

Ciliary Body Thickness Measurement with Ultrasound Biomicroscopy Following Transscleral Diode Laser Cyclophotocoagulation

Transskleral Diod Lazer Siklofotokoagülasyon Sonrası Silier Cisim Kalınlığının Ultrason Biyomikroskopi ile Değerlendirilmesi

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ABSTRACT

Purpose: To evaluate ciliary body thickness and compare with healthy eyes of the same subjects with ultrasonic biomicroscopy in refractory glaucoma patients treated with transscleral diode laser cyclophotocoagulation therapy.

Materials and Methods: The study group consisted of 8 patients (3 females, 5 males) who had transscleral diode laser cyclophotocoagulation (TDLC) therapy one year ago and responded to treatment successfully. Patients had refractory glaucoma unilaterally and the fellow eyes were healthy. One year after the TDLC treatment application, ciliary body thickness in treated eyes and in fellow eyes were compared with ultrasound biomicroscopy (UBM). UBM was performed to obtain measurements of ciliary body thickness at 1 mm (CBT1) and 2 mm (CBT2) posterior to the scleral spur.

Results: The mean pretreatment IOP was 44.7±12.1 mmHg which reduced to 15.2±5.3 mmHg at 1 year follow-up. The mean CBT1 and CBT2 values in the eyes which had diode laser treatment were 0.98±0.14 mm and 0.48±0.11 mm, respectively. The mean CBT1 and CBT2 values in the nontreated eyes were 1.21±0.07 mm and 0.60±0.13 mm, respectively (p=0.002 and 0.027, respectively). The CBT measurements at 1 mm and 2 mm in the nontreated eyes were significantly higher compared to glaucomatous eyes (p<0.005).

Conclusion: Ultrasound biomicroscopy can be used to evaluate the effects of TDLC on ciliary body.

Key Words: Ciliary body thickness, transscleral diode laser cyclophotocoagulation, ultrasound biomicroscopy.

ÖZ

Amaç: Dirençli glokomu olan hastalarda transskleral diod lazer siklofotokoagülasyon ile tedavi sonrası silier cisim kalınlığının ultrason biyomikroskopi (UBM) ile değerlendirilmesi ve aynı hastaların sağlam gözleri ile karşılaştırılması.

Gereç ve Yöntem: Çalışmaya bir gözü sağlam diğer gözünde ise dirençli glokomu olan ve bir yıl önce yapılan transskleral diod lazer siklofotokoagülasyon uygulamasına iyi yanıt veren 8 hasta (3 erkek, 5 kadın) dahil edildi. Tedavi edilen gözde ve sağlam gözdeki silier cisim kalınlıkları bir yıllık takip sonrası ultrason biyomikroskopi ile karşılaştırıldı. Silier cisim kalınlık (SCK) ölçümleri skleral spurun 1 mm (SCK1) ve 2 mm (SCK2) gerisinden yapıldı.

Bulgular: Tedavi öncesi ortalama 44.7±12.1 mmHg olan göz içi basıncı tedavi sonrası bir yıllık takipte 15.2±5.3 mmHg düzeyine geriledi. Tedavi edilen gözde ortalama SCK1 ve SCK2 değerleri sırasıyla 0.98±0.14mm ve 0.48±0.11mm iken sağlam gözde 1.21±0.07 mm ve 0.60±0.13mm idi (p=0.002 ve p=0.027, sırasıyla). Sağlam gözlerde 1 mm ve 2 mm mesafeden yapılan silier cisim kalınlık ölçümleri glokomatöz gözlerle göre daha yüksek izlendi (p<0.005).

Sonuç: Ultrasonik biyomikroskopinin transskleral diod lazer siklofotokoagülasyonun silier cisim üzerindeki etkisinin değerlendirilmesinde kullanışlı olabileceği düşüncesindeyiz.

Anahtar Kelimeler: Silier cisim kalınlığı, transskleral diod lazer siklofotokoagülasyon, ultrasonik biyomikroskopi.

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Geliş Tarihi - Received: 24.03.2015

Kabul Tarihi - Accepted: 23.07.2015

Glo-Kat 2016;11:44-47

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INTRODUCTION

Cyclodestructive procedures are considered as an alternative treatment for eyes with glaucoma refractory to traditional filtering surgery or tube shunt implantation. These procedures lower IOP by destruction of ciliary body epithelium and stroma therefore reducing aqueous humour production.¹ Histologic and transmission electron microscopic studies showed coagulation necrosis, destruction of the ciliary epithelium, pigment dispersion in the ciliary body stroma and eventually ciliary body atrophy.² Penetrating cyclodiathermy and cyclocryotherapy were the first described procedures, but they have been replaced by other techniques, especially laser cyclophotocoagulation with Nd:YAG or diode laser systems.³

Transscleral diode laser cyclophotocoagulation (TDLC) has become popular in the 1990s and took place cyclocryotherapy and Nd:YAG laser method, due to comparable efficacy, increased safety and tolerability.⁴ In many published studies, the success rate has been reported between 36.7%-94.4% in different glaucoma types.^{5,6}

The purpose of this study was to evaluate ciliary body thickness (CBT) with ultrasound biomicroscopy (UBM) among the patients with unilateral refractory glaucoma that underwent TDLC therapy and responded to treatment and compare these measurements with nontreated eyes of the same subjects.

MATERIALS AND METHODS

16 eyes of 8 patients that had undergone TDLC one year ago and responded to treatment enrolled in this cross-sectional study. Retrospective review of patient charts were performed. This study was conducted at Hafsa Sultan Hospital. The medical ethics committee of the Celal Bayar University Faculty of Medicine had approved the study protocol and all participants had given informed consent. Research was carried out in accord with the Declaration of Helsinki. All of the patients included in this study had unilateral refractory glaucoma and the fellow eyes were non-glaucomatous. One year after the TDLC treatment application, ciliary body thickness in treated eyes and in fellow eyes were compared with UBM.

Treatment was conducted under local anaesthesia (retrobulbar injection of mixture of 2% lidocaine hydrochloride and 0.5% bupivacaine) using the continuous-wave semiconductor diode laser (810nm) and the fiberoptic Iris G-probe (OcuLight SL, IRIS Medical Instruments, Mountain View, CA), (Figure 1). In the treatment protocol ciliary body was treated 270°, 3 and 9 o'clock meridians and superonasal quadrants were spared. The energy delivery started at 1500mW and 1500ms and was increased by 250 mW until audible 'pops' were heard. Then energy was reduced by 250 mW until 'pop' sounds were no longer audible and the treatment was completed under these parameters.

Steroid (prednisolone acetate 1%) and cycloplegic eye drops were used and preoperative glaucoma medication continued. Follow-up examinations were performed on the first day, after 1 week, 6 weeks, 3 months, 6 months, 9 months, and 12 months. Treatment was defined as success if IOP was reduced to 5-21 mmHg with or without additional antiglaucoma eye drops.



Figure 1: Application of transscleral diode laser cyclophotocoagulation with G probe handpiece.

UBM was performed with a 35-MHz transducer-probe (VuMax 2 Ultrasound Biomicroscope, Sonomed, NY, USA). All the scanning was performed in supine position with an immersion technique under cycloplegia (cyclopentolate 1%) by the same operator (S.E). After instillation of topical 0.5% proparacaine, a scleral shell was inserted between eyelids, polyacrylic acid gel was applied on cornea and scleral shell was filled with physiological saline. UBM probe was applied perpendicularly to the surface of the globe. The CBT measurements were performed on the image of a meridional section at the valley between ciliary processes, 1 mm and 2 mm posterior to the scleral spur as previously described.^{7,8}

The UBM images were obtained bilaterally from three oblique quadrants (inferior nasal, inferior temporal, superior temporal) and superonasal quadrants were excluded. Thickness of the ciliary body was measured three times at a distance of 1 mm (CBT1) and 2 mm (CBT2) posterior from the scleral spur in these three quadrants. CBT was measured as the length of the lines perpendicular to the local curvature of the sclera, and then the other end was extended toward the ciliary pigmented epithelium (Figure 2). Afterwards largest one of three measurements for each distance of CBT1 and CBT2 in three oblique quadrants was selected, and average of these three measurements was accepted as mean CBT thickness. The mean of these three measurements was used for the statistical analysis. The measurements were performed with the instrument's built-in caliper software package.

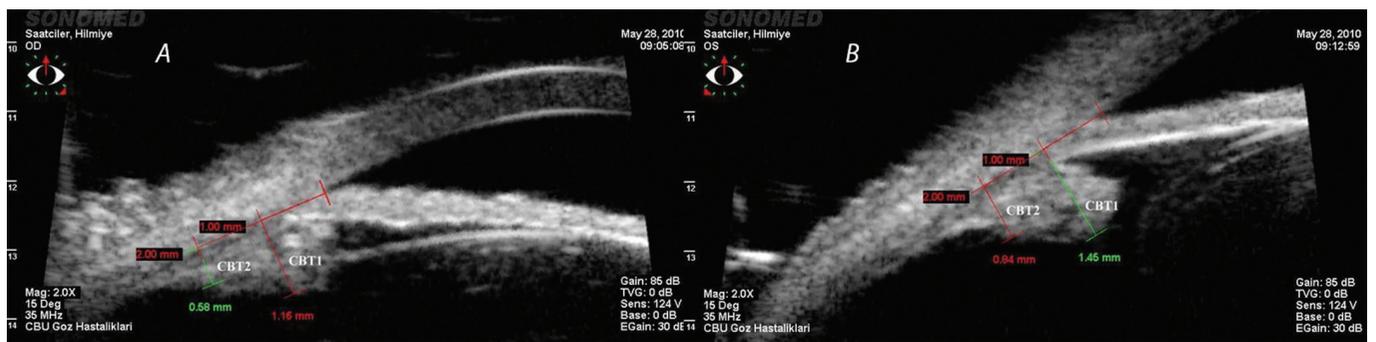


Figure 2: UBM images of the ciliary bodies of both eyes. A; treated eye B; normal eye. CBT was measured as the length of the lines perpendicular to the local curvature of the sclera.

Statistical analyses were performed with SPSS for Windows version 12.0 program (SPSS, Inc, Chicago, IL, USA). All data were reported as means \pm standart deviation. Variables in groups was determined by the Sahpiro-Wilk test. Since the test did not show normal distribution patern, for comparison of ciliary body thickness at 1 mm and 2 mm measurements between study groups, Mann-Whitney U test was used. A value of $P < 0.05$ was considered statistically significant.

RESULTS

The study group consisted of 8 patients (3 females, 5 males) with a mean age of 59.7 ± 13.0 (46-79) years. Three eyes had primary open angle glaucoma, two eyes had primary closed angle glaucoma, two eyes had traumatic glaucoma, one eye had neovascular glaucoma. The mean pretreatment IOP was 44.7 ± 12.1 mmHg which reduced to 15.2 ± 5.3 mmHg at one year follow-up.

The mean CBT1 and CBT2 values in the eyes which had diode laser treatment were 0.98 ± 0.14 and 0.48 ± 0.11 mm, respectively. The mean CBT1 and CBT2 values in the nonglaucomatous eyes were 1.21 ± 0.07 mm and 0.60 ± 0.13 mm, respectively. The CBT measurements at 1 mm and 2 mm in the nonglaucomatous eyes were significantly higher compared to glaucomatous eyes ($p = 0.002$ and 0.027 , respectively).

DISCUSSION

Diode laser cyclophotocoagulation is widely used for the management of refractory glaucoma. The infrared light (wavelength 810nm) is applied transsclerally and is absorbed by the pigmented epithelium of the ciliary body. This results in destruction of the ciliary body epithelium and vascular supply of the ciliary body and coagulation necrosis of the ciliary body stroma.²

Ultrasound biomicroscopy provides high-quality and real-time images of the anterior segments of an eye, including structures not seen with gonioscopy.^{9,10} UBM demonstrates the ciliary body and the structures nearby. It can be used to demonstrate early and late ciliary body alterations after TDLC, to locate the position of the ciliary body and ciliary body residuals

for retreatment and to rule out scleral damage after the procedure.¹¹ Ciliary body thickness can also be evaluated with UBM. In recent studies different parameters such as relation with CBT and refractive errors effect of latanoprost or pilocarpine drops on CBT, effect of SLT on CBT has been investigated; but to the best of our knowledge the effect of TDLC on CBT has not been investigated with UBM yet.¹²⁻¹⁷

One of the studies which evaluated the effects of TDLC on the anterior segment was done with Orbscan.¹⁸ In this study corneal topography, central corneal thickness (CCT) and anterior chamber depth (ACD) was evaluated with The Orbscan II system before and after laser treatment. They found no significant alteration on corneal topography or ACD; but CCT increased during the 10 days after TCDLC and returned to normal at 1 month; which was explained by the inflammation induced by TDLC.

Müller et al evaluated the effects of TDLC with contact optical coherence tomography (OCT).¹⁹ The OCT images were taken immediately before and after laser treatment. They found a marked increase of reflectivity in the treated area of the ciliary body after cyclophotocoagulation. While scleral thickness increased slightly, ciliary body thickness remained unchanged. They didn't find any difference in CBT, but the results of this study showed the changes in the ciliary body in the early term.

Our study showed one year follow-up of changes in the ciliary body structure after TDLC. UBM was not available in our clinic before diode laser treatments, therefore we did not have pretreatment values of the same eyes which is a limitation of the study. We compared the treated eye with the patient's fellow healthy eye. As expected, CBT measurements were found significantly thinner in the eyes treated with TDLC.

In a histologic study it has been showed that there is significant atrophy of the ciliary muscle with increasing age.²⁰ In our study since we measured CBTs bilaterally, the probable effect of individual variability and age were prevented.

In addition, to eliminate ciliary body configuration changes during accommodation, we made our measurements under cycloplegia.¹⁶ On the other hand, since unilateral refractory glaucoma is a rare clinical condition the number of patients in our study was limited.

Assessment of ciliary body is difficult due to irregular structure and equipments high frequency per second rate makes the image change on every slide.¹⁷ We obtained at least three measurements of the same area and compared them. We measured CBT on the image which ciliary body has the thickest measurement. Previous studies showed that the intraobserver reproducibility was high but interobserver reproducibility was variable.⁹ To overcome this effect, all measurements were done by the same person.

In conclusion, UBM clearly demonstrates the resultant effects of diode laser energy which destroys the ciliary body and causes structural changes. It would be very exciting to estimate dose-response relations by the help of UBM in glaucoma cases under TDLC treatment.

REFERENCES/KAYNAKLAR

1. Noecker RJ, Kelly T, Patterson E, et al. Diode laser contact transscleral cyclophotocoagulation: getting the most from the G-probe. *Ophthalmic Surg Lasers Imaging*. 2004;35:124-30.
2. Schlote T, Beck J, Rohrbach JM. et al. Alteration of the vascular supply in the rabbit ciliary body by transscleral diode laser cyclophotocoagulation. *Graefe's Arch Clin Exp Ophthalmol*. 2001; 239:53-8.
3. Agrawal P, Dulku S, Nolan W, et al. The UK National Cyclo-diode Laser Survey. *Eye (Lond)*. 2011;25:168-73.
4. Iliev ME, Gerber S. Long-term outcome of trans-scleral diode laser cyclophotocoagulation in refractory glaucoma. *Br J Ophthalmol*. 2007;91:1631-5.
5. Ishida K. Update on results and complications of cyclophotocoagulation. *Curr Opin Ophthalmol*. 2013;24:102-10.
6. Ramli N, Htoon HM, Ho CL, et al. Risk factors for hypotony after transscleral diode cyclophotocoagulation. *J Glaucoma*. 2012;21:169-73.
7. Pavlin CJ, Harasiewicz K, Sherar MD. Clinical use of ultrasound biomicroscopy. *Ophthalmology*. 1991;98:287-95.
8. Pavlin CJ, Harasiewicz K, Foster FS. Ultrasound biomicroscopy of anterior segment structures in normal and glaucomatous eyes. *Am J Ophthalmol*. 1992;113:381-9.
9. Lin Z, Mou DP, Liang YB, et al. Reproducibility of anterior chamber angle measurement using the tongren ultrasound biomicroscopy analysis system. *J Glaucoma* 2014;23:61-8.
10. Dada T, Gadia R, Sharma A, et al. Ultrasound biomicroscopy in glaucoma. *Surv Ophthalmol*. 2011;56:433-50.
11. Brancato R, Carassa RG. Value of ultrasound biomicroscopy for ciliodestructive procedures. *Curr Opin Ophthalmol*. 1996;7:87-92.
12. Bailey MD, Sinnott LT, Mutti DO. Ciliary body thickness and refractive error in children. *Invest Ophthalmol Vis Sci*. 2008;49:4353-60.
13. Oliveira C, Tello C, Liebmann JM, et al. Ciliary body thickness increases with increasing axial myopia. *Am J Ophthalmol*. 2005;140:324-25.
14. Muftuoglu O, Hosal BM, Zilelioglu G. Ciliary body thickness in unilateral high axial myopia. *Eye*. 2009;23:1176-81.
15. Marchini G, Ghilotti G, Bonadimani M, et al. Effects of 0.005% latanoprost on ocular anterior structures and ciliary body thickness. *Journal of Glaucoma*. 2003;12:295-300.
16. Arakawa A, Tamai M. Ultrasound biomicroscopic analyses of the human ciliary body after 1 and 2% pilocarpine instillation. *Ophthalmologica*. 2000;214:253-9.
17. Aykan U, Salcan I, Yildirim O, et al. Selective laser trabeculoplasty induced changes in the thickness of ciliary body and iris evaluated by ultrasound biomicroscopy. *Graefes Arch Clin Exp Ophthalmol*. 2011;249:887-94.
18. Arıkan G, Yaman A, Ozbek Z, et al. Effect of diode laser cyclophotocoagulation on the anterior segment an orbscan study. *Cornea*. 2008;27:152-5.
19. Müller M, Winter C, Hüttmann G, et al. Evaluation of cyclophotocoagulation effects with 1310-nm contact optical coherence tomography. *Current Eye Research* 2007;32:171-6.
20. Tamm S, Tamm E, Rohen JW. Age-related changes of the human ciliary muscle: a quantitative morphometric study. *Mech Ageing Dev* 1992;62:209-21.