Retina: Indocyanine green (ICC) angiography

Jill Fishbaugh

University of Iowa
Patients with age related macular degeneration (ARMD) are finding a ray of hope that may save their central vision. According to Prevent Blindness America (formerly the National Society to Prevent Blindness), the leading cause of blindness in the United States is ARMD. Often these patients are diagnosed too late for treatment. With the new technology of ICG digital video angiography, early detection of choroidal neovascularization—a condition arising from ARMD—can often be more clearly delineated.

Classifications
There are two classifications of choroidal neovascularization diagnosed from angiography. They are referred to as well-defined or "classic" and poorly defined or "occult." Twelve percent of patients with ARMD have "classic" choroidal neovascularization and are treatable with laser photocoagulation. The other 88% of patients with ARMD present with a probable "occult" choroidal neovascular membrane (CNVM) which is often not sufficiently evaluated by fluorescein angiography. Due to underlying hemorrhage, pigment, lipid, or serous exudate, full views of CNVMs are difficult and, therefore, not generally treatable with laser (Reichel & Puliafito, 1994a).

However, now with ICG angiography, physicians obtain greater definition and delineation of the CNVM, making laser photocoagulation treatment possible for a larger percent (at least one third) of these patients. One study recently reported poorly defined CNVMs as detected by fluorescein angiography were reclassified into well-defined CNVMs after ICG at a rate of nearly 40% of the time (Reichel & Puliafito, 1994b).

How the dye works
The reason ICG dye works so much better than fluorescein dye is twofold:
- The absorption and fluorescence peak for ICG is in the near-infrared spectrum—which means it is more easily penetrated in the retinal pigment epithelium than the visible light spectrum peaks of fluorescein dye.
- 98% of ICG dye is bound to serum proteins—which makes it leak very slowly from the choroidal circulation allowing retention and specific delineation within the choroidal neovascularization to occur. Conversely, fluorescein dye leaks rapidly into the choroidal space because it is 20 to 40% unbound to the serum proteins of the blood. ICG can image views right through retinal hemorrhages.

To illustrate the difference between a fluorescein and ICG angiography, see Figures 1 through 4. The red free photo (Figure 1) was taken prior to any type of dye injection. It shows a white lipid exudate ring outlining the large pigment epithelial detachment (PED). The early phase of fluorescein angiography (Figure 2) shows a well-defined CNVM infero-nasal to fixation along with a probable occult CNVM extending temporally. This is demonstrated most evidently in the late phase frame of the fluorescein angiography (Figure 3).

The ICG late phase angiography (Figure 4) is beneficial in demonstrating that only the infero-nasal component was definitely CNVM. ICG angiography guided laser treatment to this isolated component resulted in the resolution of the PED and improved vision. It is recommended to obtain both fluorescein and ICG angiographies because a combination of angiography gives a higher potential to treat patients with CNVMs than possible by using just fluorescein alone (Guyer, Yannuzzi, Slakter, Sorenson, & Orlock, 1994).

Nursing implications
It is important to first note the patient's allergies. Adverse reactions are rare with ICG and have been reported to happen much less frequently than with fluorescein dye. However, the most serious complications have occurred as an allergy to the ICG dye. Just as with fluorescein angiography, make sure the appropriate emergency equipment and drugs are available to manage a respiratory or cardiac arrest. Any patient with a known allergy to shellfish, or iodine (iodine is used in ICG to stabilize the dye) should not receive an ICG angiography. Secondly, collect a general health history on the patient. Since ICG is excreted entirely
Retina: Indocyanine green (ICG) angiography

by the liver, it is contraindicated for patients with liver disease. In addition, ICG is contraindicated in patients with uremia, as they are at a higher risk for adverse reactions with ICG than the general population (Hope-Ross et al., 1994).

The preparation of ICG is fairly simple. Dissolve the ICG in the solvent supplied by the manufacturer at a concentration of 3 ml solvent per 25 mg ICG powder. Then inject the solution into an antecubital vein with a #19 or #21 gauge butterfly infusion set at a rate of approximately 1 cc per second. This is followed by a flush of saline (about 5–10 ml). Because this solution is unstable, once it is has been prepared into solution, it must be used within 10 hours (Cardio-Green drug insert, 1979).

Different offices and institutions may use concentrations other than the one listed above. For example, some physicians may prefer 50 mg of ICG diluted in 7 cc aqueous solvent. 3.5 cc of ICG solution is pushed as quickly as possible and immediately flushed with at least 5 cc of normal saline. Some nurses have found it helpful to use a smaller intercath needle size, #22 (or #24 for difficult veins), and attach a primed IV extension set with sliding clamp and 3-way stopcock. This way a syringe with either the ICG or fluorescein dye can be injected into the same vein through different ports on the stopcock and flushed with the intravenous normal saline solution. The intercath is left in place until the patient's visit is complete.

ICG angiography takes about twice as long as fluorescein angiography because the best images are collected at the 30-40 minute late phase interval. Sometimes it is necessary to reinject ICG to quickly view the dye in choroidal vessels to photograph the necessary landmarks prior to laser photocoagulation after the CNVMs have been delineated.

It's a big investment to purchase a digital fundus camera (a unit may cost approximately $100,000). All physicians are not equally as enthusiastic about the quality of the enhanced results compared to those obtainable from expert angiographic photographers. However, some offices like the advantage of using a computerized reading for all fluorescein angiographies due to the quick turn around time. Without having to send the films to a lab for processing or pay a technician and dark room costs, paying the price for this unit has its benefits—particularly including the added advantage of ICG angiographic capability.

References

Bibliography