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EFFECT OF MITOMYCIN C VERSUS BEVACIZUMAB ON CORNEAL ENDOTHELIAL CELLS FOLLOWING TRABECULECTOMY IN PRIMARY OPEN ANGLE GLAUCOMA

By

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ABSTRACT

Background: Trabeculectomy is the standard treatment for patients with primary open angle glaucoma who had failed maximal tolerated medical therapy. The use of Mitomycin C (MMC) or Bevacizumab as adjuvant during trabeculectomy reduces fibrosis which in turn increases the possibility of success in filtrating surgery. However, MMC or Bevacizumab can lead to adverse effects, such as corneal toxicity especially on corneal endothelium, hypotony, formation of avascular cystic blebs, leaks, blebitis, and endophthalmitis.

Objective: To evaluate and compare corneal endothelial cell changes before and after trabeculectomy with subconjunctival Mitomycin C versus trabeculectomy with sub conjunctival Bevacizumab in primary open angle glaucoma patients (1 month and 6 months postoperatively).

Patients and methods: In this study, 20 patients (with 20 eyes) were divided into two equal groups: (Group A) included patients who underwent subscleral trabeculectomy with adjuvant intraoperative use of 0.2mg/ml MMC for 2 min, and (Group B) included patients who underwent subscleral trabeculectomy with subconjunctival injection of 1.25 mg/0.1 ml Bevacizumab.

Non-contact specular microscope (Topcon sp-1p, Topcon Medical Inc., Japan) was done preoperatively, one month postoperatively and six months post-operatively to assess the corneal endothelium as regard ECD (cells/mm²), CV in cell size, HEX and CCT.

This prospective comparative study was done at Department of ophthalmology, Sayed Galal University Hospital, Cairo, Egypt, and it was carried out from February 1st 2019 to October 30th 2020.

Results: Six males (60%) and four females (40%) in group A while five males (50%) and five females (50%) in group B. The patients' ages ranged from {25 to 47 years} (mean age35.70±6.70) in group A, and ranged from {20 to 45 years} (mean age 31.20±8.70) in group B. MMC and Bevacizumab did not have the same effect on corneal endothelium.

There was a significant decrease in endothelial cell density (ECD) after six months post-operatively in both groups with significant difference between the two groups, and insignificant increase in central corneal thickness (CCT) after six months post-operatively in both groups, Also there was a significant changes in coefficient of variation (CV), and percentage of hexagonal cells (HEX), an increase in CV (polymegathism), and decrease in hexagonality (pleomorphism) in both groups, with significant difference between the two groups.

Conclusion: MMC affected all parameters of endothelial cells more than Bevacizumab.

Keywords: Bevacizumab, Mitomycin C, Specular microscopy (SP), endothelial cell density (ECD), Coefficient of variation (CV), percentage of hexagonal cells (HEX) and central corneal thickness (CCT).

INTRODUCTION

Failure of the filtering bleb occurs at different stages after a trabeculectomy. Scarring of the filtering bleb is caused mainly by the proliferation of subconjunctival fibroblasts, the biosynthesis of collagen, and other extracellular materials *(Saeed and Aboul Nas, 2014)*.

The vasculogenesis is a process necessary for supplying oxygen, which is an important nutrient for the scar. It also helps in the migration and proliferation of tenon's fibroblasts that synthesize collagen material, finally leading to a scar tissue *(Khaw et al., 2010)*. The use of Mitomycin C (MMC) or Bevacizumab reduces fibrosis which in turn increases the possibility of success in filtrating surgery. However, MMC can lead to adverse effects, such as corneal toxicity, hypotony, formation of avascular cystic blebs, leaks, blebitis, and endophthalmitis *(Lama and Fechtner, 2013)*.

MMC is an alkylating agent derived from Streptomyces caespitous with antineoplastic and antifibroblastic properties. The antifibroblastic activity of MMC has proven to be beneficial to modulate the wound healing and to reduce cicatrization after trabeculectomy. The concentrations of MMC used during trabeculectomy range from 0.1 to 0.5mg/ml for 2 min *(Coppens and Maudgal, 2010)*.

The vascular endothelial growth factor (VEGF) has an important role in scarring as it stimulates angiogenesis and increases vascular permeability, thereby increasing fibroblast proliferation and activity *(Charnock-Jones, 2015)*. Several studies shown that the use of bevacizumab during trabeculectomy result in reduce scar formation at the trabeculectomy beleb *(Van Bergen et al., 2014)*.

The endothelium of cornea is a distinct layer of homogenously sized hexagonal cells. The quantity of these endothelial cells reduces by around 0.5%-0.6% (100-200 cells) each year *(Anbar et al., 2016)*.

Several reviews have illustrated that the smallest alterations in the arrangement of the endothelial cells may evident in the distractions in the tautness of the endothelial blockade *(Joyce and Harris, 2010)*.

As endothelial power of the cornea reduces, corneal hydration occurs. So, the CCT increases *(Anbar et al., 2016)*. Corneal endothelial cell layer is sensible for sustaining the clarity of the cornea. There is a restricted capacity of mitosis in corneal endothelium and once injured, residual cells expand to mask the lost region *(Benetz, 2011)*.

Specular microscopy (SP) gives a non-invasive technique of morphological study of the corneal endothelium. The non-contact specular microscope analysis corneal endothelium uses automated interfacing for gaining image via a discrete focusing technology *(McCarey et al., 2010)*.

The present work aimed to evaluate and compare corneal endothelial cell changes before and after trabeculectomy with subconjunctival Mitomycin C versus trabeculectomy with sub conjunctival bevacizumab in primary open angle glaucoma patients as regard: endothelial cell density (ECD), coefficient of

variation in cell size (CV), changes in percentage of hexagonal cells (HEX) and central corneal thickness (CCT).

PATIENTS AND METHODS

This was a prospective comparative study for two equal groups:

Group A: Ten patients (10 eyes) who underwent subscleral trabeculectomy with adjuvant intraoperative use of 0.2mg/ml MMC for 2 min.

Group B: Ten patients (10 eyes) who underwent subscleral trabeculectomy with subconjunctival injection of 1.25 mg/0.1 ml Bevacizumab. (Avastin; Genentech Inc., San Francisco, California, USA).

This prospective comparative study was carried out from February 1st 2019 to October 30th 2020 at Sayed Galal University Hospital.

Patients were diagnosed for primary open angle glaucoma (POAG) with uncontrolled intraocular pressure (IOP) by maximum tolerable antiglaucoma therapy. All patients had normal corneal endothelial cells parameters before operation.

The study excluded patients with neovascular glaucoma, congenital and juvenile glaucoma, history of ocular pathology rather than glaucoma such as (corneal dystrophies and uveitis), history of ocular trauma, history of intraocular surgeries, or any systemic diseases that could affect the eye such as DM. Patients who failed to complete the follow-up examinations after the surgery were also excluded.

Written informed consent was obtained after a detailed explanation of the procedure, its possible benefits and risks.

Ophthalmological examination included:

1. Uncorrected / best corrected visual acuity (UCVA/BCVA) expressed in LogMar scoring.
2. Refraction using automated refractometer (KR-800; Topcon Corporation, Tokyo, Japan).
3. Intraocular pressure (IOP) measurement by Goldman Applanation tonometry (CT-80; Topcon Corporation).
4. Slit lamp biomicroscopy to assess corneal transparency, depth of anterior chamber, condition of pupil dilatation, lens morphology.
5. Slit lamp biomicroscopy using non-contact Volk 90 Diopter lens to assess fundus.
6. Non-contact specular microscope (Topcon sp-1p, Topcon Medical Inc., Japan) to assess the corneal endothelium. Captured Images were analyzed by a built-in software where the corneal parameters were defined; ECD (cells/mm²), CV in cell size, HEX and CCT.

Surgical procedure:

Sterilization was done by using betadine 10% for the surgical field. Betadine 5% eye drops were used for the conjunctival cul-de-sac. Application of sterile drops was done. An 8–0 nylon corneal traction suture was used. The conjunctiva was dissected at the supero-nasal quadrant. A 15° knife was used to delineate and a crescent knife was used to dissect and create a half thickness, 3.5×4.5 mm, rectangular-shaped scleral flap.

(In group A) Cellulose sponges soaked with MMC (0.2mg/ml) were applied under the scleral flap, for 2 min and then the surgical area was dried and rinsed with 30 ml balance salt saline. Two diagonal scleral flap sutures were preplaced, using 10–0 nylon. A corneal paracentesis was made by a super blade knife. Sclerectomy was performed with a Kelly-Descemet's punch and the peripheral iridectomy was performed with a Vannas scissors. The scleral flap was approximated with three interrupted 10–0 nylon sutures. The conjunctiva was closed with interrupted10–0 nylon sutures. Assessment of filtration was done by injecting lactated ringer solution into the anterior chamber (AC) through the paracentesis.

(In group B) Bevacizumab was injected subconjunctivally adjacent to the temporal edge of the bleb over the scleral flap area, with a 30-G needle. The needle entrance was at least 8mm away from the bleb to prevent any needle track leakage.

Postoperative follow-up:

There were five postoperative follow-up visits within 6 months: first day, first week, first and six months postoperatively. The primary outcome measures were IOP, BCVA, and bleb appearance, number of antiglaucoma medications, postoperative interventions, and complications.

Specular microscopy: The Endothelial cell density (cells/ mm) (ECD), variation in size of endothelial cells (CV), percentage of hexagonal cells(HEX) and central corneal thickness (CCT) were analyzed using a noncontact specular microscopy, specular photomicrographs were taken at 1 and 6 months postoperatively.

Statistical methods:

Recorded data were analyzed using (Statistical Package for the Social Science version 20.00; SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD) and ranges. Qualitative variables were showed as figures and ratios. The confidence interval was set to 95% and the margin of error accepted was set to 5%. The P-value was considered no significant at the level more than 0.05, significant at the level less than 0.05, 0.01 and highly significant at the level less than 0.001.

RESULTS

This study included six males (60%) and four females (40%) in group A while five males (50%) and five females (50%) in group B. Ages ranged from {25 to 47 years} (mean age35.70±6.70) in group A and ranged from {20 to 45 years} (mean age 31.20 ± 8.70) in group B. There was no statistically significant difference between groups according to their demographic data regarding age and sex **(Table 1)**.

Table (1): Comparison between Group A and Group B as regard age and sex

Groups / Demographic data	Group A: Trabeculectomy with adjuvant MMC *(n=10)*	Group B: Trabeculectomy with adjuvant Bevacizumab *(n=10)*	p-value
Age (years)			
Mean±SD	35.70±6.70	31.20±8.70	0.211
Range	25 – 47	20 – 45	
Sex			
Female	4 (40%)	5 (50%)	0.653
Male	6 (60%)	5 (50%)	

The correlation of preoperative and postoperative specular microscopy was recorded on the first and sixth months, respectively as regard central corneal thickness. There was a statistically significant increase mean in Group A compared to Group B according to their central corneal thickness after 1m. With no significant increase mean after 6m. **(Table 2)**.

Table (2): Comparison between Group A and Group B according to central corneal thickness

Groups / (CCT)	Group A: Trabeculectomy with adjuvant MMC *(n=10)*	Group B: Trabeculectomy with adjuvant Bevacizumab *(n=10)*	p-value between groups
Pre			
Mean±SD	512.10±33.52	514.90±43.59	0.874
Range	448 – 559	440 – 570	
After 1m			
Mean±SD	526.40±5.92	519.80±6.53	0.029*
Range	460 – 582	444 – 566	
After 6m			
Mean±SD	514.30±32.13	515.40±39.18	0.946
Range	460 – 560	445 – 565	
P-value in each group:			
Pre & After1m	0.027*	0.042*	
Pre & After6m	0.775	0.867	

The correlation of preoperative and postoperative specular microscopy was recorded on the first, and sixth months, respectively as regard endothelial cell density (ECD). There was astatistically significant decrease mean in Group A compared to Group B according to their endothelial cell density after 1m and after 6m, **(Table 3)**.

Table (3): Comparison between Group A and Group B according to endothelial cell density

Groups (ECD)	Group A: Trabeculectomy with adjuvant MMC *(n=10)*	Group B: Trabeculectomy with adjuvant Bevacizumab *(n=10)*	p-value between groups
Pre			
Mean±SD	3378.60±166.55	3324.20±170.64	0.480
Range	3123 – 3558	3103 – 3629	
After 1m			
Mean±SD	3147.50±106.99	3263.60±109.21	0.027*
Range	2761 – 3326	3095 – 3548	
After 6m			
Mean±SD	3134.00±190.62	3244.00±154.29	0.029*
Range	2700 – 3380	3090 – 3550	
P-value in each group:			
Pre & After1m	<0.001**	0.08	
Pre & After6m	<0.001**	0.06	

The correlation of preoperative and postoperative specular microscopy was recorded on the first and sixth months, respectively as regard variation in size of endothelial cells (CV). There was a statistically significant decrease mean in Group A compared to Group B: according to their coefficient of variation after 1m and after 6m **(Table 4)**.

Table (4): Comparison between Group A and Group B according to coefficient of variation

Groups (CV)	Group A: Trabeculectomy with adjuvant MMC *(n=10)*	Group B: Trabeculectomy with adjuvant Bevacizumab *(n=10)*	p-value between groups
Pre			
Mean±SD	24.00 % ±2.31	24.00 % ± 2.05	1.000
Range	21 – 29%	21 – 27%	
After 1m			
Mean±SD	29.30% ±2.50	25.80% ±2.20	0.004*
Range	25 – 34%	23 – 32%	
After 6m			
Mean±SD	30.50% ±2.80	27.0% ±2.83	0.012*
Range	26 – 39%	23 – 34%	
P-valuein each group:			
Pre & After1m	<0.001**	0.059	
Pre & After6m	<0.001**	0.007*	

The correlation of preoperative and postoperative specular microscopy was recorded on the first and sixth month, respectively as regard of hexagonal cells (HEX). There was no statistically significant difference between Group A: compared to Group B according to percentage of hexagonal cells after 1m and after 6m **(Table 5)**.

Table (5): Comparison between Group A and Group B according to percentage of hexagonal cells

Groups / (HEX)	Group A: Trabeculectomy with adjuvant MMC *(n=10)*	Group B: Trabeculectomy with adjuvant Bevacizumab *(n=10)*	p-value between groups
Pre			
Mean±SD	50.50 %±3.95	49.40 % ±4.25	0.556
Range	44 % – 56%	41% – 55%	
After 1m			
Mean±SD	45.10% ±3.78	46.70 %±3.20	0.321
Range	40 % – 51%	40% – 52%	
After 6m			
Mean±SD	36.00 % ±3.65	44.80 %±2.90	0.004*
Range	28 % – 45%	40% – 50%	
P-valuein each group:			
Pre & After1m	<0.001**	0.023*	
Pre & After6m	<0.001**	0.011*	

Examples of specular microscopy of patient in group A:

Preoperatively specular microscopy of 22 years old male patient with primary open angle glaucoma (POAG) who will undergo trabeculectomy procedure with adjuvant intraoperative use of 0.2mg/ml MMC for 2 min **(Figure 1)**.

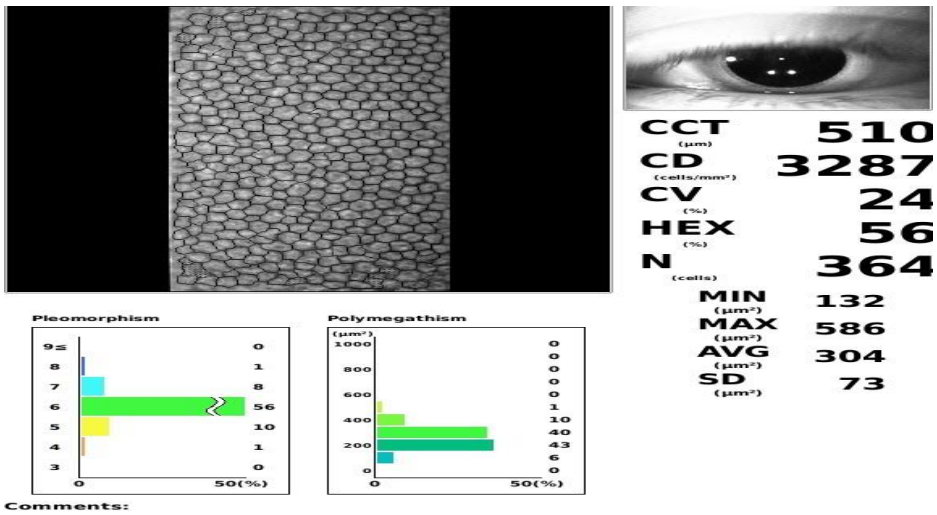

Figure (1): Specular photomicrograph of 22 years old male patient with POAG preoperatively

Specular microscopy of the same patient one month post operatively who had trabeculectomy procedure with adjuvant intraoperative use of 0.2mg/ml MMC for 2 min showing increase CCT from 510 µm to 582 µm, decrease in ECD from 3287 cells/mm2 to 2938 cells/mm2, increase in CV from 24% to31% and decrease in HEX from56% to 46% **(Figure 2)**.

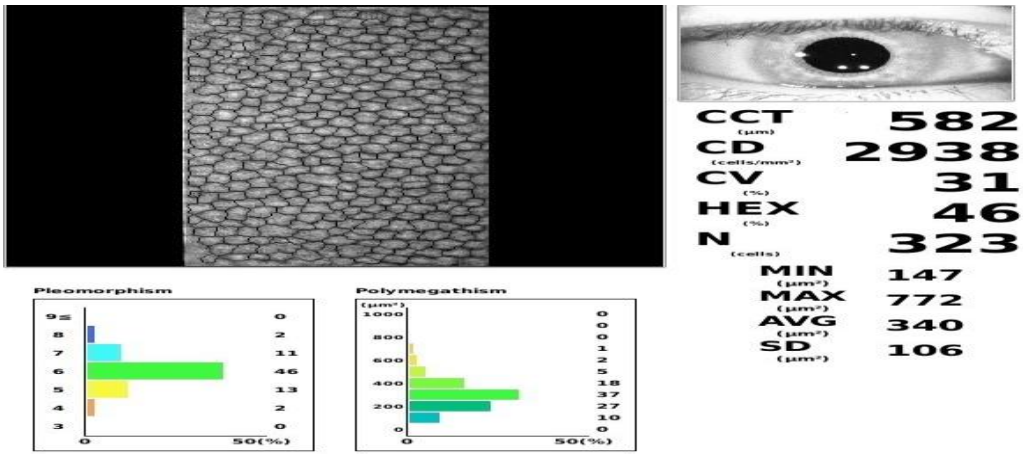

Figure (2): Specular photomicrograph of the same Patient one month post-operatively.

Specular microscopy of the same patient six months post operatively showing increase CCT from 510 µm to 545 µm, decrease in ECD from 3287 cells/mm2 to 2933 cells/mm2, increase in CV from 24% to39% and decrease in HEX from56% to 28% **(Figure 3)**.

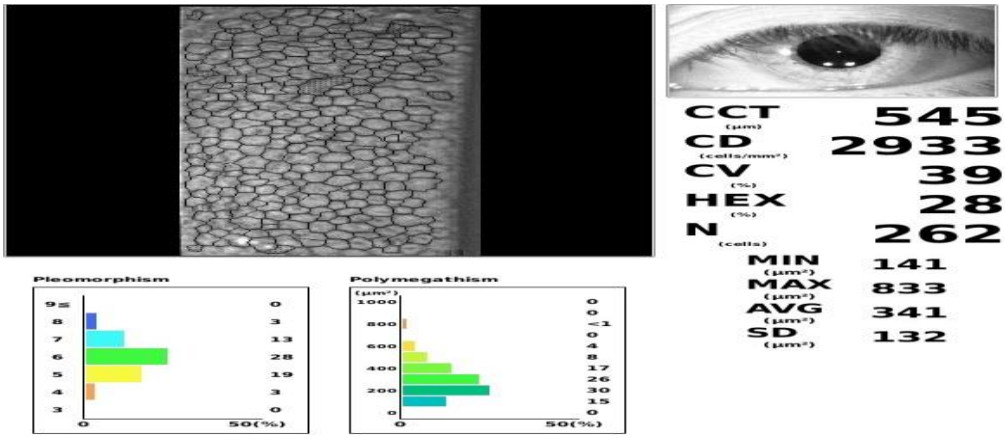

Figure (3): Specular photomicrograph of the same Patient six months post-operatively

Example of specular microscopy of patient in group B:

Preoperatively specular microscopy of 40 years old female patient with primary open angle glaucoma (POAG) who will undergo trabeculectomy procedure with adjuvant subconjunctival injection of 1.25 mg/0.1 ml Bevacizumab **(Figure 4)**.

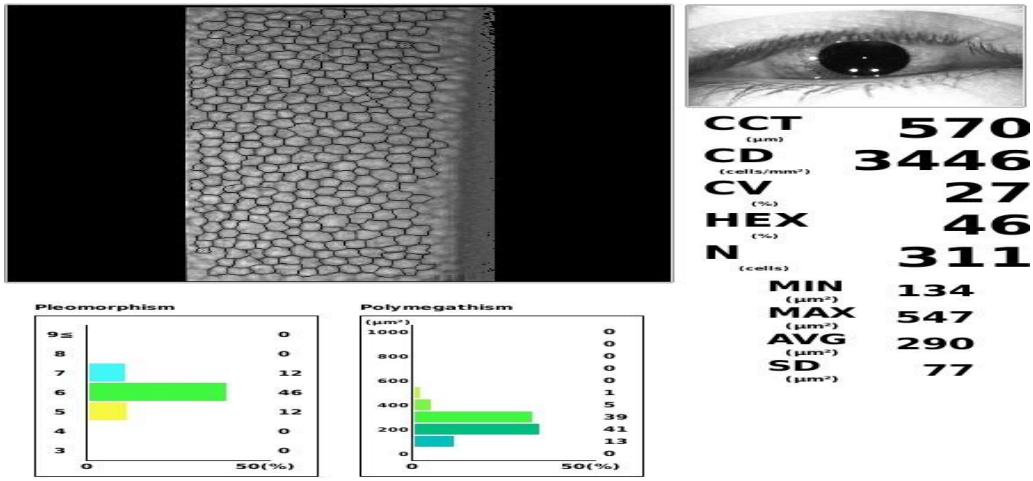

Figure (4): Specular photomicrograph of 40 years old female patient with POAG preoperatively

Specular microscopy of the same patient one month post operatively who had trabeculectomy procedure with adjuvant subconjunctival injection of 1.25 mg/0.1 ml Bevacizumab showing decrease CCT from 5 70µm to 5 24µm, decrease in ECD from 3446 cells/mm2 to 2402 cells/mm2, increase in CV from 27% to32% and decrease in HEX from46% to 43% (**Figure 5)**.

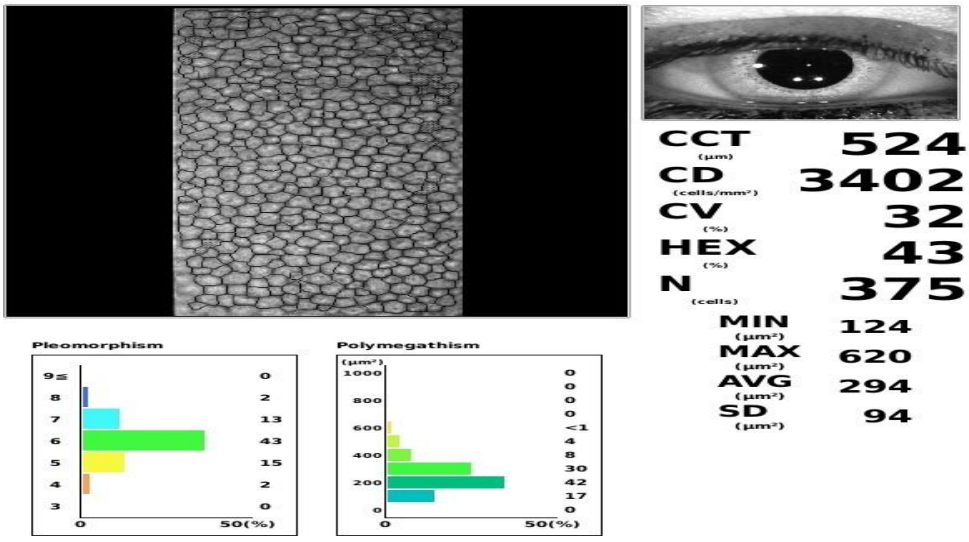

Figure (5): Specular photomicrograph of the same Patient one month post-operatively

Specular microscopy of the same patient six months post operatively showing increase CCT from 570 µm to 551 µm, decrease in ECD from 3446 cells/mm2 to 3375 cells/mm2, increase in CV from 27% to34% and decrease in HEX from 46 % to 40 % **(Figure 6)**.

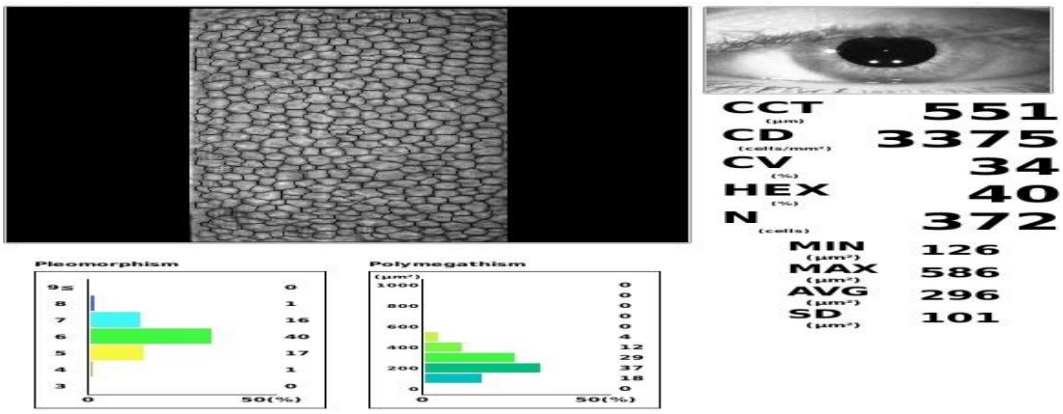

Figure (6): Specular photomicrograph of the same Patient six months post-operatively

DISCUSSION

Significant loss of endothelial cell in any anterior segment surgeries can lead to corneal decompensating and loss of corneal clarity, therefore it was necessary to know which surgical technique will be safer in view of endothelial cell loss *(Jagani et al., 2015).*

The human corneal endothelial cells are a non-regenerating predominantly hexagonal cell which covers the posterior surface of descemet's membrane and faces the anterior chamber of the eye. Corneal endothelium is metabolically active and plays an imperative role in maintaining the corneal transparency *(Van Schaick et al., 2015).*

We used specular microscopy (SP) as a non-invasive photographic technique that allows the visualization and analysis of the corneal endothelium *(Gasser et al., 2015).*

In the present study as regard group A, there was a statistically significant decrease in endothelial cell density (ECD) after six months post operatively and insignificant increase in central corneal thickness (CCT) after six months post operatively. Also, there was a statistically significant increase in coefficient of variation in cell size (CV) (polymegathism) and a statistically significant decrease of hexagonal cells percentage (HEX) (pleomorphism) after six months post operatively.

In the present study as regard group B, there was a statistically insignificant decrease in endothelial cell density (ECD) after six months post operatively and insignificant increase in central corneal thickness (CCT) after six months post operatively. Also, there was a statistically significant increase in coefficient of variation in cell size (CV) (polymegathism) and a statistically significant decrease of hexagonal cells percentage (HEX) (pleomorphism) after six months post operatively.

In comparison between the two groups in term of CCT there was no statistically significant difference between the two groups as regard preoperative CCT and CCT after six months post operatively.

In comparison between the two groups in terms of ECD there was statistically significant difference between the two

groups as regard preoperative ECD and ECD after six months post operatively.

In comparison between the two groups in terms of CV there was statistically significant difference between the two groups as regard preoperative CV and CV after six months post operatively.

In comparison between the two groups in terms of HEX there was no statistically significant difference between the two groups as regard preoperative HEX and HEX after six months post operatively.

Nilforushan et al. (2012) has a similar study done on 36 patients of POAG. 18 eyes underwent trabeculectomy with MMC (0.02% for 2 minutes) and 18 eyes underwenttrabeculectomy with subconjunctival bevacizumab injection (2.5mg/ 0.1ml), all cases were followed up on the first month and six months post operatively.

At the end of six months it was found that the mean endothelial cell loss in MMC group was 6.9% ± 0.6 and in Bevacizumab group was 2.4% ± 0.3 so the difference in pre and postoperative is statistically significant suggesting that the corneal endothelium in MMCgroup is under stress and more liable for loss as in this study.

***Higashide et al (2019)* has asimilar study done on 162 eyes of 136 patients**. Postoperative ECD measurements were performed 3.7±1.8 times (mean±SD) during a median follow-up period of 34 months. The marginal mean (SE) ECD decrease at 24 months was 9.3% (1.3%) in all cases. this study demonstrated that intraoperative application of MMC 0.02% for 2 min affect endothelial cell density and morphology up to 6 months.

Our current study results showed that:

Application of MMC 0.02% for 2 min during trabeculectomy in patients With POAG significantly affect ECD, CV and HEX during and shortly after operation. However, no progressive cell loss was observed from 1 to 6 months, demonstrating that MMC has no prolonged toxic effect on the corneal endothelium.

On the other hand, intraoperative injection of Subconjunctival injection of 1.25 mg bevacizumab during sub scleral trabeculectomy did not adversely affect CCT, ECD up to 6 months postoperatively.

Bevacizumab is effective and safer adjuvant therapy in subscleral trabeculectomy and though that; its efficacy could be somewhat below that of MMC because a large number of patients in the Bevacizumab group required antiglaucoma medication to reach the target IOP.

CONCLUSION

MMC affect all parameters of endothelial cell more than Bevacizumab.

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تأثير عقار ميتوميسن ج وعقار بيفاسيزوماب على الخلايا المبطنة للقرنية بعد عملية قط الترابطات في مرضى المياه الزرقاء الأولية مفتوحة الزاوية (دراسة مقارنة)

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خلفيـــة البحـــث: تعـــد عمليـــه قـــط الترابطـــات هـــى العـــلاج القياســـي للمرضـــى الـــذين يعـــانون مـــن الجلوكومـــا الأوليـــة المفتوحـــة الزاويـــة والـــذين فشـــلوا فـــي العـــلاج الطبـــي الأقصـــى الـــذي يمكـــن تحملـــه ويقلـــل اســـتخدام عقـــار ميتوميســـين ج أو عقـــار بيفاســـيزوماب كمســـاعد أثنـــاء استئصـــال الترابيـــق مـــن التليـــف الـــذي بـــدوره يزيـــد مـــن إمكانيـــة نجـــاح جراحـــة الترشـــيح. ومـــع ذلـــك، يمكـــن أن يـــؤدى اســـتخدام عقـــار ميتوميســـين ج او عقـــار بيفاســـيزوماب إلـــى تـــأثيرات ضـــارة، مثـــل ســـمية القرنيـــة خاصـــة علـــى بطانـــة القرنيـــة أوإنخفـــاض فـــى ضـــغط العين.

تعـــد الخلايـــا المبطنـــه للقرنيـــة هـــي المســـئولة عـــن شـــفافية القرنيـــة وهـــذه الخلايـــا لـــيس لها القدرةعلى الإنقسام.

الهـــدف مـــن البحـــث: تقيـــيم و مقارنـــة التغيـــرات التـــي تحـــدث فـــى خلايـــا بطانـــة القرنيـــة لمرضـــي الميـــاه الزرقـــاء الأوليـــة بعـــد عمليـــه قـــط الترابطـــات بمســـاعده عقـــار ميتوميســـن ج مقارنتـــاً بعقـــار بيفاســـيزوماب وذلـــك باســـتخدام جهـــاز المجهرالبـــراق وذلـــك مـــن حيـــث: كثافـــة خلايـــا بطانـــة القرنيـــة و معامـــل التبـــاين فـــى حجـــم الخلايـــا، والتغييرفـــى نســـبة الخلايـــا ذات الشكل السداسي وسمك القرنية المركزى.

المرضى وطرق البحث: اشتملت الدراسة على مجموعتين متساويتين:

مجموعـــة (أ): عشـــرة عيـــون مصـــابة بمـــرض الميـــاه الزرقـــاء الأوليـــة مفتوحـــة الزاويـــة خضعوا لإجراء عملية قط الترابطات بمساعدة عقار ميتوميسن ج.

مجموعـــة(ب): عشـــرة عيـــون بمـــرض الميـــاه الزرقـــاء الأوليـــة مفتوحـــة الزاويـــة خضـــعوا لإجراء عملية قط الترابطات بمساعده عقار بيفاسيزوماب.

و بعـــد إختيـــار المرضـــي المصـــابون بمـــرض الميـــاه الزرقـــاء مفتوحـــة الزاويـــة مـــن النـــوع الأول وبعـــد تطبيـــق معـــايير الإســـتبعاد مـــن الدراســـة وبعـــد أن تـــم شـــرح إجـــراءات الدراسة تم الآتى:

(أ) أخذ التاريخ المرضي للحالات.

(ب) الفحص من حيث:

١. قياس حدة الإبصار.

٢. قياس العيوب الانكساريه بالعين.

٣. قياس ضغط العين.

٤. فحص قاع العين.

٥. الفحـــص بـــالمجهرى البـــراق لخلايـــا بطانـــة القرنيـــة قبـــل العمليـــة وبعـــد العمليـــة بشهر وستة أشهر على التوالي.

أجريـــت الدراســـة فـــي مستشـــفى الســـيد جـــلال الجـــامعى، جامعـــة الأزهـــر بالقـــاهرة فى الفترة ما بين الأول من فبراير ٢٠١٩ إلى الثلاثين من أكتوبر ٢٠٢٠.

النتـــائج: حـــدث نقـــص فـــى كثافـــة الخلايـــا سداســـية الشـــكل المبطنـــة للقرنيـــة بنســـبة أكبـــر فـــى مرضـــى المجموعـــة (أ) عـــن مرضـــى المجموعـــة (ب) بعـــد العمليـــة بســـته أشـــهر و زيـــادة فـــى ســـمك القرنيـــة المركـــزي فـــى مرضـــي المجموعـــة (أ) عـــن مرضـــى المجموعـــة (ب) ، و زيـــادة فـــي معامـــل التبـــاين فـــى الخلايـــا ونقـــص فـــى نســـبة الشـــكل السداســـي للخلايـــا فـــي كلتـــا المجموعتين ولكن بنسبه أكبر في مجموعة (أ) عن مجموعة (ب).

الاســـتنتاج: إســـتخدام عقـــار البيفاســـيزوماب أثنـــاء عمليـــة قـــط الترابطـــات فـــي مرضـــى الميـــاه الزرقـــاء مفتوحـــة الزاويـــه أقـــل ضـــررا علـــى الخلايـــا المبطنـــة للقرنيـــة مـــن عقـــار ميتوميســـن ج.

الكلمـــات الدالـــة: بيفاســـيزوماب، ميتوميســـن ج ,جهـــاز المجهـــر البـــراق، كثافـــة خلايـــا بطانـــة القرنيـــة، معامـــل التبـــاين فـــى حجـــم الخلايـــا، نســـبة الخلايـــا ذات الشـــكل السداســـي، ســـمك القرنية المركزى.