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Biometric and Refractive Changes after Trabeculectomy with Mitomycin C
การเปลี่ยนแปลงค่าไบโอเมตริกของลูกตาและค่าสายตาหลังการทำผ่าตัดต้อหิน

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Abstract

Objective: The study aimed to evaluate the biometric and refractive changes after trabeculectomy with mitomycin C (MMC) among patients with primary glaucoma.

Design: The study employed a prospective, observational design.

Materials and Methods: We recruited 24 patients with primary glaucoma, scheduled for trabeculectomy with MMC. Best corrected visual acuity (BCVA), intraocular pressure (IOP), auto-refraction, keratometry, anterior chamber depth (ACD) and axial length (AXL) were evaluated pre- and postoperatively at 2 weeks, 1, 3 and 6 months.

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Results: BCVA, auto-refraction, keratometry (K1, K2) , AXL and ACD showed no significant change over the course of the study, however postoperative mean IOP significantly decreased at 2weeks, 1, 3 and 6 months of the follow-up period when compared with the pre-operative IOP (*p* value <0.005), .

Conclusion: No significant difference was found regarding biometric and refractive changes after trabeculectomy with MMC in patients with glaucoma .

Keywords: Biometric, Keratometry, Anterior chamber depth, Axial length, Refraction, Glaucoma, Trabeculectomy

No Author has a financial or proprietary interest in material or method mentioned.

บทคัดย่อ

ภูมิหลัง: โรคต้อหินเป็นกลุ่มโรคที่มีการเสื่อมของขั้วประสาทตา ส่งผลให้เกิดการสูญเสียการมองเห็นและเป็นสาเหตุสำคัญของภาวะตาบอดที่เกิดขึ้นทั่วโลก ซึ่งการเพิ่มขึ้นของความดันลูกตาเป็นปัจจัยเสี่ยงสำคัญที่ทำให้การดำเนินโรคเลวลงการผ่าตัดหนึ่งที่ทำกันอย่างแพร่หลายและได้ผลดีในการควบคุมความดันลูกตาคือ การผ่าตัดต้อหินทำทางระบายออกของน้ำในลูกตา (trabeculectomy) ซึ่งกระบวนการผ่าตัดทำทางระบายออกของน้ำลูกตา (trabeculectomy) และความดันลูกตาที่ลดลงอาจนำไปสู่การเปลี่ยนแปลงของความยาวลูกตาและความโค้งของกระจกตาซึ่งมีผลทำให้ค่าสายตาผิดปกติได้หลังผ่าตัด นำมาซึ่งปัญหาด้านการมองเห็น เช่น สายตาเอียง เป็นต้น ทำให้คุณภาพชีวิตหลังการผ่าตัดอาจแย่ลงจากสายตาที่มัวลงเป็นอุปสรรคต่อการใช้ชีวิตประจำวันได้ งานวิจัยนี้จะศึกษาแนวโน้มของค่าสายตาที่ผิดปกติ และค่าไบโอเมตริกของลูกตาที่เปลี่ยนแปลงหลังการทำผ่าตัด เพื่อให้แพทย์ผู้ทำการผ่าตัดสามารถปรับวิธีการผ่าตัดเพื่อลดภาวะดังกล่าว และเพื่ออธิบายและแนะนำผู้ป่วยตั้งแต่ขั้นตอนการเตรียมตัวก่อนผ่าตัดให้เข้าใจถึง ค่าสายตาผิดปกติที่อาจเกิดขึ้น

วัตถุประสงค์: ศึกษาการเปลี่ยนแปลงของค่าไบโอเมตริกของลูกตาซึ่งส่งผลให้ค่าสายตาผิดปกติหลังการผ่าตัดต้อหิน

วัสดุและวิธีการ: วัดระดับการมองเห็น (Visual acuity), วัดความดันตาด้วยเครื่องวัดความดันตา (Applanation tonometry), วัดค่าสายตา (Refraction) และค่าไบโอเมตริกของสายตาคือ ค่าความโค้งของกระจกตา (keratometry), ค่าความยาวลูกตา (axial length), วัดความลึกของช่องหน้าม่านตา (Anteriorchamber depth) ก่อนการผ่าตัดทำทางระบายออกของน้ำลูกตา และที่ระยะเวลา 2 สัปดาห์, 1, 3 และ 6 เดือน หลังการผ่าตัด, โดยผู้ป่วยจะได้รับการผ่าตัดโดยแพทย์ผู้เชี่ยวชาญโรคต้อหิน โรงพยาบาลพระมงกุฎเกล้า

ผลการศึกษา: หลังการผ่าตัดต้อหิน ค่าความดันลูกตาลดลงอย่างมีนัยสำคัญ ในขณะที่ระดับการมองเห็น, ค่าสายตา, ค่าความโค้งกระจกตา, ค่าความยาวลูกตา, ค่าความลึกของช่องหน้าม่านตา มีการเปลี่ยนแปลงอย่างไม่มีนัยสำคัญทางสถิติ ในช่วงระหว่างการวิจัย

สรุป: ค่าไบโอเมตริกของลูกตาและค่าสายตาไม่มีการเปลี่ยนแปลงอย่างมีนัยสำคัญ หลังการทำผ่าตัดต้อหิน

The changes in biometric and refractive error after trabeculectomy were evaluated by using the visual acuity, intraocular pressure, auto-refraction, keratometry, anterior chamber depth and axial length . We found no significant changes in these parameters except the significant lower intraocular pressure during the follow up periods of 6 months. Mean IOP was significantly decreased

from 19.04 mmHg preoperatively to 11.42 mmHg post operatively (P = 0.001) at last visit.

Introduction

Glaucoma is a leading cause of blindness worldwide[1]. Increase in intraocular pressure (IOP) is an important risk factor for glaucoma progression[2]; Therefore, reducing IOP is important to control this disease. One of the most effective surgical methods for reducing IOP and preventing glaucoma progression is trabeculectomy[3].

Trabeculectomy bypasses is the conventional outflow pathway by creating a fistula from the anterior chamber to the subconjunctival space. The procedure may effected visual outcomes of patients by altering the biometrics and refraction of the eye. Keratometry, axial length (AXL) and anterior chamber depth (ACD) are factors to be evaluated.

The purpose of this study was to examine the biometric and refractive changes among patients undergoing trabeculectomy and to identify correlation of changes in biometrics, refraction and IOP reduction.

Materials and Methods

This prospective observational study was approved by the Institutional Review Board, Royal Thai Army Medical Department. Written informed consent to participate in the prospective study was obtained from 18 primary open angle glaucoma (POAG) and 6 angle closure glaucoma (PACG) undergoing trabeculectomy at Phramongkutklao Hospital between September 2017 to July 2018.

Inclusion criteria included patients scheduled for trabeculectomy, older than 18 years , no history of intraocular surgery other than uncomplicated cataract surgery and no history of ocular trauma. We excluded combined phacoemulsification with IOL with Trabeculectomy from this study. Patients were examined pre-operatively and at 2 weeks, 1, 3 and 6 months postoperatively. BCVA was recorded using ETDRS chart, IOP was determined using Goldmann applanation tonometry, IOL master (IOL master 500 : Carls Zeiss co.,Ltd) for AXL and ACD measurement and refraction and keratometry were measured using an autorefractor (AR-330A,NIDEK). K1 was the flat K and K2 was the steep K.

The trabeculectomy was performed by 2 glaucoma specialists (W.I, O.J). A fornix-based conjunctival incision and a triangular or quadrangular scleral flap were used depending on surgeon preference. In all cases, 0.3 mg/mL mitomycin-C was applied intra-operatively under the scleral flap and tenon tissue for 2 to 4 minutes. The scleral and conjunctival flaps were closed with 10-0 nylon sutures. Conjunctival wound closure used interrupted sutures at each edge of the wounds. Postoperatively, all patients received a topical treatment regimen consisting of 1% topical prednisolone acetate q 4-6 hrs for 1 month then tapered and topical antibiotics QID for 2 weeks . Laser suture lysis and transconjunctival needling with 5 Fluorouracil (5 FU) subconjunctival injection were performed, when needed to adjust IOP.

Statistical Analyses

Statistical analyses were performed using

software STATA/MP, Version13. Repeated Measure ANOVA was used to compare the pre- and postoperative values. The level of significance was set at $p < 0.05$.

Sample size calculation was 25

Results

Twenty-three patients underwent initial trabeculectomy and 1 patient underwent a second trabeculectomy. There were 14 males and 10 females, mean age was 65.5 ± 12.41 years (range 35 to 86 years). Indication for surgery was poorly controlled IOP despite maximum antiglaucoma medications. All 24 trabeculectomies were performed without intra-operative complications. Mean pre-operative visual acuity was 0.46 ± 0.47 logMAR (range between 0 and counting fingers) as shown in Table 1.

Mean BCVA, IOP, ocular biometry, refractive error and spherical equivalence before and after trabeculectomy are shown in Table 2. Mean difference of BCVA, IOP and ocular biometry and refraction before and after trabeculectomy

Table1 Demographics of the study participants (N=24)

Age (years)	65.50 ± 12.41
Sex, M/F	14/10
Mean BCVA (logMAR)	0.46 ± 0.47

Table 2 Mean ocular biometry and refractive condition before and after trabeculectomy

	Before operation	Postoperative 2 wks.	Postoperative 1 month	Postoperative 3 months	Postoperative 6 months	*p*-value
BCVA (logMAR)	0.46 ± 0.45	0.49 ± 0.45	0.48 ± 0.45	0.5 ± 0.47	0.55 ± 0.53	0.601
IOP(mmHg)	19.04 ± 5.3	13.96 ± 7.86	13.91 ± 7.19	11.64 ± 2.68	11.42 ± 2.35	0.001*
AXL (mm)	23.64 ± 1.01	23.31 ± 0.66	23.57 ± 1.1	23.64 ± 1.12	23.61 ± 1.35	0.096
ACD (mm)	3.94 ± 0.63	3.61 ± 0.58	3.8 ± 0.63	3.87 ± 0.64	3.88 ± 0.63	0.282
RF sphere	-0.17 ± 1.54	-0.76 ± 1.13	-0.80 ± 1.43	-0.54 ± 1.33	-0.62 ± 1.53	0.521
RF cylinder	-0.7 ± 1.29	-1.31 ± 1.02	0.53 ± 2.03	-0.97 ± 0.93	-0.688 ± 1.53	0.299
RF cylinder (degree)	91.79 ± 44.85	57 ± 40.28	75.88 ± 53.4	77.76 ± 41.25	104.55 ± 52.15	0.060
Spherical equivalence (SE)	-0.73 ± 1.42	-0.65 ± 1.07	-0.46 ± 1.09	-0.74 ± 1.10	-0.55 ± 1.26	0.612
K1	43.80 ± 1.28	43.62 ± 1.78	43.81 ± 1.64	43.74 ± 1.31	43.8 ± 1.39	0.104
K1, (degree)	85.88 ± 48.35	81.25 ± 60.01	83.95 ± 49.2	86.78 ± 50.91	80 ± 51.38	0.574
K2	45.06 ± 1.54	49.01 ± 12.16	45.19 ± 1.96	47.44 ± 9.95	45.12 ± 1.5	0.332
K2, (degree)	91.38 ± 64.54	85.83 ± 53.6	96.84 ± 57.11	89.24 ± 55.39	104.55 ± 59.83	0.373
K2-K1	1.25 ± 0.78	5.40 ± 12.05	1.37 ± 1.10	3.70 ± 9.78	1.32 ± 0.64	0.299
K2-K1, (degree)	48.6 ± 27.89	13.8 ± 31.34	42.6 ± 24.79	40.42 ± 25.47	2.45 ± 90.55	0.527

*Repeated Measure ANOVA

BCVA = best corrected visual acuity, IOP = intraocular pressure, AXL= axial length,

ACD = anterior chamber depth, RF = refraction, K= keratometry (K1= flat K, K2= steep K)

are shown in Table 3. The biometry referred to keratometry (K1, K2), AXL and ACD. IOP was the only parameter revealing significant change after trabeculectomy with MMC.

The postoperative mean IOP was significantly decreased at every visit during the follow-up period when compared with the pre-operative mean IOP (2 weeks , *p* value 0.023; 1 month , *p* value 0.008, 3months, *p* value <0.001 and 6 months, p value <0.001 **(Table 3)**. However, BCVA, refraction, keratometry (K1, K2), AXL and ACD showed no significant change over the course of the study. Similar results were found in both open and closed angle glaucoma groups.

Table 3 Mean difference of ocular biometrics and refractive condition before and after trabeculectomy

	Before operation	Postoperative 2 wks.	Postoperative 1 month	Postoperative 3 months	Postoperative 6 months
BCVA (logMAR)	0.46 ± 0.45	-0.027 ± 0.026	-0.027 ± 0.025	-0.031 ± 0.03	0.03 ± 0.03
p-value		0.323	0.297	0.311	0.422
IOP(mmHg)	19.04 ± 5.30	4.857 ± 1.979	5.762 ± 1.953	7.905 ± 1.209	7.83 ± 1.65
p-value		0.023*	0.008*	< 0.001*	< 0.001*
AXL (mm)	23.64 ± 1.01	0.079 ± 0.031	0.081 ± 0.048	0.089 ± 0.028	0.09 ± 0.04
p-value		0.951	0.766	0.128	0.080
ACD (mm)	3.94 ± 0.63	0.019±0.059	-0.005 ± 0.114	-0.251 ± 0.156	0.03 ± 0.12
p-value		0.761	0.966	0.151	0.842
RF sphere	-0.17 ± 1.54	-0.343 ± 0.299	0.125 ± 0.52	-0.155 ± 0.164	-0.06 ± 0.20
p-value		0.289	0.817	0.377	0.837
RF cylinder	-0.7 ± 1.29	0.61 ± 0.40	-1.23 ± 0.76	0.26 ± 0.31	-0.29 ± 0.81
p-value		0.176	0.15	0.415	0.734
RF cylinder, degree(°)	91.79 ± 44.85	0.609 ± 0.404	-1.234 ± 0.762	0.265 ± 0.306	-0.29 ± 0.81
p-value		0.176	0.150	0.415	0.734
K1	43.76 ± 1.52	0.57 ± 0.27	0.13 ± 0.13	0.07 ± 0.15	0.079 ± 0.189
p-value		0.063	0.336	0.668	0.689
K1, degree(°)	85.88 ± 48.35	-16.2 ± 18.246	-11.1 ± 18.275	-0.3 ± 17.518	-6.37 ± 20.58
p-value		0.398	0.559	0.987	0.766
K2	45.06 ± 1.54	-5.542 ± 5.329	-5.542 ± 5.329	-5.542 ± 5.329	-5.542 ± 5.329
p-value		0.333	0.366	0.329	0.718
K2 , degree(°)	91.38 ± 64.54	18.6 ± 9.233	-5.1 ± 22.732	7.876 ± 5.482	-13.12 ± 21.71
p-value		0.075	0.827	0.185	0.565
K2-K1	1.25 ± 0.78	5.17 ± 4.19	0.45 ± 0.35	4.56 ± 4.17	0.13 ± 0.28
p-value		0.248	0.238	0.302	0.648

BCVA = best corrected visual acuity, IOP = intraocular pressure, AXL= axial length,
ACD = anterior chamber depth, RF = refraction, K= keratometry (K1= flat K, K2= steep K)

One eye developed hypotony maculopathy 2 weeks after trabeculectomy and resolved spontaneously within 1 month.

Discussion

This study showed that the postoperative mean IOP significantly decreased at every follow-up visit. This result is unsurprising given that trabeculectomy is one of the most effective surgical methods for reducing IOP and preventing glaucoma progression. The biometrics and morphologic changes of the eye after surgery are controversial. These changes can affect the visual outcomes of patients.

In a retrospective study, Cashwell and Martin found a significant decrease in axial length (mean -0.423 mm) at various times following trabeculectomy.[4] In a cohort study of 16 patients undergoing trabeculectomy with mitomycin C (MMC), Kook et al. observed significantly induced corneal astigmatism and decreased AXL (mean -0.9 mm).[5] Four days after trabeculectomy, Nemeth and Horoczi noted decreased AXL and increased thickness and volume of the ocular wall.[6]

In our study no significant changes were observed in BCVA, refraction, keratometry, ACD, or AXL. One possible explanation is that all of these previous studies used contact A-scan ultrasonography with an applanation biometry probe to measure AXL. Contact measurements can induce bias by probe deformation of the eye resulting in falsely low postoperative readings of AXL, especially in hypotony eyes. Our study used noncontact optical biometry, which is accurate and reproducible and is unaffected by small eye movements. An autorefractor was used to measure refraction and keratometry.

The mean pre-operative refractive error (in spherical equivalent) measured -0.73 diopters (range -3.87 to +4.12) indicating slightly less myopia at 1 month after surgery. This effect may be due to decreased in ACD. In a population-based, cross-sectional study, Ecosse L. Lamoureux et al. determined the impact of corrected and uncorrected myopia and hyperopia on visual functioning in an urban Malay population. They found only uncorrected myopia (defined as spherical equivalence (SE) ≤-0.50 D) was independently associated with poorer overall visual functioning and involving activities such as reading street signs, recognizing friends and watching television.[7] Similarly, the fluctuated refractive error found early postoperatively in our study could cause the patients to experience clinical concerns regarding similar problems. In early post operative period AXL decreased and also ACD resulting in slightly change in refraction However, we found that the refraction returned to baseline within 3 months postoperatively (Table 2).

The results indicated that patients undergoing trabeculectomy would not experience significant biometric and refractive changes after surgery.

Several limitations were found in this study. First the number of patients was small, partially because of the short course of the surgery for those having complete follow-up during the 6-month period. Second, the trabeculectomy were performed by 2 glaucoma specialists, so the surgeon factor may have influenced different

trabeculectomy outcomes. Further studies are needed to identify biometric changes.

Conclusion

No significant difference was found regarding biometric and refractive changes after trabeculectomy among patients with glaucoma.

What is already known on this topic?

Several studies reported controversial results of biometrics changes after trabeculectomy and there is no such study of the refractive changes.

What this study adds?

The results indicated that patients undergoing trabeculectomy would not experience significant biometric and refractive changes after surgery. The fluctuated refractive error found early postoperatively in our study could cause the patients to experience clinical concerns regarding similar problems. However, we found the refraction returned to baseline within 3 months postoperatively

Conflicts of interest

The authors declare no conflict of interest.

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