. If you think that the reaction may be more severe, stay with the patient and dispatch another person for a physician or registered nurse (a reminder: the person injecting should remain in the room for at least 1 minute after the injection). Signs of a more severe reaction include lightheadedness, difficulty breathing, fainting, and tightness in the chest.

Moderate adverse reactions to sodium fluorescein include urticaria (hives), which may occur 3–10 minutes after the injection. Urticaria is the result of an allergic reaction that releases histamine. The physician may prescribe an injectable or oral antihistamine to abate the problem. The patient should be monitored until all itching has stopped.

Both vasovagal and more severe reactions require decisive action. Obtain trained medical help immediately. Do not leave the room; rather, make the patient comfortable, perhaps helping him or her to lie on a stretcher or the floor and loosening any clothing around the neck. Locate the emergency supplies and assist emergency personnel. Help with transporting the patient or performing cardiopulmonary resuscitation as needed.

Keep in mind that your patients may be sick or fragile. The population that is likely to have fluorescein angiography includes the elderly as well patients with diabetes. Learn about the special needs of these patients as well as the reactions specific to this test.

Advanced Angiography Techniques

Oral Fluorescein Angiography

Intravenous injection of sodium fluorescein is the administration method of choice. In patients who are unable to receive an injection, it may be advantageous to administer the sodium fluorescein orally.¹¹ Photographing the injected dye reveals a full range of phases: choroidal, arterial, arteriovenous, and “lates.” Oral fluorescein photographs disclose only the late phase of angiography. Oral administration is useful for determining the status of late leaking retinal conditions such as clinically significant macular edema or cystoid macular edema.

Double the intravenous dosage of sodium fluorescein and dissolve it in cold tomato or vegetable juice, or milk for children. Tomato juice masks some of the taste and most of the color. Staining of the patient’s teeth can be reduced by using a straw. Powdered sodium fluorescein in capsules is available in Great Britain and Japan but not currently in the United States. Normal side effects, including staining of the skin and urine, are present. Expose a control photograph and record the dye at 5, 10, 15–20, and 30–40 minutes postingestion. This timing allows comparison of any leakage sites at multiple time intervals.

Angiography in Children

As with any medical procedure designed for adults, special considerations must be made for children. The dosage of sodium fluorescein should be