The Effects of Cyclopentolate Between Adults and Children; Scheimpflug and OCT Imaging Study

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Öz

Amaç Siklopentolatın kullanımının ön kamera ve arka göz yapılarına olan etkilerinin erişkin ve çocuk yaş gruplarında kıyaslanması.

Metod Çalışmaya 65 hastanın 65 gözü alındı. 16 yaştan büyük katılımcılar erişkin grubunu oluşturuken, 16 yaştan küçük olanlar çocuk grubunu oluşturdu. Siklopentolat uygulaması öncesi ve sonrası katılımcılara ait sferik eşdeğerleri, göz içi basınçları, ön kamera derinliği, ön kamera hacmi, pupil çapı, merkezi makula kalınlığı, merkezi makula hacmi, tüm makula hacmi, merkezi makular koroid kalınlığı ölçüldü. Çıkan değerler, SPSS proğramı kullanılarak, gruplara göre analiz edildi.

Bulgular Ön kamera değişiklikleri açısından gruplar arasında anlamlı fark bulunmadı. Macular koroid kalınlığ her ki grupta da incelme göstermesine karşın bu incelme çocuk grubunda anlamlı olarak daha belirgindi. Merkezi makula kalınlığı, erişkin grubunda istatistiksel anlamlı fark göstermezken; çocuk grubunda anlamlı olarak daha kalın bulundu. Merkezi makula hacmi ve tüm makula hacmi her iki grupta da fark göstermedi.

Sonuç Ön kamera verileri göz önüne alındığında ilaç uygulamasında benzer etkiler oluştu. Merkezi makula kalınlığı erişkin grubunda fark göstrmezken, çocuk grubunda istatistiksel anlamlı olarak kalın bulundu. Merkezi makular koroid kalınlığı her iki grupta incelmesine ragmen, bu incelme çocuk grubunda daha belirgindi.

Anahtar Kelimeler Siklopentolat, Çocuk, Erişkin, Ön Kamera, Retina

Abstract

Object To compare the effects of cyclopentolate on the anterior and posterior ocular structures in age groups between adults and children.

Methods The study included 65 eyes of 65 participants. The ''children group'' consisted of participants below the age of 16 and the ''adult group'' consisted of participants at the age of 16 or older. Spheric equivalent(SE) values, intraocular pressure(IOP) values, anterior chamber depth(ACD), anterior chamber volume(ACV), pupil diameter(PD), central macular thickness(CMT), central macular volume(CMV), total macular volume(TMV), central subfoveal choroidal thickness(CSCT) were measured for each participant before the application of cyclopentolate. Obtained values were assessed for in-groups and between-groups by using the SPSS.

Results There was no statistical significance in terms of anterior chamber changes between groups. CSCT in posterior ocular structures displayed thinness in both groups but this thinning was statistically significantly higher in the children group. In CMT, while there was no change in the adult group, a statistically significant thickening was observed in the children group. It was also observed no significant changes in CMV and TMV.

Conclusion Cyclopentolate had similar effects in adult and pediatric age groups in terms of anterior chamber changes. There was an increase in CMT in pediatric group whereas no change in adult group. A decrease was observed in CSCT value. It was seen that effects of study drug on choroidal thickness was more prominent in pediatric age group.

Keywords: Cyclopentolate, Children, Adult, Anterior Chamber, Retina

Introduction

Mydriatics lead mydriasis by influencing on iris sphincter and dilator muscles.[1] Cyclopentolate, a mydriatic agent, cause mydriasis and cycloplegia by its anti-muscarinic (parasympatholytic) effect; thus, it is indispensable in the refraction testing of children. In addition, it is frequently used in routine ocular examination, preoperative preparation and to prevent synechia in uveitis. It has shorter duration of action when compared to atropine, the prototype of anti-muscarinic agents; thus, it is commonly used in clinical practice.[2]

Various changes occur while the drug exerts its mydriatic and cycloplegic effects.[3] Ocular tissues accounting for some diagnoses and calculations alter with drug use, including anterior chamber depth and angle, corneal thickness. For these diagnoses and calculation, it is important to know whether these changes are statistically significant. In addition, several changes occur in retinal and choroidal structures. In particular, changes related to choroidal structures have distinct consequences.[4-7]

There are drug studies investigated either anterior chamber or posterior segment alone.[4,5,6,8] Available studies involve certain age groups.[9,10] However, to best of our knowledge, there is no study assessing both anterior chamber and posterior segment in adults and children. For this purpose, changes in pupil diameter (PD), spherical equivalent (SE), intraocular pressure (IOP), corneal thickness, corneal volume, anterior chamber depth (ACD), anterior chamber volume (ACV), central macular thickness (CMT), central macular volume (CMV), total macular volume TMV and central subfoveal choroidal thickness (CSCT) were investigated in both adult and pediatric age groups in our study.

Methods

This was designed as a randomized, double-blinded study including a single eye of participants. The study followed the tenets of the Declaration of Helsinki and was approved by the Local Ethics Committee. All individuals received both oral and written information about the study, and each was provided written and informed consent before participation to the study.

All individuals underwent a screening process involving a complete ophthalmologic examination, including visual acuity and refraction, slit-lamp biomicroscopy, fundus examination, and IOP measured using non-contact tonometry. Axial length (AL) was measured using an IOL Master (Carl Zeiss Meditec, Dublin, CA). Anterior chamber parameters were measured using a Pentacam rotating Scheimpflug camera (Oculus, Wetzlar, Germany). The retina nerve fiber layer and choroidal thickness measurements were obtained through the Spectralis OCT (Heidelberg Engineering, Heidelberg, Germany).

All individuals required a best corrected visual acuity of 20/25 or better, with refractive error less than 5 diopters, 3 diopters of cylinder, and absence of glaucomatous optic disc changes. Exclusion criteria included any retinal diseases, history of ocular injury or surgery, any reasons for poor image quality of OCT such as unstable fixation or severe cataract.

A hundred and thirty eyes of 65 individuals satisfying the inclusion criteria were enrolled in the study between May 2015 and Augst 2015. Both eyes were enrolled, and one eye of each indivi-

dual was randomly selected. All individuals were assigned into 2 groups based on the application of age. The ''children group'' consisted of participants below the age of 16 and the ''adult group'' consisted of participants at the age of 16 or older. All individuals received a drop of of cyclopentolate 1% 3 times at 10 min intervals.

For each subject, corneal thickness, ACD, corneal volume, anterior chamber angle, corneal curvature, and ACV were obtained through Pentacam (Oculus, Wetzlar, Germany) before and after instillation of drops.

Procedure of Image Acquisition; Following the detailed ophthalmologic examination, the Spectralis domain (SD) OCT device (Spectralis OCT Heidelberg Engineering, Dossenheim, Germany) was used for the assessment of the retina. The SD-OCT assessments involved in the study were performed by the same experienced technician. The macula were performed using an internal fixator. During the assessments,macular thickness and volume analysis was used. The procedure of obtaining EDI-OCT has been previously described.11 The subfoveal choroidal thicknesses (CSCT) were measured by using spectral-domain OCT (Spectralis, Wave-length: 870 nm; Heidelberg Engineering Heidelberg, Germany) with EDI modality. CSCT were defined as the vertical distance from the hyperreflective line of Bruch's membrane to the hyper-reflective line of the inner surface of the sclera. All subjects were imaged by the same experienced tecnician. Two independent clinicians (İ.Y. and E.P.) measured CSCT, and the average of these measurements was used in the analysis in a masked fashion without knowledge of information of the subjects and the mean values were recorded. EDI-OCT images of each subject were obtained before the administration of drops and 60 min after instillation. All scans were performed around the same time of the day, between 11:00-12:00, to minimize the possibility of CSCT changes attributable to diurnal CSCT fluctuations.[12]

Statistical analysis; All statistical analyses were performed by using SPSS for Windows version 22.0 software (SPSS, Inc, Chicago, IL, USA). Continuous variables were presented as mean ± standard deviation. The Pearson chi-square test was used to evaluate qualitative variables. Normal distribution was evaluated by using Kolmogorov-Smirnov test. Homogeneity of variances was tested by using Levene's test. For parametric statistics, data with normal distribution were analyzed by using paired-samples t-test and independent samples t-test. Non-parametric statistical data were assessed by using Wilcoxon signed-ranks test and Mann-Whitney U test. A P value < 0.05 was considered as statistically significant.

Results

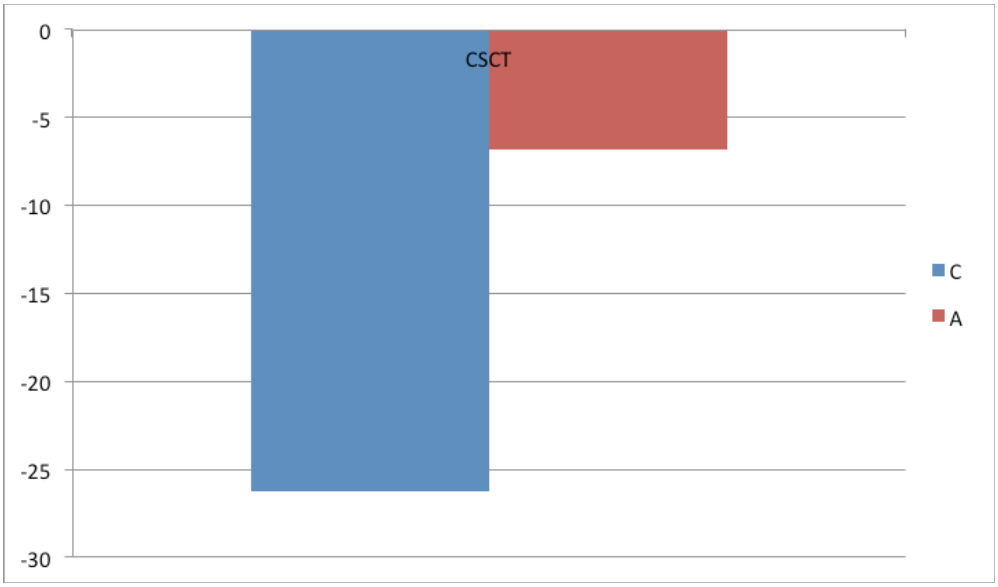
There were 33 adult and 32 pediatric patients in the present study. Mean age was calculated as 32.45 years (18-54) in the adult group and 11.56 years (8-15) in the children group. The mean axial length (AL) was 23.32 ± 0.65 mm in adult group and was 23.43 ± 0.77 mm in children group. The changes of ocular structures in children and adult groups are shown in detail in Table 1.

When adult and children group were compared, no significant difference was observed in terms of changes in SE (p=0.15), IOP (p=0.14), PD (p=0.38), ACD (p=0.23), ACV (0.79), CMV (0.07), CMV (p=0.53) and TMV (p=0.21) before and after drug use. The effect of drug on CSCT was found to be more prominent in children (p=0.014). (Figure 1 shows the CSCT changes).

Table 1: Ocular changes before and after cyclopentolate application

	Adult Group (n=33)			Children Group (n=32)		
	B	A	p	B	A	p
SE	-0.64±1.34	-0.12±1.08	0.004	-0.65±1.18	-0.05±1.05	0.04
IOP	14.75±2.37	14.00±2.68	0.036	15.34±3.46	14.59±2.69	0.036
ACV	166.90±34.11	193.00±40.90	<0.01	194±31.91	213±29.88	0.00
ACD	2.97±0.33	3.09±0.31	0.01	3.16±0.24	3.32±0.23	0.00
PD	3,13±0.61	6,56±0.63	<0.01	3.54±0.81	7.10±0.47	0.00
CMV	0.2±0.01	0.2±0.01	>0.05	0.21±0.01	0.21±0.01	0.78
TMV	8.79±0.2	8.78±0.2	>0.05	8.85±0.41	8.85±0.42	0.89
CSCT	322.36±88.82	313.57±90.64	0.018	308.40±96.44	289.21±95.51	0.00
CMT	259.33±12.97	259.54±14.65	>0.05	266.90±21.35	271.03±22.86	0.01

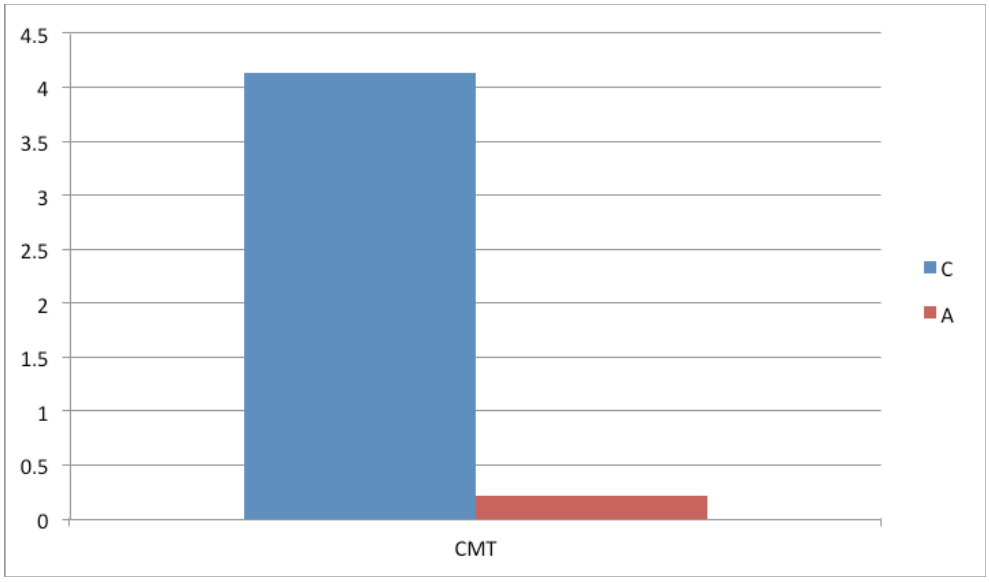
Abbreviations; B: before, A: after, SE: spheric equivalan, IOP: intraocular pressure, ACV: anterior chamber volume, ACD: anterior chamber depth, PD: pupil diameter, CMV: central macular volume, TMV: total macular volume, CSCT: central subfoveal choroidal thickness, CMT: central macular thickness



Abbreviations; CSCT: central subfoveal choroidal thickness, C: children, A: adult

Figure 1; CSCT thickness changes between adult and children group

No significant difference was detected in CMT change in adult patients while significant increase was detected in pediatric patients (p=0.006). (Figure 2 shows the CMT changes)



Abbreviations; CMT: central macular thickness, C: children, A: adult

Figure 2; CMT thickness changes between adult and children group

Discussion

Cyclopentolate is commonly used in clinical practice because of its mydriatic and cyclopegic effects. By these effects, the drug leads a number of changes in depth, volume and angle of anterior chamber, iris thickness, lens thickness and choroidal thickness.[13-15] Some of these parameters (i.e. corneal thickness for adjusted intraocular pressure or anterior chamber depth for intraocular lens) are used for descriptions and calculations in clinical practice. Thus, understanding of the changes after drug is important when performing these calculations.

Findings of a study [8] in which changes in anterior chamber were evaluated by using cyclopentolate, are similar to our results. In that study[8], ACD value increased from 3.08 to 3.19 while ACV value from 183.64 to 190.96. In addition SE value increased from -0.71 to 0.21. All changes were found to be significant in that study. Besides, on the contrary to this study, there was no control group in our study and values obtained with drug were compared to those before drug use.8 In addition, a pediatric group was employed for further comparison. In addition, CMT, CMV, TMV and CSCT values were also evaluated in our study.

In a study using cyclopentolate on pediatric patients, ACD and ACV values were increased while CCT value was decreased 45 minutes after cyclopentolate use.[9] In our study, ACD and ACV values were significantly increased after drug use. In addition, on the contrary to this study [9], no significant change was observed in CCT value. Corneal volume analysis employed is supportive for this finding. These discrepancies may result from sensitivity of equipments used as well as individual variations. In that study, authors attributed this effect to decrease in tear caused by drug. It is apparent that there may be individual differences. On the contrary to this study, conducted on adult patients by using a mydriatic agent with similar mechanism of action, found an increase in CCT.[16]

According to another study, no significant difference in corneal thickness is observed for adults.[8] As measurements of thickness employ certain points, there may be angular alteration due to focusing; thus, corneal volume can be a better marker. In our study, similar to corneal thickness, there was no significant change in corneal volume. Further studies are needed in this issue.
In our study, IOP values were decreased significantly after drug use. In previous publications on this topic, there are studies reporting increase or no change in IOP, although it is generally reported to be increased after use of a mydriatic agent.[17,18] Narrow or wide angles or flatness or convexity of iris can be determining in IOP changes. The change in IOP occurs as a sum of effects of drug on all intraocular tissue rather than its effects on a single point; thus, individual variations are inherent. In a study, using homatropine, no significant difference was detected in the first measurement after 30 minutes; however, mean elevation of 1 mmHg was observed after 60 minutes.[6] In our study, measurements were performed 50 minutes after application of drug and a decrease by approximately -0.75 mmHg was observed. In addition, no significant difference was found in effect size between adults and children.

In our study, anterior chamber volume showed increase in both groups after use of study drug. No significant difference was detected in intra-group comparison. In previous studies, anterior chamber volume was found to be increased in both adults and children.[9,10] Our results are in agreement with previous studies. This difference seems to be resulted from posterior displacement of lens diaphragm and thinning of lens.

When change in SE values were evaluated, hypermetropic shift was observed in both groups. The result was found to be statistically significant. However, the difference between groups didn't reach statistical significance. Assuming that ability of accommodation becomes poorer by time, this result seems to be discrepant. Lower mean age (32.45 years) in adult group and higher prevalence of myopia in the study population (mean SE value was -0.64D in adults and -0.65 D in children) might have effect in this result. In agreement with our study, hypermetropic shift in adults is found in the aforementioned study, as well.[8]

It has been reported that choroidal fluid is discharged by constriction of non-vascular smooth muscles after mydriatic use, which may result in choroidal thinning.[19-21] Again, dominant parasympathetic effect in choroidal vasculature causes vasodilatation; however, cyclopentolate cause parasympatholytic effect.[22]

In addition, events such as posterior displacement of lens diaphragm and increased anterior chamber depth can cause somewhat choroidal thinning. In previous studies, there are discrepant findings with some studies suggesting choroidal thickening/thinning and some others suggesting no change in choroidal thickness by mydriatic use.[4-6] In our study, increased CMT and choroidal thinning in were found in pediatric patients while choroidal thinning and no change in CMT were found in adult patients. No significant change was observed in CMV and TMV in both groups. When pediatric and adult patients were compared, it was seen than there was significantly more choroidal thinning in pediatric patients than adults. Since there is no choroidal measurement in pediatric age group for comparison, it is needed to be supported by further studies. There are publications reporting choroidal thinning in adults with use of cycloplegin and/or other mydriatic agents. Our results are in agreement with literature. It is shown that choroidal become thinner by time.[23,24] The proportional

difference between groups might be resulted from this fact. Moreover, it is thought that posterior penetration, effect and degradation process of the drug may show alteration by age. Thus, further studies are needed to support these findings. No significant difference was detected in CMT measurements in adult patients although it showed significant change in pediatric age group. This might be due to leakage of fluid to tissues which is discharged during constriction of choroidal structures as a result of drug effect. On contrary, no significant increase was detected in CMV and TMV. Lack of such effect in adults might be due to inadequate compliance to measurement in children. Nevertheless, it is possible to cause changes in CMT only in tissues where measurements are performed at micron level.

Our study has some limitation. First, more meaningful results could be obtained in the assessment of posterior structures if pediatric age group included younger children. This resulted from difficulty in cooperation of younger children regarding examination and measurements. Second, sample size might be larger.

In conclusion, cyclopentolate had similar effects in adult and pediatric age groups. In our study, there were increased in SE, ACD, ACV and choroidal thickness whereas decrease in IOP value after use of study drug. No significant differences were detected in CT, CMV and TMV values. There was an increase in CMT in pediatric group whereas no change in adult group. A decrease was observed in CSCT value. It was seen that effects of study drug on choroidal thickness was more prominent in pediatric age group. However, no difference was observed in effect direction. Further studies are needed on this topic.

Conflict of Interests; The authors declare no conflict of interests.

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