OCT of Retinal and Choroidal Tumors

Essay

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List of Abbreviations

CC	:	Chorio-Capillaris
CCD	:	Charge-coupled device
CCH	:	Circumscribed choroidal hemangiomas
CHRPE	:	Congenital hypertrophy of the retinal pigment epithelium
CSC	:	Central serous choriodopathy
CV	:	Choroidal volume
EDI	:	Enhanced depth imaging
OCT	:	Optical Coherence Tomography
ONH	:	Optic nerve head
PCA	:	Posterior ciliary artery
PED	:	Pigment epithelial detachment
PS-OCT	:	Polarization sensitive optical coherence tomography
ROP	:	Retinopathy of prematurity
RPE	:	Retinal pigment epithelium
SD-OCT	:	Spectral Domain Optical Coherence Tomography
SNR	:	Signal-to-noise ratio
SS-OCT	:	Swept Source Optical Coherence Tomography
TD	:	Time Domain
VCSEL	:	Vertical cavity surface-emitting laser
VHL	:	Von Hippel-Lindau Syndrome

List of Abbreviations(Cont.)

EDI-OCT: Enhanced Depth Optical Coherence Tomography

NFL	:Nerve Fiber Layer
GCL	:Ganglion Cell Layer
IPL	:Inner Plexiform Layer
OPL	:Outer Plexiform Layer
ONL	:Outer Nuclear Layer
ELM	:External Limiting Membrane
IS/OS	:Inner Segment / Outer Segment
CSJ	:Choroido-Scleral Junction
SCL	:Sclero-Choroidal Line
VCT	:Vascular Connective Tissue
StCT	:Stromal Connective Tissue
CT	:Choroidal Thickness
TCT	:Total Choroidal Thickness
FDML	:Fourier Domain Mode Locking
ICGA	:Indo Cyanine Green Angiography
MEMS	:Micro-Electro-Mechanical System
SL	:Sattler's Layer
HL	:Haller's Layer
UBM	:Utra-Sonography Biomicroscopy

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Introduction

Since Optical Coherence Tomography (OCT) inception in 1991 ***(Huang et al., 1991)***, the OCT has found wide role in medicine including gastroenterology ***(Testoni and Mangiavillano, 2008)***, dermatology ***(Gambichlet et al., 2005)***, cardiology ***(Bezerra et al., 2009)***& ophthalmology ***(Say et al., 2011).*** Traditional time domain OCT (TD-OCT), sold commercially in 1995 ***(Humeric et al., 2012)***. It was used primarily by retina and glaucoma specialists ***(Monetro and Saxena, 2012)*** then it has been largely replaced by Spectral or Fourier domain OCT that provides higher resolution images (4-7um) and faster scanning speeds (up to 40, 000 scans per second) ***(Walsh, 2008)*** that could be translated into broader application of OCT for other ophthalmic subspecialties including pediatric ophthalmology, oculoplastics, and ocular oncology ***(Shields et al., 2004) (a).***

OCT is an emerging technology for performing high resolution cross sectional imaging. Unlike conventional histopathology which requires removal of a tissue specimen and processing for microscopic examination, OCT can provide images of tissue in situ ***(Fujimoto et al., 2000).***

However the deeper an object to be imaged, the more delay there is to capture that image. In standard OCT moving away from the "zero-delay" which is the point where the interferometric signals are strongest, resulting in diminished choroidal details ***(Spaide et al., 2008***). This is because the

choroid lies behind the retinal pigment epithelium (RPE) and within the opaque sclera so that the choroid has been difficultly imaged. Conventional OCT imaging of the choroid is impeded by the scattering effects of the blood and by the presence of melanin (***Spaide & Mrejen, 2013).***

New OCT technologies now allow imaging the choroid, this includes: (a) Enhanced Depth OCT Imaging (EDI-OCT) (b) Swept Source OCT (SS-OCT) ***(Adhi et al., 2013).***

If the zero-delay line is placed further posteriorly, usually at the inner sclera, the choroid can be better visualized. This technique is known as EDI-OCT ***(Spaide& Mrejen, 2013).*** It can allow in vivo cross-sectional imaging of Choroidal tumors & characterization of the thickness of small (<3mm thick) choroidal lesions including Choroidal nevus and melanoma ***(Say et al., 2011).***

As regard the SS-OCT, It can visualize clearly the choroidoscleral interface and calculate the mean Choroidal volume (11.77+/-3.13 mm^3) so it allows better Choroidal analysis ***(Adhi et al., 2014).***

Advances in OCT will provide better understanding of pathogenesis and response to treatment of chorioretinal diseases ***(Adhi and Duker, 2013).***

Aim of the essay

To review the role of Optical Coherence Tomography in imaging retinal and Choroidal tumors.

History of OCT:

The OCT principle was born at Massachusetts Institute of Technology at the beginning of 1990s ***(Talu et al., 2009).*** Carl Zeiss (Jena, Germany) made available the first commercial version of OCT in 1996 ***(Pierre-Khan et al., 2005).*** The peripapillary area of the retina and the coronary artery were the first structures examined with OCT technology ***(Huang et al., 1991).*** The continuous progress in OCT technology transformed this imaging method into a valuable examination tool for the retinal practice ***(Ghazi et al., 2009).*** OCT is able to visualize precisely the retinal layers something done before only pathology slides. It is simple, non-invasive & rich in information it gives ***(Li et al., 2001).***

OCT versus the Ultrasound :

OCT became soon a main investigative tool in most of the retina practices and more useful than ultrasound. OCT & ultrasound are based on similar principles, with the difference that OCT uses light instead of sound. Because light propagates nearly a million times faster than the sound, it allows obtaining much higher resolution images in the posterior pole of the eye: 10μm or less ***(Holz and Spaide, 2006).*** OCT examination does not require the physical contact with the examined eye, making the examination more comfortable for the patient than ultrasound ***(Romas et al., 2009).***