



699 Pulse Administration of ICG During Choroidal Angiography Increases Visualization of Vascular Details



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Introduction

Recording the wide swings of ICG intensity during the early and late phases of fundus camera based choroidal angiography is problematic. Standard ocular angiography technique requires a bolus injection of dye.¹ Because of the relatively high initial post injection concentration of circulating ICG, portions of the transit phases of choroidal angiograms are often overexposed. As the test progresses, the amount of circulating dye decreases dramatically, requiring the ophthalmic photographer to maximize both the flash intensity and camera sensitivity.² Additionally, as the ophthalmic photographer successfully manipulates the exposure and sensitivity scales during the choroidal angiogram to provide an adequate image, the tonalities within each of the images are based on different exposure and sensitivity values. Consequently, in choroidal angiography, the intensity of early phase and the intensity of late phase hyperfluorescence is not comparable, as it is in fluorescein angiography.

We describe a pulse-ICG injection technique which better matches the illumination range of the fluorescing ICG to the exposure range of fundus camera based digital angiography.

Methods

- Choroidal angiography was performed using a Canon 60UVI Fundus Camera (Lake Success, New York) with an OIS (Ophthalmic Imaging System, Sacramento, CA) digital angiography system.
- Flash and digital camera sensitivity settings required during the transit, and at the 5, 10, and 25 minute pictures in 12 consecutive patients were recorded. Adequate exposure was evaluated during the angiograms by an experienced ophthalmic photographer (PJS).
- Each patient was injected with 50mg of ICG dye reconstituted in 3.5cc of diluent.
 - "Even numbered" patients received the ICG injected at 3 consecutive 30 second intervals in 1.5cc, 1cc, and 1cc increments.
 - "Odd numbered" patients received a standard bolus dye injection of ICG (injection duration: 5 seconds).
- Late landmark injections were not performed.³
- Vascular details in early and late images were examined by experienced retinal specialists (RAS, JCC).

Results

- Using the two sample Wilcoxon rank-sum (Mann-Whitney) test, there was a statistically significant decrease in the level of exposure needed for adequate late recirculation phase photographs using the pulse injection technique:
 - 5 minute: $p=0.03$
 - 10 minute: $p=0.02$
 - 25 minute: $p=0.01$
- Using the two sample Wilcoxon rank-sum (Mann-Whitney) test, there was no statistically significant difference in the level of exposure needed for adequate transit phase images ($p=0.26$).
- Interpreting physicians noted increased choroidal vascular detail and earlier identification of subsequent late hyperfluorescence when the pulse technique was used.

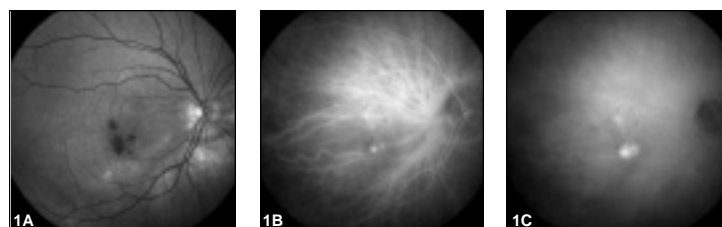


Figure 1: Frames from a sample pulse ICG. (A) Red free photograph documenting hemorrhage overlying suspected CNVM. (B) 6 minute frame shows area of suspected hyperfluorescence. (C) 25 minute late frame confirms area of late hyperfluorescence.

- The pulse nature of the ICG injection is seen as 3 separate instances of bright choroidal fluorescence during the transit phase (Figure 2: Pulse 1-3). All standard choroidal angiography phases⁴ were identified in each study.
- The ophthalmic photographer experienced less exposure variability and fewer flash setting changes when using the pulse ICG injection technique.
- No additional complications or adverse reactions from either the dye or the injection technique were identified.

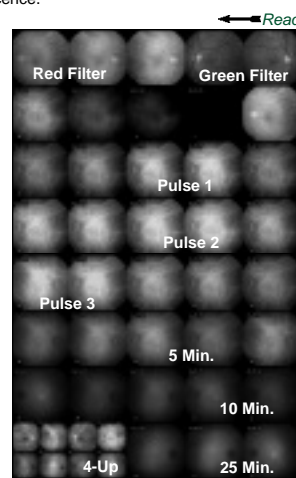


Figure 2: Complete Pulse ICG Angiogram

Discussion

Standard retinal angiography technique records the dynamic nature of the ocular circulation after a bolus injection of sodium fluorescein. When the same bolus injection technique (illustration 3A) is utilized in ICG angiography, the brightest (*) transit images are overexposed, while late images require maximal flash intensity and camera sensitivity.

ICG pharmacokinetics are described as a two compartment open model.⁵ The initially high concentration of circulating ICG immediately after injection is rapidly cleared by the liver, leaving small amounts of the dye in the plasma. Pulse ICG injection (illustration 3B) effectively lowers the initial overexposure while increasing the amount of dye available for late imaging of the choroid by redistributing the dye.

After the initial 1/3 of the ICG dye dosage is injected, the dye concentration in the choroid peaks and then begins to clear via the liver. With less dye, the exposure is at a slightly lower, more manageable level, and the transit phase is less likely to appear washed out. The next 1/3 is then introduced, peaks and clears. Then the third and final stream of ICG dye is introduced, peaks and clears. **In effect, the choroid is bathed in not one, but three different applications of ICG dye.** The earlier appearance of hyperfluorescence and the lower exposure requirements during late phase photographs are a direct result of the increased availability of choroidal ICG.

The earlier appearance of hyperfluorescent areas improves both physician visualization of the disease process and the digital overlay procedure because the retinal vasculature is more clearly visible in the early images.

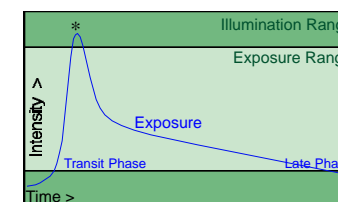


Figure 3A: Bolus ICG Injection

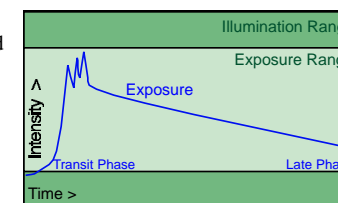


Figure 3B: Pulse ICG Injection

Conclusions

- The pulse method of ICG dye administration for ocular angiography increases the visualization of choroidal vascular detail.
 - Pulse ICG dye administration decreases the available circulating ICG during the early phase of angiography, resulting in more evenly exposed transit phase images.
 - Pulse ICG dye administration increases the ICG available during the late recirculation phase, resulting in lower camera sensitivity.
- We recommend further study to evaluate choroidal angiography using pulsed ICG dye administration.

Summary

We suggest that using a pulse injection technique will increase the clinical information available in your ICG angiograms. Divide your usual dose into thirds, inject the first third, wait 30 seconds, inject the second third, wait 30 seconds, then inject the final third. Your transit images will be better exposed, your late phase ICG photographs will be easier to image, and areas of late hyperfluorescence will often be visualized earlier.

References

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