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OPHTHALMOLOGY
Research Article

Mobile Phone Funduscopy Screening for Retina Manifestations of Systemic Disease in Poor Resource Settings of Sub-Sahara Africa

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Abstract

Summary

Background: Early detection of retina manifestations of systemic disease may save both sight and life. Mobile phone retinal imaging may be taught to health workers for telemedical purposes. The aim of this review was to discuss the use of mobile phones in screening for retina manifestations of some major non communicable systemic diseases in Nigeria. The diseases are diabetic retinopathy, retinopathy of prematurity, retina vascular changes from systemic hypertension and sickle cell retinopathy.

Methods: The review describes the method of mobile phone examination and the role in telemedicine and teaching.

Results: The pictures appear satisfactory for diagnosis and onward transmission for telemedical purposes

Conclusions: Mobile phone fundus examination may help in the screening for retina manifestations of systemic diseases in poor resource settings. Early detection can prevent irreversible visual loss.

Keywords: *Mobile phone screening; Retinopathy of prematurity; Diabetic retinopathy; Hypertensive retinal vascular disease; Sickle cell retinopathy*

Introduction

The use of mobile phones for fundus examination has been documented recently [1]. Its use in poor resource settings of Sub Sahara Africa is advocated [2]. These settings lack adequate manpower and infrastructure to tackle infectious diseases talk less of the non-communicable diseases. It is hoped that the adaptation of mobile phones for eye examination will translate to better telemedical services in the area. The aim of this review was to discuss the use of mobile phone Funduscopy in screening for retina manifestations of some systemic diseases in Nigeria. The diseases are diabetic retinopathy, retinopathy of prematurity, retina vascular changes from systemic hypertension and sickle cell retinopathy.

Diabetic retinopathy is now an emerging eye disease in Nigeria [3]. It is a significant cause of blindness and low vision in Nigeria [4]. Changing lifestyles and increasing urbanization is responsible. Nigeria has the highest number of diabetics in Africa [5]. Since blindness from diabetic retinopathy is largely irreversible, timely intervention will safe vision. The disease is of public health importance. Diabetic retinopathy is symptomless in early stages; screening of diabetic population for retinopathy is cost effective. Screening for diabetic retinopathy poses a challenge in poor resource settings of Sub Sahara Africa. Retina camera is ideal in these settings but is too expensive. The other available tool for screening is the indirect ophthalmoscope. Most physicians are not trained to screen, and the available ophthalmologists have not created enough time to screen for the disease. The indirect ophthalmoscope is too cumbersome for both the general physicians and the general ophththalmologists. Mobile phone fundoscopy can capture the posterior pole and mid periphery well, an area

where diabetic retinopathy affects. The mobile phone pictures can be readily uploaded into emails for telemedical services. Patient education is another important advantage. Teaching of medical students, resident doctors and physicians is possible with this system.

Retinopathy of prematurity is another emerging condition affecting preterm neonates in sub-Sahara Africa. The condition was initially thought to be non-existent due to the fact that low birth weight preterms do not survive. With improvement in neonatal care, more preterms are surviving in Nigeria. Recent developments have shown that retinopathy of prematurity is prevalent in Nigeria [6-8]. Screening is challenging. Indirect ophthalmoscopy is ideal. The Neonatologists are not trained to screen, the general ophthalmologists have not acquired the skill to screen and the few retinal surgeons in Nigeria are too busy with other retinal diseases to create time to screen. What is needed is an effective method of screening. The retina camera, RETCAM is too expensive for poor resource settings and direct ophthalmoscope is inadequate for screening. Mobile phones combined with a 20 Diopter lens may be more suited for the environment.

Sickle cell retinopathy is a significant cause of blindness and low vision in Nigeria [9]. Screening for retinopathy in Hemoglobin SC and SS patients may prevent irreversible blindness. The proliferative stage of the disease is symptomless initially before bleeding occurs. Treatment with laser photocoagulation may halt the progression to advanced stage of the disease if done early. Indirect ophthalmoscopy by the ophthalmologist or retina surgeon is required to detect proliferative stages. Mobile phones combined with 20 Diopter lens may be more cost effective and less cumbersome to the general physicians.

Hypertensive retinopathy and retinal vascular changes from systemic hypertension was initially thought to be rare in Nigeria [10]. Recent developments have shown that it is common [11]. Retinal vascular changes in hypertensive patients may predict morbidity and mortality [12]. Physicians in Nigeria are not trained to detect these changes. Mobile phones combined with 20 Diopter lens may be more effective than direct ophthalmoscopy with its limited field of view.

Method of examination I phone system

The iphone combined with a 20 diopter lens is described. The system requires an application, Filmic pro for image stability and lighting adjustment to prevent excessive glare. The flash of the phone serves as the source of illumination, while the 20 diopter lens captures the retina image which is displayed on the screen of the mobile phone. (Figure 1 and 2) The application is launched in video mode. This enables a video recording of the retinal examination. Still images can be extracted from snapshots, edited and stored in image gallery for uploading into emails for telemedical purposes. Various photo editing applications are available to further sharpens the images and adjust the exposure. (Figure 3-6)

Results

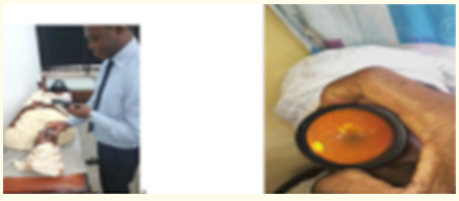

Figure 1: *Mobile phone with 20D lens for Funduscopy and photography.*
a. Method of examination .
b. Snapshot of image on the screen of the mobile phone.

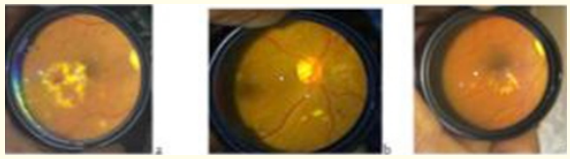

Figure 2: *Diabetic macular edema and non proliferative diabetic retinopathy.*

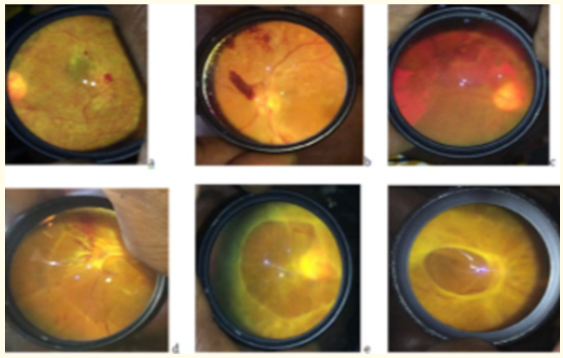

Figure 3: *Proliferative diabetic retinopathy (a-c) and advanced diabetic eye with tractional retina detachment (d- f).*

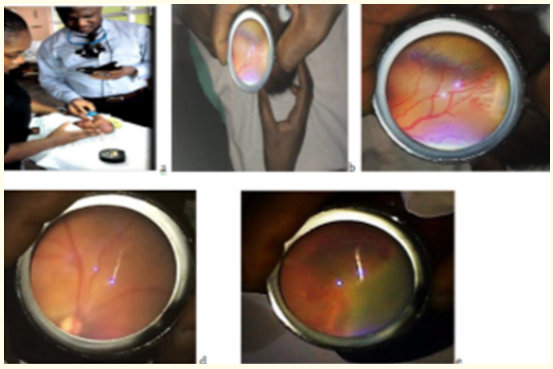

Figure 4: *Mobile phone for Retinopathy of prematurity screening. (a) method of examination; (b) snapshot from the mobile phone screen; (c) Edited image in b; (d) Image of vascularized nasal retina;(e) hemorrhagic vascular retina and the avascular retina.*

Hypertensive Eye Disease

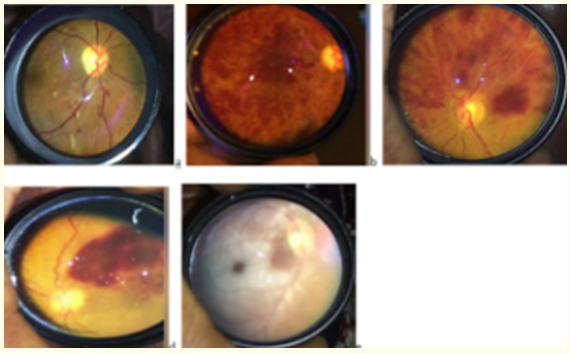

Figure 5: *Retina vascular changes in hypertensive patients. (a) Hypertensive retinopathy. (b) Central retinal vein occlusion. (c) Superior hemi central retinal vein occlusion. (d) Supero temporal branch retinal vein occlusion. (e) Central retina artery occlusion with a patent cilioretinal artery.*

Sickle cell retinopathy

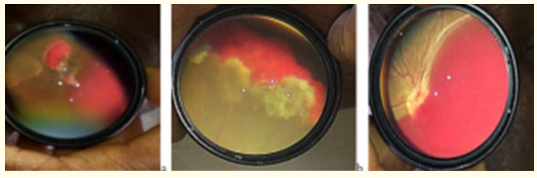

Figure 6: *Proliferative sickle retinopathy. (a) Bleeding new vessels. (b) Bleeding peripheral sea fan.(c) Pre retinal hemorrhage.*

Figure 7: *Resident doctors learning to use mobile phones for retinopathy screening.*

Discussion

The use of mobile phones for screening for the above diseases is worth considering in poor resource settings of Sub Sahara Africa. Telemedicine will find the described systems to be useful in transferring information about patients seen in the remote areas to specialist ophthalmologists in the cities. Furthermore, patients' education and teaching of medical students, nurses and doctors is enhanced.

Recent studies suggested the use of a lens bracket attached to the mobile phones [13]. (Figure 8). This will improve the ease of use, and also free the second hand for other procedures such as indentation, and parting of eyelids.

Figure 8: *Lens bracket to hold the 20D lens.*

The use of the lens bracket will enable teaching of middle level ophthalmic workers at the primary eye care level to take pictures and send to centers where advice on further management can be given.

The android phones are readily available in poor resource settings of Africa. An application, Camera/ Cinema FV-5 is required to capture the image of the retina in combination with a 20D lens. The application is similar to the one described above for the iPhone system. Video recording of the examination is made after which the still images can be edited and stored.

Limitations of the mobile phone based system of examination include significant media opacity such as cataracts and vitreous opacities.

In conclusion, mobile phone combined with a 20D lens is useful for screening for retinal manifestation of systemic diseases in poor resource settings of sub-Sahara Africa. This will enhance telemedical services. The authors declare that no conflict of interest is associated with the paper.

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