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Age Related Macular Degeneration: Optical Coherence Tomography Vs Fluorescein Angiography

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Abstract: ***Aim: To compare role of Optical Coherence Tomography (OCT) and Fluorescein Angiography (FA) in diagnosis of Age related macular degeneration (AMD). Materials and methods: The study enrolled 140 patients. Cases included patients aged more than 50 years, both males and females, diagnosed as AMD on routine fundoscopy in either of the eye. After careful examination with slit lamp and dilated fundoscopy, OCT and FA was done and findings were analysed. Results: Mean age of AMD patients was 67±6.54 years. 71.43 % patients had Early AMD while 28.57% had Advanced AMD. Dry AMD constituted 17.14% while Wet AMD constituted 11.43% of total patients. Involvement was unilateral in 46 (32.86%) patients while it was bilateral in 94 (67.14%) patients. Specificity of OCT was less than FA. So, using OCT as initial tool before FA, the specificity and sensitivity came out to be 0.8478 and 1 respectively. Conclusion: OCT may be a good complementary imaging technique to FFA regarding the diagnosis of AMD.***

Keywords: AMD, OCT, FA, CNV

1. Introduction

Age-related macular degeneration (AMD) is a common cause of irreversible blindness in elderly populations of the Western countries. The exact etiology of AMD remains unknown, yet it is thought that environmental factors as well as mutations in genes of various biochemical pathways including lipid transport and metabolism, the complement cascade, remodelling of the retinal extracellular collagen matrix, and the angiogenesis pathway may contribute to the development of AMD.[1]

It can be classified into 2 main types: 1) “dry” or atrophic AMD, which accounts for 85–90% of AMD cases and presents with atrophy of the retinal pigment epithelium (RPE) with subsequent progressive visual loss, and 2) “wet” or neovascular AMD, accounting for 10–15% of cases and characterized by the growth of new blood vessels from the choroid into the Bruch’s membrane with subsequent leakage and bleeding that disrupt the normal architecture of the photoreceptor-RPE complex and, ultimately, lead to scar formation.[2] Severe vision loss occurs primarily due to 2 processes: geographic atrophy in advanced nonexudative AMD and choroidal neovascularization (CNV) in exudative AMD culminating in fibrosis.

Advancements in imaging over the past 15 years have revolutionized the diagnosis and treatment of AMD. Imaging is especially critical at 2 junctures in the course of the disease: (1) monitoring for the development of CNV and leakage (signifying the progression to exudative AMD) and (2) monitoring the response to anti–vascular endothelial growth factor (anti-VEGF) therapy in exudative disease.

Though, Fluorescein Angiography (FA) is of greatest utility in showing dynamic changes in fluorescent patterns, such as leakage, staining, and pooling, as well as dye transit time to the eye. However, it provides only a limited 2-dimensional (2D) depth resolution of the retinal and choroidal vasculature and poorly visualizes vessels that may be obscured by fluid, hemorrhage, pigment, RPE detachments, fibrosis, or other areas of hyperfluorescence.[3,4] Neovascular patterns under the RPE are difficult to evaluate as well. Indocyanine green angiography (ICGA) can provide a more detailed image of the choroid and in particular neovascular membranes beneath the RPE, as well as in the AMD variants idiopathic polypoidal choroidal vasculopathy (IPCV) and retinal angiomatous proliferation (RAP).

In the past decade, OCT has established itself as an essential imaging modality in the diagnosis and management of AMD.[5] OCT is currently the primary method to monitor for structural changes, such as neovascular membranes, fibrosis, intraretinal and subretinal fluid, and pigment epithelial detachments. Exudation manifests as intraretinal and subretinal fluid and retinal thickening on OCT. Sequential OCT imaging enables clinicians to monitor response to anti-VEGF therapy in exudative AMD by following intraretinal and subretinal fluid and retinal thickening as well as pigment epithelial detachments. Optical coherence tomography is easier and faster to acquire than FA, does not require invasive injections, and provides cross-sectional and en face images of retinal and choroidal features.

Considering these, this study was taken up with following purpose:
To compare role of OCT and FA in diagnosis of Age related macular degeneration.

2. Materials and Methods

This study was conducted during the period of September 2016 to August 2017 in Regional Institute of Ophthalmology, Guwahati (Assam, India). The study enrolled 140 patients. Cases included patients aged more than 50 years, both males and females, diagnosed as AMD on routine fundoscopy in either of the eye from outdoor as well as indoor facility. Informed consent was obtained from

all patients. Patients with media opacities obscuring details of central retina, ocular trauma, other retinopathies and those with retinal detachment or with other choroidal inflammatory conditions were excluded. Those with history of cardiac ailments, bronchospasm and kidney disease were also excluded due to FA related adverse reactions.

A detailed ocular and systemic history was taken. To assess distant vision we used Snellen's illiterate "E" chart, held at 6 m distance from the patient. If a person could not correctly identify "E" of the top line, the test was repeated at 3 m distance. The near vision was tested using a Jaeger near vision chart, held at 25-33 cm from the face. A person's vision was tested with his/her spectacles on.

The anterior segment of the eye was evaluated using slit lamp bio-microscope which included intraocular pressure measurement The retina and optic nerve head were examined by using +90 D Volk lens and slit lamp bio-microscope and/or Indirect Ophthalmoscopy. A red free filter was applied to distinguish drusen from exudates and hemorrhage. A slit beam was used to determine macular edema.

AMD was graded as per the international classification.[6]The digital image using fundus photographs were evaluated. The mild AMD included the presence of soft drusen of more than 63µ size, presence of hyper or hypo pigmentation of retinal pigment epithelium or both of these above mentioned conditions. Dry AMD includes geographic atrophy. The eye with chorio-retinal atrophy secondary to other obvious cause like high myopia and chronic granulomatous eye disease in the past were excluded while labelling eye with dry AMD. Wet AMD included neo-vascular vessels of chorio-capillary plexus in macular area (CNV), exudative pigment epithelial defect (PED), macular scar or combinations of any of these three conditions.

Routine blood and urine investigations along with serum creatinine, fasting serum lipid profile, fasting and post-prandial sugar were done.

OCT imaging was done with Stratus OCT machine model 3000 (Carl Zeiss Meditec Inc.) with software version 4.0. The Fast macular thickness (FMT) protocol was used followed by FA. Photographs were taken every second for first 10 seconds, then every 2 seconds up to 30 seconds. Few late photographs were also taken at 3, 5 and 10 minutes.

3. Statistical Methodology

The data obtained were recorded in a set protocol and were presented as the mean ± standard deviation. Statistical differences during follow ups were assessed using a Paired t-test. To find correlation between the variables Pearson's correlation of coefficient was applied. A p-value of less than 0.05 was considered to be statistically significant.

4. Results

A. Demographics

Mean age of AMD patients was 67±6.54 years. Largest number of patients, 70 (50%) were in age group > 70 years. We found that with increase in age, risk for advanced AMD increased.

Out of 140 cases, 56 (40%) were males while 84 (60%) were females.

71.43 % patients had Early AMD while 28.57% had Advanced AMD. Dry AMD constituted 17.14% while Wet AMD constituted 11.43% of total patients. Involvement was unilateral in 46 (32.86%) patients while it was bilateral in 94 (67.14%) patients. (Table 1 and Figure 1)

Table 1: Showing age distribution in Early and Advanced AMD

Age Groups (in Years)	No. of patients with AMD	Early AMD	Advanced AMD	
			Dry AMD	Wet AMD
50-59	22	22		
60-69	48	38	4	6
≥ 70	70	40	20	10
Total	140	100	24	16

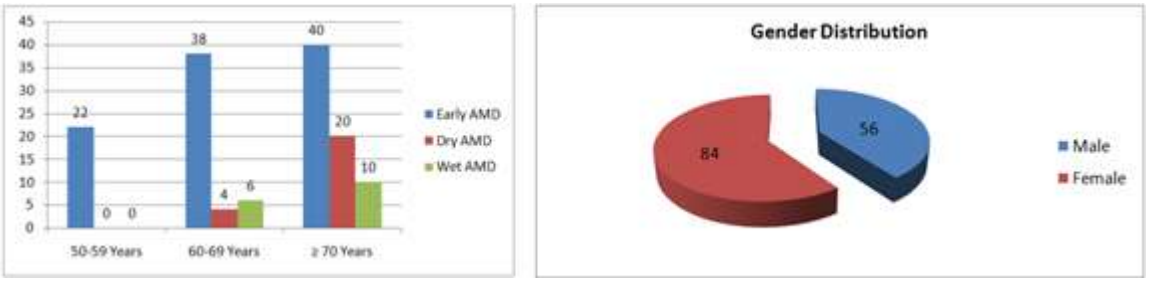


Figure 1: Showing Age and Gender distribution in AMD

B. Visual Acuity

Most of the patients in Early AMD had vision better than 6/18 while 50% of patients with Advanced AMD had vision less than 6/18. 10 patients (14.28 %) had severe visual impairment out of which one patient was socially blind (Bilateral vision < 3/60). (Table 2)

Table 2: Visual impairment in AMD

Degree of Visual Impairment (BCVA)	No AMD	Early AMD	Advanced AMD	Total Eyes (280)
Normal (>6/18)	46	150	40	236
Moderate Visual Impairment (6/18-6/60)	-	4	30	34
Severe Visual Imapirment (<6/60-3/60)	-	-	8	8
Blindness (<3/60)	-	-	2	2

C. OCT Findings

OCT done in 280 eyes of 140 patients. 154 eyes showed drusen, 46 eyes were found to be normal, 48 eyes showed Geographical atrophy, 16 had Serous Pigment Epithelial Detachments (PED), 12 had Choroidal neovascularisation (CNV) of which 6 showed presence of subretinal fluid and lastly 4 had fibrovascular PED. (Figure 2)

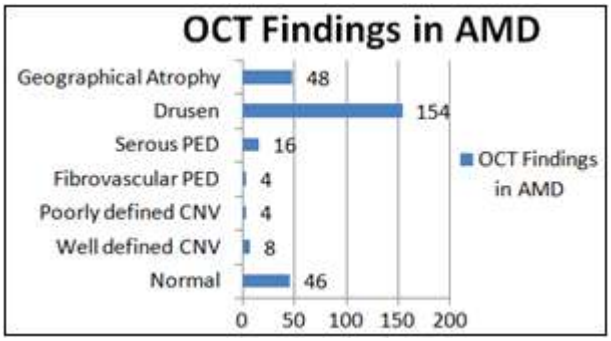


Figure 2: OCT Findings in AMD

D. FA findings in AMD patients

FA was done in 280 eyes of 140 patients. 54 eyes were normal, 92 eyes showed the presence of hard drusen with or without hyperpigmented patch, 62 had soft drusen with or without RPE atrophy, 42 has Geographical atrophy, 14 showed serous PED, 14 showed classic CNV and 2 showed occult CNV, all were subfoveal. The occult CNV was fibrovascular PED variety, no late leakage from undetermined source variety was evident. (Figure 3)

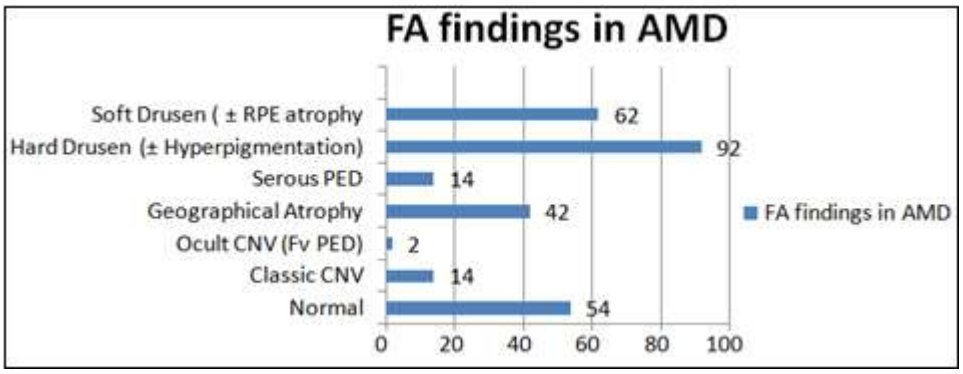
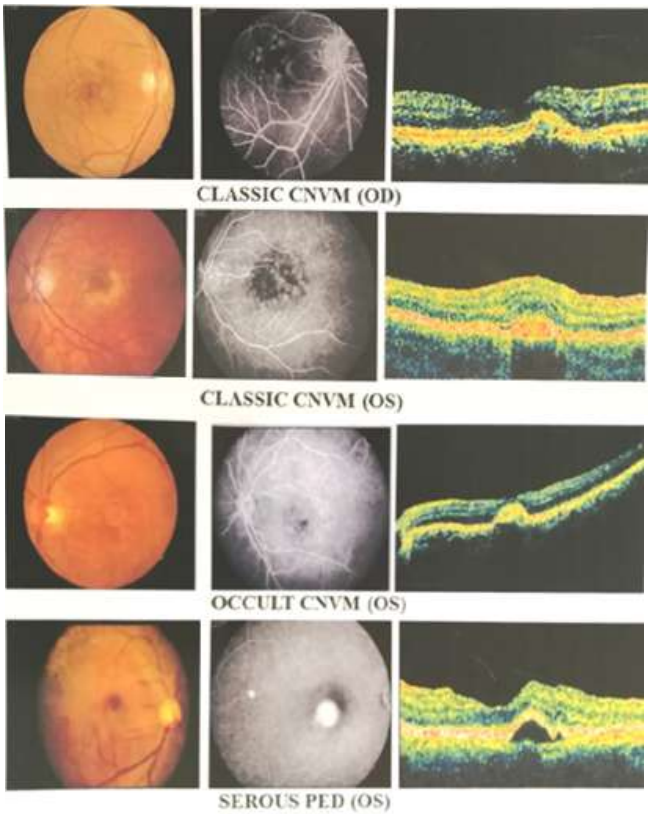


Figure 3: FA Findings in AMD



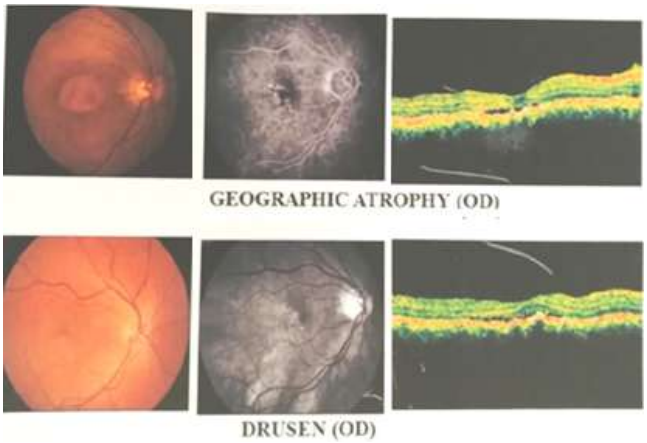


Figure 4: Fundus photo, FA and OCT in different AMD patients

E. Comparison between OCT and FA

Certain discrepancies were found between OCT and FA findings and it was found that OCT was less specific than FA in detecting few lesions. 4 cases of poorly defined CNV in OCT came out to be classic CNV in FA. 2 case of Occult CNV (Fibrovascular PED) in OCT turned out to be classic CNV in FA. 16 cases diagnosed as serous PED in OCT were confirmed by FA as 14 actual serous PED cases and 6 soft drusens were misdiagnosed in OCT. Oct diagnosed 124 drusens, but there was no proper differentiation between hard and soft drusen. Out of 124 drusen cases, 62 came out as hard drusen, 56 soft drusens and 6 cases were normal. Regarding well defined CNV and geographical atrophy cases, OCT and FA findings were similar.

When this was statistically analysed, specificity of OCT was less than FA. SO, using OCT as initial tool before FA, the specificity and sensitivity came out to be 0.8478 and 1 respectively.

5. Discussion

AMD is one of the leading causes of visual impairment in individuals more than 50 years of age in developed countries. The AMD pattern observed in our study closely matches (in most respects) that seen in past reports on AMD in India as well as the Western world. Mean age of AMD patients in our study was 67±6.54 years out of which 50% were in age group > 70 years. Prevalence of AMD in Beaver Dam study **(Klein BEK et al, 1992)**[7] and in **Framingham study (Leibowitz H et al, 1980)**[8] was higher in age groups older than 75 years In the Study by **Sudhalkar A et al (2015)**[9]**,** the median age of the patients was 74.24 ± 8.23 years with a range of 63–93 years.

In our study 10 eyes (4.16 %) of total 240 eyes had severe visual loss (Vision <6/60) while one patient was bilaterally socially blind (Vision <3/60). **Vinding T(1990)** [10] found major visual impairment (vision < 6/60) in 13.3 % of the eyes and the proportion of exudative AMD was significantly more in such visual impairment.

Sandhu SS et al (2005)[11] found that sensitivity and specificity of OCT for detecting new potentially treatable CNV lesions compared to FA was 96.4 % and 66% respectively. He concluded that OCT is good in detecting new CNV but is less accurate in identifying exact components of CNV and at present cannot replace FA, however it has got role as a screening tool

Liakopoulos S et al. (2008) [12] also suggested that quantitative analysis of OCT images allowed for an improved understanding of the anatomical characterstics of angiography defined CNV lesions

Castillo MM (2014)[13] in his study suggested that although TD-OCT is a relatively sensitive test for the initial diagnosis of nAMD, it is of moderate specificity. Consequently, it should not be used as the only test to diagnose nAMD. The current evidence suggests that TDOCT should not replace the reference standard of FA in the diagnosis of nAMD.

6. Conclusion

OCT may be a good complementary imaging technique to FFA regarding the diagnosis of AMD. Using FA as a standard reference, OCT has high sensitivity but only moderate specificity in detecting AMD lesions. However , OCT imaging may have a role ias a screening tool to help prioritise FA requests.

7. Financial Support and Sponsorship: Nil

8. Conflicts of Interest: There are no conflicts of interest

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