The Angiographic Phases of FA & ICG-A

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Resumen

El Proposito
El proposito es comparar el aspecto de “fluorescein angiografia” (FA) y de “indocyanine verde angiografia” (ICG-A).

Metodos
Concurrente “digital fundus camera angiographies” ha sido evaluado.

Resultados
Un FA normal incluye “choroidal flush,” el relleno de la arteria de la retina y luego relleno venoso, transito completo, la recirculacion media, recirculacion tardia. Un ICG-A normal incluye “choroidal arterial”, luego relleno venoso, “ retinal arterial”, luego relleno venoso, transito completo, recirculacion media, y la evacuacion chorodial tardia . Estas angiografias comparten semejanzas analogias (por ejemplo: flujo venoso laminar) y las diferencias (por ejemplo ICG-A el cubrimiento del vertiente y efecto de “Mie”). El FA tardio demuestra un nervio optico brillante; el ICG-A tardia demuestra un nervio optico oscuro.

Conclusiones
FA describe relleno de la retina. Ambos rellenos, choroidal y de la retina estan identificados durante ICG-A. Un reconocimiento mas amplio de los modelos normales/anormales “hypo/hyperfluerescenten ICG-A es alentado .

Abstract

Purpose
Compare the phases of fluorescein angiography (FA) with indocyanine green angiography (ICG-A).

Methods
Concurrent digital fundus camera angiograms were evaluated.

Results
The normal phases of FA include the choroidal flush, retinal arterial and venous filling, full transit, mid-recirculation, and late recirculation. Normal ICG-A phases include the choroidal arterial then venous filling, retinal arterial and venous filling, full transit, mid-recirculation, late choroidal evacuation. FA & ICG-A share similarities (example: venous laminar flow) and differences (examples: ICG-A watershed perfusion and Mie effect). Late FA shows a bright optic nerve; in late ICG-A the optic nerve is dark.

Conclusion
FA describes sequential retinal vascular filling. Both choroidal and retinal filling are identified during ICG-A. Heightened recognition of normal/abnormal hypo/hyperfluorescent patterns of vascular filling in ICG-A is encouraged.

Methods

The fundus camera-based digital angiograms of 27 consecutive patients who underwent concurrent fluorescein angiography (FA) and pulse[1] indocyanine green angiography (ICG-A) were reviewed and evaluated by two retina specialists and one ophthalmic photographer. Normal filling phases and hypo/hyperfluorescence were identified and compared in each angiogram.

Recent literature describing ICG angiography was reviewed.[2-8]

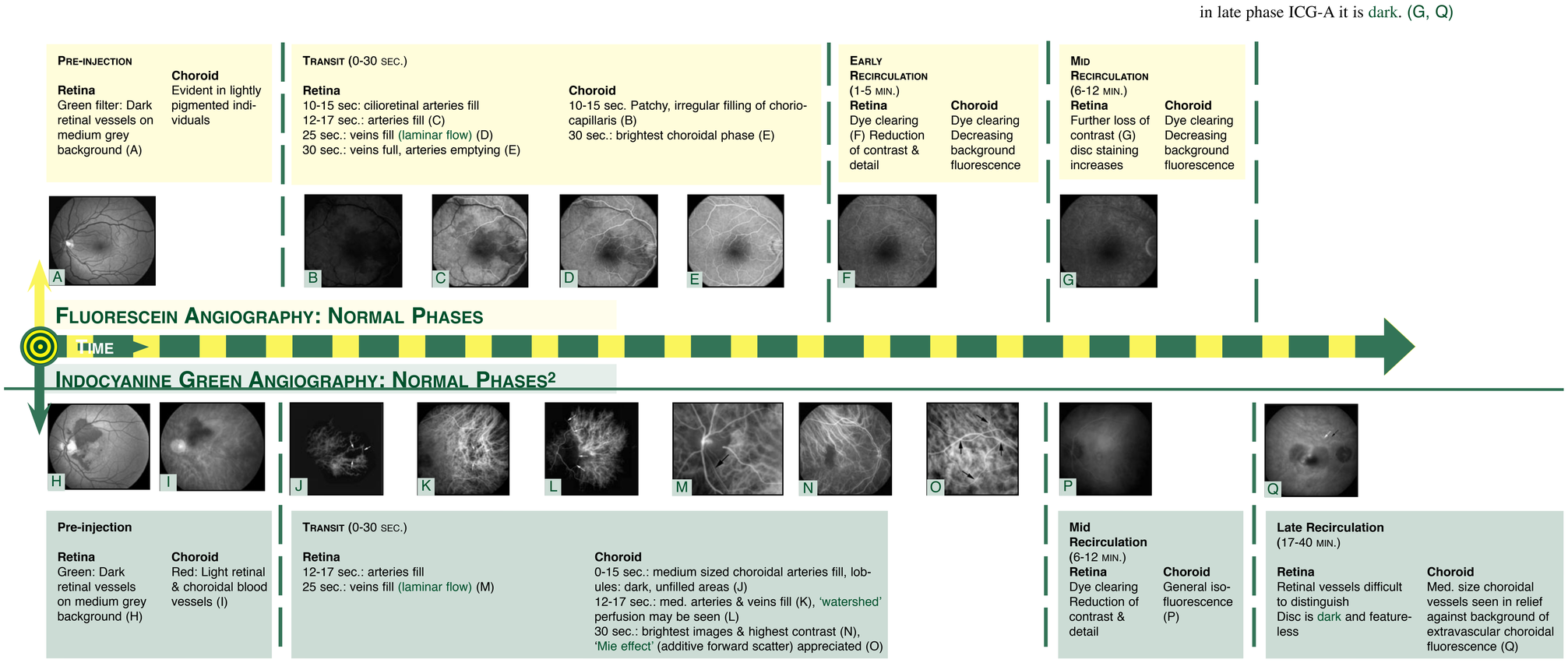
Results

The normal course of FA includes these phases:
- choroidal flush (B)
- retinal arterial filling (C)
- retinal venous filling (D)
- full transit (E)
- mid recirculation (F)
- late recirculation (G)

The normal course of ICG-A includes these phases:
- choroidal arterial filling (J)
- choroidal venous filling (K)
- retinal arterial filling (L)
- retinal venous filling (M)
- full transit (N)
- mid recirculation (P)
- inversion phase (late choroidal recirculation) (Q)

Similarities: normal FA & ICG-A filling phases
- laminar flow during retinal venous filling (D,M)

Differences: normal FA & ICG-A filling phases
- choroidal arterial and venous filling phases can be distinguished in ICG-A (J,K)
- watershed perfusion pattern of short posterior ciliary arteries during ICG-A choroidal arterial filling phase (L)
- Mie effect (additive forward scatter) during ICG-A full transit phase (O)
- Optic nerve in late phase FA is bright; in late phase ICG-A it is dark. (G, Q)



Discussion

The accurate interpretation of clinically relevant characteristics in FA and ICG-A requires recognition of the fundamental fluid dynamics and the biophysical properties of these two dyes. FA represents accumulating hyperfluorescence from leakage, while the ICG-A hyperfluorescence represents an accumulation of protein bound ICG dye.

The normal phases of FA are characterized by the hemodynamics of fluorescein dye movement through the retinal vasculature, with minimal contribution by rapidly dissipating dye in the choroidal vasculature.

Normal phases of ICG-A are characterized by the hemodynamics of ICG dye movement through the retinal vessels, the choroidal and choriocapillaris vascular beds, and the prominent retention of the ICG dye within the choroidal vasculature.

ICG-A has been recommended for the identification of polypoidal choroidal vasculopathy, occult choroidal neovascularization, neovascularization associated with piment epithelial detachments, and recurrent choroidal neovascular membranes.[3]

Case 1 Illustrates the capacity of ICG-A to image abnormal hypofluorescence obscured by overlying hemorrhage.

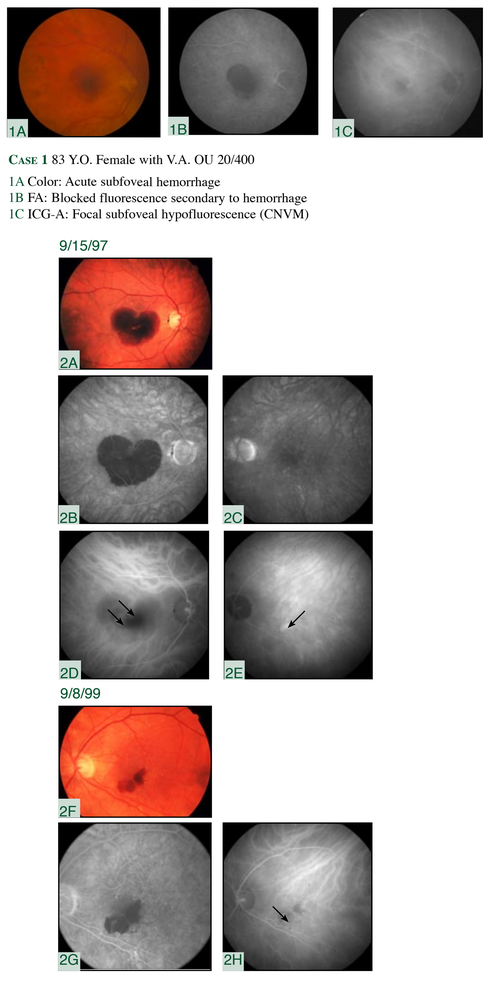
Case 2 The right eye FA & ICG-A studies similarly demonstrate ICG-A’s facility in revealing underlying hypofluorescence (arrows). The left eye FA/ICG-A images suggest the possible predictive value of ICG-A in early recognition of CNVM.[4]

Case 3 ICG-A in Stargardts’/Fundus Flavi highlights choroidal hyperfluorescence associated with the multifocal pisciform lesions of the disease.

Case 4 ICG-A in metastatic lung cancer demonstred both multifocal tumor hyperfluorescence in the clinically involved OD, and unsuspected multifocal macular hyperfluorescence in the fellow eye.[5]

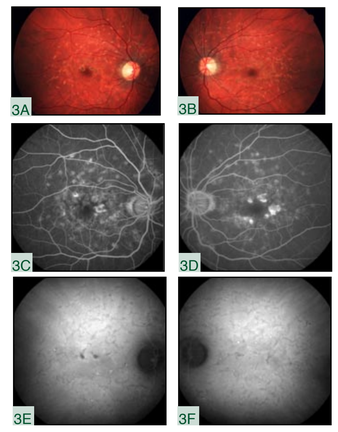
Familiarity with the standard phases of FA and ICG-A encourages clinical interpretation based on the underlying histopathological and structural alterations in diseased ocular tissue.

Indocyanine Green and Fluorescein Angiography: Clinical Examples

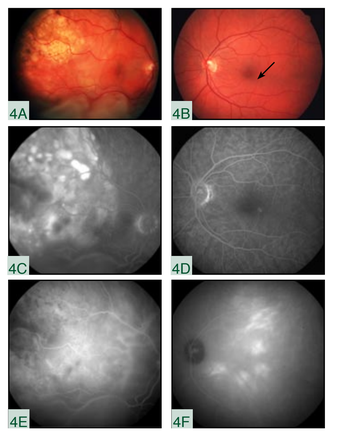


Case 1 83 Y.O. Female with V.A. OU 20/400
1A Color: Acute subfoveal hemorrhage
1B FA: Blocked fluorescence secondary to hemorrhage
1C ICG-A: Focal subfoveal hypofluorescence (CNVM)

Case 2 79 Y.O. Female VA OD 20/400; OS 20/30 Age Related Macular Degeneration[6,7]
9/15/97 2A OD: subretinal hemorrhage obscuring macular detail
2B FA OD: ill defined hyperflourescence obscured by blood
2C FA OS: drusen without increasing hyperflourescence
2D ICG-A OD: hyperfluorescent foci of presumed CNVM *(arrow)*
2E ICG-A OS: discrete hyperfluorescent macular lesion *(arrow)*
9/8/99 2F OS: fresh macular subretinal hemorrhage
2G OS FA: vague ill defined hyperfluorescence
2H OS ICG-A: focal discrete hyperfluorescence underlying new hemorrhage; *localized to prior (2E) area of choroidal ICG hyperfluorescence (arrow)*



Case 3 47 Y.O. Female with V.A. OU 20/20
3A/3B Stargardts/Fundus Flavimaculatus[8]
3C/3D FA: Bilaterally symmetrical, foveal sparing, multifocal, pisciform areas of discrete macular hyperfluorescence
3E/3F ICG-A: multifocal reticulated areas of choroidal hypofluorescence with scattered punctate hyperfluorescent dots



Case 4 48 Y.O. Female with V.A. OD HM/ OS 20/25
4A OD: exudative retinal detachment with subretinal mass[5]
4B OS: small RPR detachment *(arrow)*
4C FA OD: multifocal RPE leakage, dye pooling
4D FA OS: subtle RPE transmission defect
4E ICG-A OD: diffuse hyperfluorescence of choroidal mass
4F ICG-A OS: multiple discrete hyperfluorescent choroidal foci *undetected* on FA or clinical exam

Conclusion

- Vessel filling in both the choroidal and retinal circulations can be identified on ICG-A, while the normal phases of FA describe retinal filling patterns only.
- Normal and abnormal hypo/hyperfluorescent angiographic patterns familiar to retinal specialists during the interpretation of FA differ from the hypo/hyperfluorescent patterns found during ICG-A.
- Heightened recognition of the spectrum of normal ICG-A characteristics during interpretation is encouraged.

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