Acta Medica Alanya

RESEARCH ARTICLE

ARAŞTIRMA

Acta Medica Alanya

2019;3(2):159-163

DOI:10.30565/medalanya.550500

Choroid thickness measurement in second and third trimester pregnancies by enhanced depth imaging optical coherence tomography

İkinci ve üçüncü trimester gebelerde artırılmış derinlik optik koherens tomografi ile koroid kalınlık ölçümü

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ABSTRACT

Aim: Evaluation of choroid thickness in 2nd and 3rd trimester pregnancies by Enhanced Depth Imaging –EDI Optic Coherence Tomography (OCT).

Patients and Methods: In this study, the subfoveal, 2 mm nasal, 2 mm temporal choroidal thicknesses of both eyes in 40 pregnant and 40 non-pregnant (control) women were evaluated. The pregnant women were categorized in 2 groups, 20 being 16-24 weeks pregnant (second trimester) and 20 being 24-39 weeks pregnant (third trimester). The average age of the pregnant women and non-pregnant women was calculated as 27.4±5.8 and 26.9±7.1, respectively.

Results: The choroid thicknesses in the pregnant women were recorded by EDI-OCT as follows; right eye subfoveal 295.3±51.8µm, 2 mm nasal 242.4±49.2µm, 2 mm temporal 252.3±52.9µm and left eye subfoveal 298.4±66.7µm, 2 mm nasal 251.5±54.7µm, 2 mm temporal 263.6±64.3µm. The control group was recorded as follows; right eye subfoveal 307.8±64.5µm, 2 mm nasal 267.6±54.2µm, 2 mm temporal 292.9±50.9µm and left eye subfoveal 295.3±71.3µm, 2 mm nasal 269.6±63.7µm, 2 mm temporal 292.0±59.5µm. The comparison of the choroid thicknesses in the pregnant subjects and the control group shows that the thickness in the 2 mm nasal (p=0.032) and 2 mm temporal (p=0.001) areas of the right eye and 2 mm temporal (p=0.044) area of the left eye is significantly different. No significant difference was observed in the other areas (p>0.05)

Conclusions: In this study, choroidal thickness measurement with EDI OCT was found to be thinner in pregnant patients compared to similar age group.

Keywords: Choroid Thickness, Pregnancy, Optic Coherence Tomography, Retina

ÖZ

Amaç: Gebelerde ikinci ve üçüncü trimesterde artırılmış derinlik görüntüleme (Enhanced Depth İmaging –EDİ) Optik Koherens Tomografi (OKT) kullanarak koroid kalınlığı belirlemek.

Yöntemler: Bu calısmada 40 gebe ile gebe olmayan (kontrol) 40 sağlıklı kadının her iki gözü EDİ-OKT kullanarak subfoveal, 2 mm nazal, 2 mm temporal koroidal kalınlıkları değerlendirildi. Gebelerden 20' si 16-24. haftalar arası (ikinci trimester), 20' si 24-39. haftalar arası (üçüncü trimester) olarak 2 gruba ayrıldı. Yaş ortalaması gebelerde 27.4±5.8, kontrol grubunda 26.9±7.1 olarak hesaplandı.

Bulgular: Gebelerde koroid kalınlıkları EDİ-OKT ile sağ gözde subfoveal 295.3±51.8µm, 2 mm nazal 242.4±49.2µm (p=0.032); 2 mm temporal 252.3±52.9µm (p=0.001) iken sol göz ölçümlerinde subfoveal 298.4±66.7µm, 2 mm nazal 251.5±54.7µm, 2 mm temporal 263.6±64.3µm (p=0.044) olarak kaydedildi. Kontrol grubunda sağ göz subfoveal 307.8±64.5µm, 2 mm nazal 267.6±54.2µm, 2 mm temporal 292.9±50.9µm, sol göz subfoveal 295.3±71.3µm, 2 mm nazal 269.6±63.7µm, 2 mm temporal 292.0±59.5µm olarak ölçüldü. Gebe grubu ile kontrol grubu koroid kalınlığı karşılaştırıldığında sağ göz 2 mm nazal (p=0.032) ve 2 mm temporal (p=0.001) alanlar ile sol göz 2 mm temporal (p=0.044) alanda kalınlık kontrol grubunda daha yüksek olup istatistiksel olarak anlamlı fark saptanmıştır. Diğer bölgelerde fark bulunmamıştır (p>0.05).

Sonuç: Bu çalışmada gebe hastalarda benzer yaş grubu ile kıyaslandığında EDİ OKT ile yapılan koroid kalınlık ölçümünün daha ince olduğu tespit edilmiştir.

Anahtar Kelimeler: Koroid Kalınlığı, Gebelik, Optik Koherens Tomografi, Retina

Received Date: : 07.04.2019 Accepted date: 21.05.2019 Published Date:23.08.2019

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INTRODUCTION

Pregnancy is a physiological process associated with metabolic, hormonal and hemodynamic changes. The most different changes occur in the hormonal and cardiovascular systems. Estrogen and progesterone levels increase rapidly. The blood volume begins to increase in the 1st week of the pregnancy and peaks on the 3rd trimester. By this way, the peripheral vascular resistance is decreased during pregnancy in order to prevent an increase in mean arterial blood pressure [1]. In a normal pregnancy, the blood pressure decreases until the 18-20th week but then begins to increase till delivery [2,3]. Many studies show an increase in macular volume and retinal foveal thickness during the 2nd and 3rd trimester due to fluid accumulation [4]. The hemodynamic changes during the pregnancy also affect the blood stream of the choroid. The choroid is the vascular layer between the retina and sclera. The choroid is consistent of a vascular network and plays a role in ocular feeding by volume regulation and is very sensitive to variations in the blood pressure. The choroidal thickness is affected by the blood flow and perfusion pressure [5]. Various eye diseases may occur during pregnancy and certain ocular diseases such as diabetic retinopathy can worsen during this period [6]. Previous studies reported intraocular pressure (IOP) and changes in the corneal curvature during pregnancy [7]. Pregnancy is known to be a high risk factor for several ocular pathologies like central serous chorioretinopathy (CSCR) [8]. Changes were reported in the thickness of the choroid during diseases like CSCR and retinal vein occlusion [9,10]. Optic Coherence Tomography (OCT) provides a high resolution sectional digital image of living biological tissues. OCT-EDI provides choroidal imaging and allows for measurement of choroidal thickness. OCT-EDI and high penetration OCT are 2 diagnostical modes used during measurement of the choroidal thickness [11-12].

PATIENTS AND METHODS

This study was conducted in the ophthalmology clinic of the Ahi-Evran University Training Research Hospital. Eighty eyes of 40 healthy and pregnant women in week 16-39, of which 20 are in the 2nd trimester (16-24th week) and 20 are in the 3rd trimester (24-39th week) and 80 eyes of 40 healthy, non-pregnant women were included in the study. Women between the ages 18-43 with a regular menstrual cycle were included in the study as a control group. Individuals with systemic diseases like diabetes mellitus, hypertension which affect the retinal and choroidal thickness and those who had a history of a previous intra-ocular surgery were excluded from the study. Individuals with pre-eclampsia and eclampsia during the pregnancy and pregnancy diabetics as well as those with systemic connective tissue diseases or a history of a previous intra-ocular surgery were excluded. The auto-refractometer, best corrected visual acuity (BCVA), biomicroscopy and fundus examinations of all patients were performed. The choroidal thickness was measured by two ophthalmologists in the EDI mode without pupil dilation with a Heildelberg Spectral Domain OCT (Heildelberg Engineering, Germany) The choroidal thickness was measured sub-foveal from the 2-mm nasal and 2-mm temporal fovea. All measurements were performed at 09: 00-10: 00 in the morning.

Statistical Methodology

The statistical analyses were performed using the Statistics Package for Social Sciences (SPSS) soft ware version 23.0. The variables were investigated using visual (histograms, probability plots) and analytical methods (Kolmogorov-Smirnov / Shapiro-Wilk test) to determine whether or not they are normally distributed. Descriptive analyses were presented using means and standard deviations for normally distributed variables. The student's t-test was used to compare parameters between two groups. While investigating the associations between non-normally distributed variables, the correlation coefficients and their significance were calculated using the Spearman test. A p-value of less than 0.05 was considered to show a statistically significant result.

RESULTS

No difference was observed regarding age and refractive error in the pregnant and control group ($p>0.05$) (Table 1). The comparison of the choroidal thicknesses of the pregnant and control group shows that the 2 mm nasal ($p=0.032$) and 2 mm temporal ($p=0.001$) areas of the right eye and 2

mm temporal (p=0.044) area of the left eye have a statistically significant higher thickness in the control group. No significant difference was observed in the other areas (p>0.05) No statistically significant difference (p>0.05) was observed in the choroidal thickness of the pregnant subjects in the 2nd and 3rd trimester as shown in Table 2. The comparison of the choroid thicknesses between the 2nd trimester pregnant group and the control group shows a higher thickness only in the 2 mm temporal area of the right eye in the control group which is statistically significant (p=0.031). No significant difference was observed in the other areas (p>0.05) The comparison of the choroid thicknesses in the 3rd trimester pregnant women and the control group shows that the thickness in the 2 mm nasal (p=0.021) and 2 mm temporal (p=0.001) areas of the right eye and 2 mm temporal (p=0.008) area of the left eye is higher in the control group which is statistically significant. No significant difference was observed in the other areas (p>0.05).

Table 1: Means of age, choroid thickness, refractive error in pregnant women and controls

		Pregnant		Control		*P
		Mean	SD	Mean	SD	
		27.4	5.8	26.9	7.1	0.718
Refractive Error(D)	R	-0.6	1.2	-0.4	1.0	0.408
	L	-0.5	1.2	-0.4	1.1	0.641
Choroid Thickness(μ)						
Two mm nasal	R	242.4	49.2	267.6	54.2	0.032
	L	251.5	54.4	269.6	63.7	0.176
Subfovea	R	295.3	51.8	307.8	64.5	0.339
	L	298.4	66.7	295.3	71.3	0.844
Two mm temporal	R	252.3	52.9	292.9	50.9	0.001
	L	263.6	64.3	292.0	59.5	0.044

*İndependent samples T test, R: Right, L: Left Y: year, D: Dyoptry, μ: Micron, SD: Standard Deviation

In Table 3, the association between choroidal thickness, age and refractive error in the pregnant and control group was investigated. A statistically significant negative correlation (r= -0.32,p=0.041) was observed between the 2 mm nasal area thickness of the right eye and refraction error of the pregnant subjects. No relationship was observed in the other areas (p>0.05).

The investigation of the association between the choroidal thickness and age of the control group shows a negative, low level and statistically significant correlation (r=-0.35;p=0.027) between the thickness of the sub-foveal area of the right eye and age. No relationship was observed in the other areas between the choroidal thickness and age (p>0.05).

DISCUSSIONS

Pregnancy causes many physiological changes of hormonal, hemodynamic, cardiovascular, metabolic and immunologic nature which affect many systems of the woman body, including the eyes. Many studies have been made on prenatal diagnosis and diagnostic methods have been tried to be developed on it [13]. Very important cardiovascular changes occur during and after pregnancy. The blood volume and red blood cell count increases and physiological anemia develops whereas the blood pressure drops. The increase in total body volume and intra-cellular volume develops slowly [14]. Sixty five to eighty five percent of the ocular blood flow is originating from the choroid, therefore a structurally and physiologically normal choroid is important for retinal function. The thermoregulation of ocular tissues, uveascleral aqueous drainage, regulation of intraocular pressure and the waste removal of the eyes are performed by the choroid [15]. During pregnancy, non-pathological conditions occur, such as increased corneal thickness due to water retention. Changes in the choroidal thickness have been reported to occur secondary to water retention. Many anterior segment pathologies occurring due to pregnancy have been studied [16]. Many ocular pathologies related to pregnancy, such as vascular changes during pre-eclampsia, worsening of diabetic retinopathy, serous retinal detachment and CSCR occur in the posterior segment of the eye [6]. In addition to systemic diseases, the structure and thickness of the choroid is affected by different ocular pathologies, therefore analysis of the choroid structure is important [17-21]. Recent developments in the OCT technology allows for detailed analysis of the choroid. Kara et al. [22] investigated the choroidal thickness in the 15-38 weeks pregnant women and demonstrated that there is an increase in sub-foveal choroidal thickness, but they were not able to demonstrate

Table 2: Comparison of the choroid thicknesses among second trimester, third trimester Pregnant women and control

		Pregnant				Control				
		TM 2		TM 3						
		Mean	SD	Mean	SD	Mean	SD			
								TM2-TM3	TM2–Control	TM3–Control
Two mm nasal(µ)	R	249.7	56.8	235.2	40.3	267.6	54.2	0.357	0.24	0.021
	L	253.7	63.2	249.3	45.6	269.6	63.7	0.804	0.364	0.21
Subfovea(µ)	R	285.2	61.9	305.3	38.4	307.8	64.5	0.225	0.199	0.873
	L	295.4	65.5	301.4	69.5	295.3	71.3	0.78	0.998	0.756
Two mm temporal(µ)	R	259.1	64.6	245.5	38.2	292.9	50.9	0.421	0.031	0.001
		280.5	65.0	246.8	60.6	292.0	59.5	0.098	0.496	0.008

*İndependent samples T test TM: Trimester, R: Right, L: Left .µ: Micron, SD: Standard Deviation

Table 3. Correlation between age ,refractive error and Choroid thickness in the pregnant and control groups

CORRELATION		Pregnant		Control	
		r	p	r	p
AGE*					
Two mm nasal	R	0.06	0.735	-0.03	0.868
	L	-0.07	0.648	-0.11	0.513
Subfovea	R	-0.05	0.753	-0.13	0.425
	L	0.03	0.857	-0.35	0.027
Two mm temporal	R	-0.03	0.866	0.03	0.845
	L	-0.14	0.377	-0.31	0.052
RİGHT REFRACTİVE**(D)					
Two mm nasal	R	-0.32	0.041	0.14	0.391
Subfovea	R	0.09	0.582	0.06	0.729
Two mm temporal	R	-0.20	0.228	0.04	0.817
LEFT REFRACTİVE(D)					
Two mm nasal	L	0.17	0.291	0.12	0.449
Subfovea	L	0.20	0.222	0.06	0.729
Two mm temporal	L	0.01	0.955	0.04	0.817

*Spearman Test , R: Right, L: Left, r: Range, D: Dyoptry

a significant difference between gestational age and choroidal thickness. Sayın et al. [23] reported that subfoveal choroidal thickness was significantly thicker in pregnant women than in nonpregnant women. However Takahashi et al [24] showed no difference in choroidal thickness between pregnant women and non-pregnant women. We were not able to demonstrate a statistically significant difference in choroidal thickness of 2nd and 3rd trimester pregnant subjects, but the comparison of the choroidal thickness between the 2nd trimester pregnant subjects and the control group shows that only the 2 mm temporal area thickness of the right eye of the control group was higher in a statistically significant manner, whereas the comparison of the choroidal thickness between the 3rd trimester pregnant subjects and the control group shows that 2 mm nasal and 2 mm temporal area thickness of the right eye and the 2 mm temporal area thickness of the left eye of the control group was higher in a statistically significant manner. Ulusoy et al. [25] investigated the sub-foveal choroid thickness during and after pregnancy and found a statistically significant increase in the sub-foveal choroid thickness of pregnant women.

Choroidal thickness, in addition to systemic diseases like diabetes, is affected by ocular pathologies such as choroidal neo-vascular membrane, uveal effusion syndrome, CSCR, Vogt-Koyanagi-Harada, angioid streaks and polypoidal choroidal vasculopathy [17-21]. High refraction and age affect the choroidal thickness [12,13]. A negative, low level, statistically significant correlation was observed in our study between the 2 mm nasal area thickness of the right eye and refractive error

of pregnant women. Also, no relationship was observed between choroidal thickness and age. This might be due to the close ages of our subjects.

The investigation of the relationship between the choroid and age of the control group shows a negative, low level and statistically significant correlation between the thickness of the sub-foveal area of the right eye and age. Also, no relationship was observed between choroidal thickness and refractive error. Our study had several limitations. Firstly, we did not know the choroidal thickness of the pregnant subjects before their pregnancy. Secondly, we were not able to measure the ocular blood flow.

As a result, no increase in choroidal thickness was observed in 2nd and 3rd trimester pregnant women in comparison to healthy women.

Funding sources: There is no any source of funding or financial interest in this study.

Conflict of Interest: The authors have no conflicts of interest relevant for this article.

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How to cite this article/Bu makaleye atıf için:
Kocamış Ö, Songur Dağlı S. Choroid thickness measurement in second and third trimester pregnants by enhanced depth imaging optical coherence tomography. Acta Med. Alanya 2019;3(2):159-163 doi:10.30565/medalanya.550500