Nonmydriatic Digital Ocular Fundus Photography on the iPhone 3G: The FOTO-ED Study

The widespread use of smartphones provides a unique opportunity for telemedicine. In ophthalmology, smartphones are used for visual acuity assessments and to document examinations, particularly in settings like the emergency department, where the usual ophthalmic tools and photographic services are unavailable. However, to our knowledge, these devices have not been used for systematic, remote review of clinical photographs in ophthalmology as they have in radiology and dermatology. We performed a pilot investigation to compare the quality of nonmydriatic fundus photographs displayed on an iPhone 3G (Apple Inc) vs a desktop computer.

Methods. Three hundred fifty patients with headache, focal neurologic deficit, visual changes, or diastolic blood pressure 120 mm Hg or higher were prospectively enrolled during the Fundus Photography vs Ophthalmoscopy Trial Outcomes in the Emergency Department (FOTO-ED) study. Nonstereoscopic, nonmydriatic, single-field photographs of the ocular fundus were obtained using the Kowa α-D camera. All photographs were stored as JPEG lossy compression images (resolution, 2528 × 1936 pixels; compression ratio, 1:5). Photographs were graded for general quality by 2 neuro-ophthalmologists (C.L. and B.B.B.) on a computer monitor (Figure) using a previously validated 5-point scale. Six weeks after initial review on the computer display, 100 photographs were chosen by a pseudorandom sequence and graded on an iPhone 3G (Figure) by both neuro-ophthalmologists. Zoom level could be adjusted on both devices. Photographs were transferred to the iPhone via the wired interface without modification. One year later, 1 neuro-ophthalmologist (C.L.) regraded the same 100 photographs on the iPhone.

Agreement was assessed by quadratic (Fleiss-Cohen) weighted κ. Systematic differences in ratings were assessed by the Bishop, Fienberg, and Holland modification of the McNemar χ² test. P values were Bonferroni corrected.

Results. The quality ratings on the computer display for the 100 randomly selected photographs were the following: 31 photographs, grade 1 (inadequate for any diagnostic purpose); 19 photographs, grade 2; 13 photographs, grade 3; 16 photographs, grade 4; and 21 photographs, grade 5 (ideal quality). There was no difference in quality ratings of photographs with vs without abnormalities. The 2 reviewers had excellent interreviewer and intrareviewer agreement on either the desktop computer or the iPhone display without evidence of systematic differences (κ = 0.93-0.97; 95% CI, 0.68-1.00; χ² ≤ 4.3; P ≥ .19) (eTable 1, http://www.archophthalmol.com). The agreements for the same reviewer on the desktop computer vs the iPhone were also excellent (κ = 0.82-0.91; 95% CI, 0.56-1.00). Both reviewers tended to rate an image’s quality on the iPhone as superior to that same image viewed on the computer display (χ² = 36.4-43.1; P < .001) (eTable 1 and eTable 2).

Comment. We expected equal- or lower-quality ratings for photographs displayed on the iPhone compared with the desktop computer, but instead we found that reviewers assigned higher ratings on average for photographs...
displayed on the iPhone. Because the magnitude of this difference was similar for both reviewers and no bias in the other ratings was observed, we believe this occurred because the advantages of the iPhone’s display (eg, higher dot pitch and brightness) outweighed its disadvantages (eg, lower resolution and smaller screen area). The factors contributing to this difference warrant additional investigation. It also remains to be seen whether relevant abnormalities found on the computer display would also be found on the iPhone display under routine conditions. This was not studied directly because currently no iPhone software exists to transfer and review a large number of photographs grouped by patient. However, our results support the iPhone’s display as a potential component in a telemedicine network. We are not suggesting using the iPhone to screen for subtle conditions (eg, diabetic retinopathy) or as a replacement for in-person ophthalmologic consultation. Rather, we believe the iPhone, and similar devices, in combination with nonmydriatic photography can complement ophthalmologic consultations in settings such as the emergency department—by allowing for rapid and remote identification of obvious conditions affecting the posterior pole such as papilledema and malignant hypertension.

Cédric Lamirel, MD  
Beau B. Bruce, MD, MS  
David W. Wright, MD  
Nancy J. Newman, MD  
Valérie Biousse, MD

Author Affiliations: Departments of Ophthalmology (Drs Lamirel, Bruce, Newman, and Biousse), Neurology (Drs Bruce, Newman, and Biousse), Emergency Medicine (Dr Wright), and Neurological Surgery (Dr Newman), Emory University, Atlanta, Georgia.

Correspondence: Dr Newman, Department of Ophthalmology, Emory Eye Center, Emory University, 1365-B Clifton Rd NE, Atlanta, GA 30322 (ophtnjn@emory.edu).

Author Contributions: All authors had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Financial Disclosure: None reported.

Funding/Support: This study was supported in part by a departmental grant (Department of Ophthalmology) from Research to Prevent Blindness and core grant P30-EY06360 (Department of Ophthalmology). Dr Lamirel is supported by Institut Servier, Fondation Planiol, and the Philippe Foundation. Dr Bruce is supported by grants KL2-RR025009 and UL1-RR025008 from the US Public Health Service and K23-EY019341 from the National Eye Institute, by the Knights Templar Eye Foundation, and by the American Academy of Neurology Practice Research Fellowship. Dr Wright is supported by grant KL2-RR025009 from the US Public Health Service. Dr Newman is a recipient of the Lew R. Wasserman Merit Award from Research to Prevent Blindness. Dr Biousse is supported by grant UL1-RR025008 from the US Public Health Service.

Role of the Sponsors: The sponsors had no role in the design or conduct of the study; in the collection, analysis, or interpretation of data; or in the preparation, review, or approval of the manuscript.


Intravitreal Daptomycin in a Case of Bilateral Endogenous Endophthalmitis

Bacterial endophthalmitis is a devastating intraocular infection that, in its most severe form, can result in complete loss of vision in the affected eye. In patients with endogenous bacterial endophthalmitis, 69% have a final visual acuity worse than counting fingers. Visual outcomes are directly related to the infecting bacteria, with eyes infected with coagulase-negative Staphylococcus faring much better than those infected with Staphylococcus aureus, Streptococcus, and gram-negative organisms. With the emergence of drug-resistant bacteria, increasing the arsenal of safe and effective antibiotics for treatment is of particular importance. We report a case of bilateral endogenous methicillin-resistant S. aureus endophthalmitis treated successfully with intravitreal injections of daptomycin.

Report of a Case. A 69-year-old previously well woman who was retired, married, and caregiver to her chronically ill husband was taken to the emergency department by her daughter with an acute onset of confusion, disorientation, and generalized malaise. Her medical history included a remote history of angina, intermittent pleurisy, a total abdominal hysterectomy with bilateral salpingo-oophorectomy, and cataract surgery in the left eye. Her only medication was estrogen replacement. There was no illicit drug use, recent dental work, or indwelling venous catheter. The patient was admitted to the hospital for workup of altered mental status and eventually found to have bacterial endocarditis with methicillin-resistant S. aureus. The bacterial isolate had an intermediate resistance to vancomycin hydrochloride (minimum inhibitory concentration, 4-8 µg/mL). Magnetic resonance imaging of the brain showed multiple bilateral acute ischemic changes, and echocardiography revealed mitral valve endocarditis.

The ophthalmology service was consulted for evaluation of the patient’s blurred vision. At initial examination, the patient’s visual acuity was at least counting fingers OU and intraocular pressures were normal. Findings on anterior segment examination at the bedside were nor-