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Results of intracameral dexamethasone injection versus intracameral triamcinolone acetonide injection at the end of phacoemulsification surgery

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Abstract
Background: The emergence of intracameral steroid injection at the end of phacoemulsification provides good control of postoperative inflammation. While much research has evaluated the effectiveness of intracameral steroid injection, fewer research has focused on comparing between different steroids and their safety regarding corneal endothelium and intraocular pressure (IOP).
Objective: To compare the results of intracameral injection of dexamethasone versus intracameral injection of triamcinolone acetonide and their effects on intraocular pressure and corneal endothelium in patients who underwent uncomplicated phacoemulsification surgery.
Patients and Methods: A prospective, randomized, comparative, interventional study that was conducted on 40 eyes of patients with cataract. They went through an equal and random categorization into two groups underwent an elective uneventful phacoemulsification and intrabagal foldable IOL implantation where dexamethasone 0.4 mg in 0.1 ml was injected into the anterior chamber in group I and triamcinolone acetonide 2 mg in 0.05 ml was injected into the anterior chamber in group II. They were compared preoperatively and postoperatively regarding visual outcomes, inflammatory scores, IOP and corneal endothelial parameters.
Results: A statistically significant difference was documented among both groups as regard the increase in central corneal thickness (CCT) as well as postoperative IOP on 5th week. Nevertheless, no statistically significant variations were documented regarding other corneal endothelial parameters, other IOP values, inflammatory scores or the visual outcomes.
Conclusion: Both dexamethasone and triamcinolone acetonide are similarly effective in controlling postoperative inflammation with similar visual outcome. Corneal parameters were marginally less altered in group I in comparison with group II however both groups are safe regarding corneal endothelium and IOP.

Keywords: Intracameral steroid, cataract, phacoemulsification, postoperative inflammation

Introduction
Cataract is the leading cause of blindness worldwide. Blindness is associated with considerable disability and excess mortality [1]. Treatment of this pathology consists of the surgical removal of the opaque crystalline lens and its replacement by an intraocular lens. Cataract surgery is currently a quick, painless and effective procedure [2]. Phacoemulsification is a highly successful technique. It is the standard method of cataract surgery in higher income countries [3]. The art of phacoemulsification has evolved over years perfecting itself in every aspect from the construction of incisions to the implantation of intraocular lenses (IOLs) [4].
Despite improved surgical techniques and intraocular lenses, postoperative inflammation is one of the most common postoperative complications. Blood aqueous barrier is damaged due to surgical trauma which causes leakage of proteins and inflammatory cells into the anterior chamber [5].
Uncontrolled inflammation can cause increased intraocular pressure (IOP), cystoid macular edema, synechia development, secondary glaucoma, and posterior capsule opacification [6]. Postoperative visual symptoms attributed to inflammation include dryness, irritation, and pain, which may delay the postoperative recovery and affect patient satisfaction. Hence, addressing the inflammation is an important part of the postoperative care [7].
The most common treatment option for postoperative inflammation is topical steroids. Apart from the topical route, other means of administration of steroids include subconjunctival, intracameral and intravitreal injection [8].

Traditional topical drug delivery has some drawbacks including compliance, tearing and blinking; which results in medication spillage, drug dilution, tear film turnover and inadequate absorption [9]. Steroid injections into the sub-conjunctival space are still one of the most common treatments for preventing postoperative inflammation, although they may be uncomfortable in instances when topical anesthetic is used and can result in sub-conjunctival bleeding and chemosis. Further research revealed that intracameral triamcinolone acetonide (TAAC) injections given during and immediately after surgery helped to reduce intraocular inflammation and corneal edema [10]. Other studies have shown that when dexamethasone (DXM) is injected intracamerally, there is a statistically significant increase in efficacy when compared to other routes of administration, such as subconjunctival or sub-Tenon's [7].

Endothelial cells are vital for maintaining corneal transparency. Endothelial cell loss (ECL) can be induced or accelerated in response to different conditions, including accidental and surgical trauma, corneal infections and hereditary corneal dystrophies. As ECL progresses, the cornea starts to swell until a critical level is reached, which is believed to be below 500-700 c/mm2, after which corneal decompensation and bullous keratopathy occurs. The most common causes of corneal decompensation are Fuchs's endothelial corneal dystrophy (FECD) and pseudophakic bullous keratopathy [11].

Corneal edema after phacoemulsification in the immediate postoperative period often leads to patient dissatisfaction and worsening of outcome [4]. Many medications are implicated in toxic changes to the endothelium including intracameral drug injections. Thus, the evaluation of risk factors for endothelial cell loss provides important information for the cataract surgeon [12].

To evaluate the corneal state, corneal thickness and endothelial cell density (ECD) and morphology are the top two clinical concerns. Central corneal thickness (CCT), as an indicator of the physiological condition of the corneal endothelium [13]. Specular microscopy (SP) is the most widely used modality to obtain endothelial cell images. SP uses a principle similar to slit lamp specular reflection, by which it can capture images that are automatically processed and analyzed to give a quantitative report of corneal endothelial parameters [14, 15].

Thus, our research was aimed at comparing the results of intracameral injection of dexamethasone and intracameral injection of triamcinolone acetonide and their effects on intraocular pressure and corneal endothelium in patients who underwent uncomplicated phacoemulsification surgery.

Materials and Methods

Study design

A prospective, comparative, interventional, randomized study, that was conducted on 40 eyes of patients with cataract who underwent an elective uneventful phacoemulsification and foldable IOL implantation. Patients were recruited from Tanta University Ophthalmology Hospital, Gharbia governorate, Egypt in the period from May 2023 to May 2024. Our study was approved by the Institutional Research Ethics Committee of the Faculty of Medicine, Tanta University.

All participants were asked to fill an informed consent. Additionally, there were adequate provisions to ensure all participants privacy and confidentiality of the data will be preserved. They were randomly distributed into two groups 20 eyes each. All eyes were operated by the same surgeon. At the end of the surgery, intracameral dexamethasone injection in group I and intracameral triamcinolone acetonide injection in group II.

Inclusion Criteria

Age: 40- 70 years

Sex: Males and Females

Presence of a cataract that is suitable for phacoemulsification.

Nuclear Cataract of opalescence less than or equal to N3.

Corrected distant visual acuity (CDVA): 0.3 or lower (in decimal notation).

Intraocular pressure ≤ 21 mmHg.

Endothelial cell density (ECD) ≥ 1500 cells/mm2.

Exclusion Criteria

Intraoperative complications like posterior capsular rupture and vitreous loss.

Postoperative complications like IOL malposition or iris prolapse.

Patients who had any previous ocular surgery or trauma.

Patients with co-existing ocular pathology other than cataract like glaucoma, CNV, or high myopic degenerative retinal changes, uveitis.

Diabetes mellitus.

Current use of oral or topical anti-inflammatory agents (steroidal or non-steroidal).

History of steroid responsiveness.

Corneal disease.

Patient Evaluation

The included patients will be subjected to the following: -

1) A complete medical & surgical history.
2) Pre-operative ophthalmological examination including:
- Uncorrected visual acuity (UCVA) corrected distant visual acuity (CDVA) assessment by Snellen's chart and converted to logMAR chart for statistical analysis.
- Anterior segment examination using slit-lamp biomicroscopy. (Cataract Evaluation using the Lens Opacities Classification System III. All grades of cortical cataract and posterior subcapsular cataract were included. Nuclear cataract of opalescence less than or equal to NO3 were included.)
- Posterior segment examination using indirect ophthalmoscopy.
- IOP measurement using air Puff tonometry (a non-contact air puff tonometer (Huvitz HNT-7000).

3) Post-operative ophthalmological evaluation was performed by the same ophthalmologist in order to obtain consistent grading scores (on 1st and 3rd day then weekly for 5 weeks) including:
- Symptoms of any ocular discomfort such as blurry vision, redness, foreign body sensation, tearing or photophobia.
- Anterior chamber cells and flare were graded according to the SUN working group grading scheme.
- UCVA, CDVA assessment by Snellen's chart and converted to logMAR chart for statistical analysis.
- Anterior segment examination using slit-lamp biomicroscopy.
- IOP measurement using air Puff tonometry.

4) Endothelial cell density (ECD) and central corneal thickness (CCT) using specular microscopy (Topcon Specular Microscope SP-3000P) (pre- operative and post-operative on day 7 and 35).

Operative technique

Phacoemulsification was done using Oertli CataRhex 3 using phaco tip 2.8 mm, US power (30%) in pulse mode, vacuum (450 mmHg) and an aspiration flow rate of 35 cc/minute. Low US features and high vacuum allow mechanical fracture of the nucleus without sculpting a groove (phaco-chop techniques). This technique reduces the energy released during surgery preventing eye injury and inflammation and promoting faster visual rehabilitation. At the end of the surgery, patients were randomly allocated to one of two groups:

In group I (n = 20 eyes of 20 patients), 0.4 mg in 0.1 ml dexamethasone (Dexamethasone sodium phosphate 8 mg/ 2ml - Dexamethasone - by Eipico company) was injected into the anterior chamber.

In group II (n = 20 eyes of 20 patients), 2 mg in 0.05 ml Triamcinolone acetonide (Triamcinolone acetonide 40 mg/ ml suspension - Epirelefan - by Eipico company) was injected into the anterior chamber.

Postoperative treatment

All participants received topical antibiotic eyedrop (Moxifloxacin hydrochloride 0.5% -Vigamox) 5 times / day for 1 week along with a topical corticosteroid eyedrop (prednisolone acetate 1.0% suspension -Econopred plus) 5 times / day for 1 week then gradually tapered over a period of 5 weeks.

Statistical Analysis

The data went through a statistical analysis utilizing SPSS V20, for windows. Following normality testing utilizing Kolmogorov-Smirnov test, Qualitative data were displayed as numbers as well as percentages, while Quantitative data were displayed as median for nonparametric data as well as Mean±SD for parametric data. Student t-Test was utilized for comparing normally distributed quantitative variables among two groups, Paired t-Test was utilized for comparing normally distributed quantitative variables within the same group and Chi-square was utilized for comparing not normally distributed variables. The significance was deemed to be at $p \leq 0.05$.

Results

Demographic data

There was no statistically significant difference between the two groups regarding age (P= 0.696) nor gender (P= 0.204) as shown in table 1.

Table 1: Epidemiological-demographic characteristics of the studied groups.

		Group				T-Test	
		Group I		Group II		T	P-value
Age	Range	50-65		50-70		0.394	0.696
	Mean±SD	60.700±5.100		60.000±6.096			
Chi-Square		Number	%	Number	%	X2	P-value
Sex	Male	12	60.00	7	35.00	2.506	0.113
	Female	8	40.00	13	65.00		
Eye	Right	9	45.00	12	60.00	0.902	0.342
	Left	11	55.00	8	40.00		

CDVA (In logMAR notation)

In both groups a statistically significant improvement was documented regarding postoperative CDVA ($p< 0.001$) as compared to the preoperative CDVA. Nevertheless, no statistically significant variation was documented between both groups as regards postoperative CDVA (P= 0.674) as shown in table 2.

Table 2: CDVA data (in logMAR notation).

CDVA (logMAR)		Group		T-Test	
		Group I	Group II	T	P-value
Preoperative	Range	0.5 - 1.3	0.7 - 1.3	-2.751	0.009*
	Mean±SD	0.805±0.235	1.015±0.248		
Postoperative	Range	-0.1 - 0.3	-0.1 - 0.3	-0.424	0.674
	Mean±SD	0.150±0.115	0.165±0.109		
Pre-Post	Differences	0.655±0.250	0.850±0.291		
	Paired Test	<0.001*	<0.001*		

Inflammation scores (Subjective complaint, anterior chamber cells, flare)

Subjective complaints of pain, blurry vision, redness, foreign body sensation, tearing and photophobia were in 2 patients in group I and in 3 patients in group II only on the postoperative first day with no significant difference between both groups (P = 0.633). There were no subjective complaints in both groups on postoperative days 7 and 35. There was no statistically significant difference between the two groups regarding anterior chamber cells grade or anterior chamber flare grade at any of the postoperative visits as shown in table 3 and table 4.

Table 3: Anterior chamber cells grade

AC Cells grade		Group						T-Test	
		Group I			Group II			T	P-value
Postoperative day 1	Range	0	-	2	1	-	2	-0.515	0.609
	Mean ±SD	1.250	±	0.716	1.350	±	0.489		
Postoperative day 7	Range	0	-	1	0	-	1	0.000	1.000
	Mean ±SD	0.350	±	0.489	0.350	±	0.489		
Postoperative day 35	Range	0	-	0	0	-	0	-	-
	Mean ±SD	0.000	±	0.000	0.000	±	0.000		

Table 4: Anterior chamber flare grade.

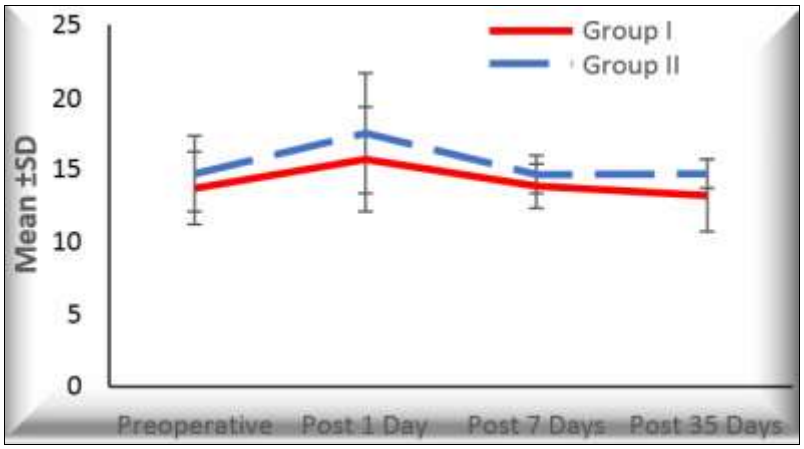
Flare	Group							T-Test	
	Group I				Group II			T	P-value
Postoperative day 1	Range	0	-	1	0	-	1	0.000	1.000
	Mean ±SD	0.350	±	0.489	0.350	±	0.489		
Postoperative day 7	Range	0	-	1	0	-	0	1.453	0.154
	Mean ±SD	0.100	±	0.308	0.000	±	0.000		
Postoperative day 35	Range	0	-	0	0	-	0	-	-
	Mean ±SD	0.000	±	0.000	0.000	±	0.000		

Intraocular pressure (mmHg): Preoperative mean IOP values were similar in both groups (P= 0.226). There was no statistically significant difference between the two groups regarding IOP values on postoperative days 1 and 7 (P= 0.152, P= 0.084 Respectively). On postoperative days 35, IOP values in group I were lower than IOP values in group II with a statistically significant difference between the two groups (P= 0.017).

In comparison of postoperative IOP values with preoperative IOP values, IOP values increase in both groups on postoperative day 1 with a statistically significant difference (p< 0.001 in both groups). On postoperative day 7 visit, IOP values decrease close to preoperative values in both groups with no statistically significant difference (P = 0.659, P= 0.881 respectively). On postoperative day 35 visit, IOP values remain close to preoperative values in group II with no statistically significant difference (P = 1). However, IOP values in group I decrease below preoperative values with a statistically significant difference (P= 0.004) as shown in table 5 and graph 1.

Table 5: Intraocular pressure (IOP).

IOP		Group		T-Test	
		Group I	Group II	t	P-value
Preoperative	Range	10 - 18	12 - 18	-1.232	0.226
	Mean±SD	13.700±2.515	14.700±2.618		
Postoperative day 1	Range	12 - 22	14 - 23	-1.460	0.152
	Mean±SD	15.700±3.614	17.500±4.161		
Postoperative day 7	Range	12 - 17	13 - 16	-1.776	0.084
	Mean±SD	13.850±1.531	14.650±1.309		
Postoperative day 35	Range	10 - 18	14 - 16	-2.495	0.017*
	Mean±SD	13.200±2.505	14.700±0.979		
Postoperative day 1 - Preoperative	Differences	+2.000±1.451	+2.800±2.067		
	Paired Test	<0.001*	<0.001*		
Postoperative day 7 - Preoperative	Differences	+0.150±1.496	-0.050±1.468		
	Paired Test	0.659	0.881		
Postoperative day 35 - Preoperative	Differences	-0.500±0.688	0.000±1.717		
	Paired Test	0.004*	1.000		



Graph 1: Intraocular pressure (IOP).

Central corneal thickness (In µm)

There was a statistically significant difference in preoperative and postoperative CCT in both groups. In comparison of postoperative CCT values with preoperative CCT values, there was a statistically significant increase (p< 0.001) in the CCT on postoperative day 7 as compared to the preoperative CCT in each group with an increase of 2.53% and 3.38% in group I and group II respectively. On postoperative day 35 visit, CCT values decreased close to preoperative values in group I with no statistically significant difference (P = 0.210) with overall increase of 0.51% in CCT. However, there was a statistically significant difference in group II (P= 0.001) with an overall increase of 2.63% in CCT as shown in table 6.

Table 6: Central corneal thickness (CCT).

CCT		Group		T-Test	
		Group I	Group II	t	P-value
Preoperative	Range	483 - 574	473 - 509	5.061	<0.001*
	Mean±SD	530.250±26.827	494.650±16.429		
Postoperative day 7	Range	491 - 585	498 - 535	4.222	<0.001*
	Mean±SD	543.700±30.380	511.200±16.192		
Postoperative Day 35	Range	478 - 562	487 - 542	2.492	0.017*
	Mean±SD	527.450±26.445	507.700±23.607		
Postoperative day 7 - Preoperative	Differences	+13.450±11.138	+16.550±12.467		
	Paired Test	<0.001*	<0.001*		
	% of Change	2.53	3.38		
Postoperative day 35 - Preoperative	Differences	-2.800±9.644	+13.050±15.686		
	Paired Test	0.210	0.001*		
	% of Change	0.51	2.63		

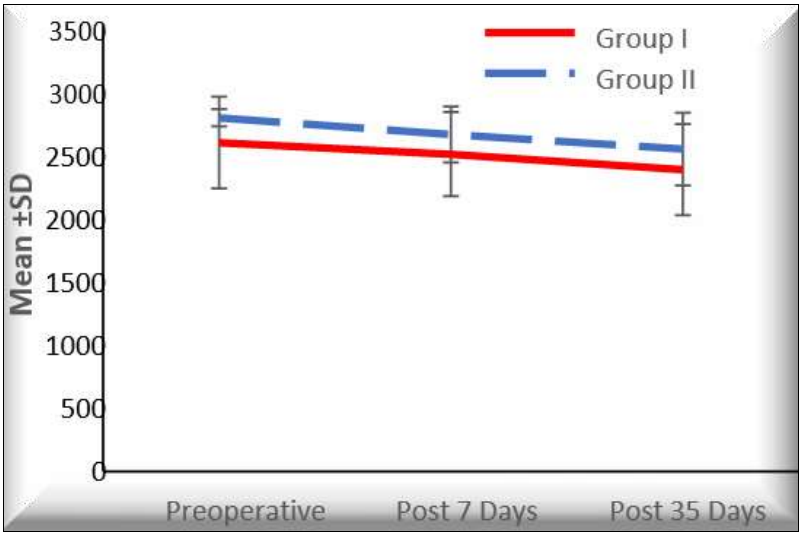
Corneal endothelial parameters

Endothelial cell density (ECD)

There was a statistically significant endothelial cell loss in each group. On postoperative day 7 visit, mean ECL was 90.730±113.018 in group I and 131.400±158.034 in group II. On postoperative day 35 visit, mean ECL was 211.175±173.153 in group I and 244.945±220.032 in group II. ECL% after 7 days was 3.33% in group I (P=0.002) and 4.86% in group II (P=0.001). Overall ECL% after 35 days was 8.15% in group I (p<0.001) and 9.01% in group II (p<0.001) as shown in table 7 and graph 2.

Table 7: Endothelial cell density (ECD) data.

ECD		Group		T-Test	
		Group I	Group II	t	P-value
Preoperative	Range	1942.1 - 3152.8	2690.3 - 2851.9		
	Mean±SD	2578.025 ±358.746	2772.555 ±67.495	-2.383	0.022*
Postoperative day 7	Range	1926.8 - 2988.9	2350.5 - 2808		
	Mean±SD	2487.295 ±328.912	2641.155 ±218.966	-1.741	0.090
Postoperative day 35	Range	1733.2 - 2812.2	2153.4 - 2777.3		
	Mean±SD	2366.850 ±356.222	2527.610 ±284.136	-1.578	0.123
ECL after 7 days	Differences	90.730±113.018	131.400±158.034		
	Paired Test	0.002*	0.001*		
	% of Change	3.33	4.86		
ECL after 35 days	Differences	211.175 ± 173.153	244.945±220.032		
	Paired Test	<0.001*	<0.001*		
	% of Change	8.15	9.01		



Graph 2: Endothelial cell density (ECD) data.

Coefficient of variation (CV): There was no statistically significant difference in preoperative CV between both groups (P= 0.704). Furthermore, there was no statistically significant difference in postoperative CV between both groups on postoperative day 7 (P= 0.901) or postoperative 35 (P= 0.604) as shown in table 8.

Table 8: Coefficient of variation (CV) data.

CV		Group		T-Test	
		Group I	Group II	T	P-value
Preoperative	Range	23 - 61.4	27.4 - 41.2	0.382	0.704
	Mean±SD	36.825±11.961	35.670±6.281		
Postoperative day 7	Range	21 - 62.4	31 - 46.7	0.126	0.901
	Mean±SD	38.960±12.314	38.565±6.753		
Postoperative day 35	Range	22 - 53.5	25.4 - 48	-0.524	0.604
	Mean±SD	34.680±10.675	36.370±9.714		
Difference on Postoperative day 7	Differences	+2.135±4.913	+2.895±4.485		
	Paired Test	0.067	0.009*		
Difference on Postoperative day 35	Differences	-2.145±4.098	+0.700±6.276		
	Paired Test	0.030*	0.624		

Hexagonality (HEX): There was no statistically significant difference in preoperative HEX between both groups (P= 0.423). Furthermore, there was no statistically significant difference in postoperative HEX between both groups on postoperative day 7 (P= 0.719) or postoperative 35 (P= 0.427) as shown in table 9.

Table 9: Hexagonality (HEX) data.

HEX		Group						T-Test	
		Group I			Group II			T	P-value
Preoperative	Range	46	-	76	42	-	78	0.809	0.423
	Mean±SD	61.200	±	10.551	58.250	±	12.430		
Postoperative day 7	Range	38	-	78	44	-	64	0.362	0.719
	Mean±SD	56.300	±	14.949	54.900	±	8.699		
Postoperative day 35	Range	47	-	76	44	-	71	0.802	0.427
	Mean±SD	59.400	±	10.600	56.600	±	11.459		
Difference on	Differences	4.900	±	11.154	3.350	±	10.510		
Difference on Postoperative day 35	Differences	-3.100±11.872			-1.700±9.911				
	Paired Test	0.257			0.452				

Discussion

Phacoemulsification is the gold standard in cataract surgery. Modern improvements in cataract surgery, such as instruments, procedures, and foldable intraocular lenses, minimized the physical stress associated with the procedure. Despite these advancements, most patients still experience postoperative ocular irritation and inflammation following cataract surgery which upsets the patient and can lead to many complications. Management of postoperative inflammation is thus a focus in the modern era of cataract surgery.

Corticosteroids have been utilized to treat intraocular inflammation [16]. Topical corticosteroid has several disadvantages: the low and unreliable intraocular levels of topically applied drops, fluctuation of concentrations from instillations till reaching peak concentrations taking approximately 1 hour after application. Also, loss of compliance because of frequent application needed at postoperative period. Moreover, it has an unfavorable effect on the cornea, resulting in tear film disruption and later irritation. The cost of eye drops may be an additional problem [17, 18]. As a result, different approaches have been employed to overcome these drawbacks.

We have conducted this study to evaluate the effect of intracameral injection of steroids (Triamcinolone acetonide versus dexamethasone) in controlling post-operative inflammation after phacoemulsification in patients with cataract. Also, to evaluate safety of intracameral steroids on the state of the cornea and corneal endothelial health and their effect on IOP.

Regarding the epidemiological-demographic data of the studied groups including age (P= 0.696) and gender (P= 0.113) there was no statistically significant difference between the two groups.

Although there was a significant difference in the preoperative CDVA (In logMAR notation) between the 2 groups (P= 0.009), there was no significant difference in the postoperative CDVA between the 2 groups (P= 0.674).

The treatment modalities used in the two groups reduced anterior chamber cells and flare equally, and no statistically significant differences were observed at any postoperative visits (p>0.05). There was no significant difference in incidence of postoperative complaints in both groups (P= 0.633).

In group II, TAAC was visible in the AC and capsular bag at the end of the case. Once all the solution was injected, balanced salt solution (BSS) was injected to firm the anterior chamber. Injection of TAAC into the AC resulted in a ‘snow-globe effect’ of various densities at slit lamp examination. Despite the suspension of TAAC crystals, it was easy to assess cells and flare between the crystals. The exact cleaning time of TAAC crystals from the eye is unknown. The TAAC crystals spread throughout the eye, the iris, the wound sites, the capsular bag, and into the vitreous. Much of the TAAC may progress through different channels of access to the anterior chamber such as the trabecular meshwork and the iris itself [19, 20].

In our study, Preoperative mean IOP values were similar in

both groups (P= 0.226). Mean IOP values on postoperative first day were slightly higher in both groups but with no statistically significant difference between the two groups. Mean IOP values returned close to baseline in subsequent follow up visits. Moreover, Group I show a statistically significant reduction in mean IOP values on postoperative day 35 (P = 0.004).

IOP rise in the first postoperative day is mostly due to residual OVDs. The OVDs remaining in the lens capsule or the anterior chamber may obstruct the trabecular meshwork resulting in postoperative IOP increase [21]. There was no recorded value of IOP higher than 25 mmHg. This may be due to washing of OVDs from AC and capsular bag at the end of the surgery. Also, we have excluded patients with a known family history of glaucoma and patients on current use of steroids from the study.

Reduction of IOP mean values in group I on postoperative day 35 by 0.5±0.688 mmHg is consistent with previous studies reporting IOP after phacoemulsification [22, 23]. Carolan *et al*. (2021) [24] stated that surgeons should expect to reduce intraocular pressure approximately 1-2 mmHg with phacoemulsification in patients with preoperative IOP less than 20 mmHg and patients with lower pre-operative IOP had lower reductions after phacoemulsification [24].

Syed *et al*. (2015) [25] conducted a study on 20070 patients who underwent cataract surgery at UK Specialist Hospitals between July 2005 and March 2013 and recorded that IOP rise above 21 mmHg occurred in 63 cases (0.31%) [25]. On the contrary, Elfersy *et al*. (2016) [26] conducted a study to determine the incidence of intraocular pressure (IOP) elevation on the first postoperative day after cataract surgeries that were performed at Henry Ford Health System Adrian between July 2012 and December 2012. 1847 eyes were included. There was a significant rise in IOP on the first postoperative day. IOP values higher than 23 mmHg were recorded in 14.6% (P=0.005) and IOP rise more than 10 mmHg over baseline was recorded in 10.9% (p<0.001) [26]. This study has a higher incidence of IOP rise. This may be due to the inclusion of glaucomatous patients (13%) and glaucoma suspect (14%) in the study. Also, there were surgeries that were performed by resident surgeons and had a higher incidence of IOP rise.

Karalezli *et al*. (2010) [18] conducted a study to evaluate the effect of 1mg intracameral TAAC on postoperative IOP after routine cataract surgery. The patients were randomized into two groups. Eyes in group 1 received an injection of 1 mg TAAC into the anterior chamber at the end of the surgery, but eyes in group 2 did not. Mean IOP at 6 and 20-24h postoperatively were significantly higher than baseline measurements in both groups. The mean IOP values at postoperative 6 and 20-24 h were found slightly higher in group 1 than in group 2. The mean IOPs at week 1 and 1-6 months after surgery were not significantly different from baseline values in both groups [18].

Chang *et al*. (2009) [27] conducted a study to evaluate the effect of intracameral dexamethasone injection on the first postoperative day after cataract surgery in eyes with and without glaucoma. He demonstrated that intracameral dexamethasone given at the end of cataract surgery significantly reduces postoperative AC cells in eyes with and without glaucoma and improves subjective reports of recovery in non-glaucomatous eyes. There were no statistically significant risks of IOP elevation or other complications in glaucomatous eyes [27].

Phacoemulsification cataract surgery has been associated with various reports of significant decrease in endothelial cells in both the short term and long term. The corneal endothelium damage during phacoemulsification can be caused by factors such as irrigation flow, turbulence and movement of fluids, presence of air bubbles, direct trauma caused by instruments or lens fragments, and the phaco time and power needed to achieve nuclear emulsification [28, 29].

Published data regarding the Topcon Specular Microscope SP-3000P used in our study is scarce. It's known that significant differences can exist between the outcomes of different SP devices [30-33]. As most specular microscopes, the Topcon Specular Microscope SP-3000P generates a set of findings that we classified into basic parameters, including ECD, CV and HEX and cell area parameters including Min, Max and Avg. Most of the specular microscopy-based studies focus on these basic parameters. Some studies even used ECD as a sole outcome measure of corneal endothelial status.

In our study, significant differences in mean ECD values between preoperative and postoperative (1 week and 5 weeks follow-up visits) were evidenced within each group independently; this could be attributable to endothelial cell loss induced by the surgical procedure; moreover, there was a statistically significant difference in preoperative ECD between both groups (P= 0.022). However, no statistically significant differences were found when comparing ECD at each postoperative measurement point between groups. ECL% after 7 days was 3.33% in group I (P=0.002) and 4.86% in group II (P=0.001). Overall ECL% after 35 days was 8.15% in group I (p<0.001) and 9.01% in group II (p<0.001) as shown in table IX. Therefore, no significant changes were demonstrated in ECL% between intracameral injection of TAAC and dexamethasone.

In literature, multiple studies have discussed phacoemulsification related endothelial cell loss with variable percentage of ECL in the early postoperative period. Variable phacoemulsification related ECL is due to different factors such as different phacoemulsification machines, different parameters, different techniques. It is reported that more severe endothelial depletion occurs after phacoemulsification of hard cataracts [29].

Most studies coincide with our study in ECL% in both groups. Li *et al*. (2016) [34] found that ECL was 5.02% after 1 week and 9.06% after 1 month of phacoemulsification in non-diabetic patients. The study had a relatively large sample size of 227 eyes non-diabetic patients and 224 eyes of diabetic patients [34]. Kim *et al*. (2010) [35] conducted a study to compare phacoemulsification-related endothelial cell loss in transplanted corneas and normal corneas. The mean percentage of endothelial cell loss in normal corneas after 1 month was 7.91%±2.35% [35].

Some studies have different ECL% that doesn't coincide with our study. Yan *et al*. (2014) [36] found that ECL was 9.16% after 1 week and 15.95% after 1 month of phacoemulsification in non-diabetic patients. The study had a sample size of 89 eyes non-diabetic patients and 135 eyes of diabetic patients [36]. Baradaran-Rafii *et al*. (2009) [37] conducted a study to evaluate the effect of power, vacuum, and flow rate on endothelial cell loss after phacoemulsification of grade +3 nuclear sclerosis. ECL% in the low-vacuum group and high-vacuum group,

respectively, was 9.5% and 10.6% at 1 week (P = 0.6), 8.7% and 9.1% at 6 weeks (P =0.8) [37].

CCT is an indicator of the physiological condition of the corneal endothelium. Although CCT is not exactly a corneal endothelial parameter, SP devices can estimate it.

In our study, there was a statistically significant increase ($p<$ 0.001) in the CCT on postoperative day 7 as compared to the preoperative CCT in each group with an increase of 2.53% and 3.38% in group I and group II respectively. On postoperative day 35 visit, CCT values decreased close to preoperative values in group I with no statistically significant difference (P = 0.210) with overall increase of 0.51% in CCT. However, there was a statistically significant difference in group II (P= 0.001) with an overall increase of 2.63% in CCT. This small change in CCT indicates that ECL does not affect endothelial cell function.

There was no statistically significant difference in preoperative and postoperative CV between both groups. Also, there was no statistically significant difference in postoperative HEX between both groups.

When commenting on the cell area parameters, instead of referring to them separately. It's generally believed that when endothelial cell dysfunction happens, the values of ECD and HEX decrease while CCT and CV increase. Lee *et al*. (2001) [38] postulated that the sequence of the corneal endothelial cell changes in contact lens wearers is a change in HEX followed by a change in CV, with the ECD decreasing last [38]. It is believed that pleomorphism and polymegathism indicate that the cornea is under stress, whereas ECD decrease indicates that cell death has happened. However, in clinical practice, especially upon using fully automated methods for cell identification, CV and HEX were found to be highly sensitive to the extremes of values (outliers) and strongly affected by the number of scanned cells and the type of SP device used [39, 40]. A trade-off situation exists. The morphological characteristics of individual cells are best studied with a highly resolved and magnified image, while density studies require a large field. It's worth mentioning that in the COMPASS-XT trial, a 5% difference in ECD determined by 2 readers needed a third reader to resolve while a third reader was needed for differences more than 15% in CV and HEX [41].

Summary and Conclusion

In conclusion, this study demonstrates that intracameral dexamethasone and intracameral TAAC were similarly effective in controlling postoperative inflammation after uncomplicated cataract surgery with phacoemulsification. However, the intraocular pressures on the postoperative first day were slightly higher in both groups and then stabilized in a few days. Significant differences in mean ECD values between pre-surgical and postoperative (1 week and 5 weeks follow-up visits) were evidenced within each group independently; this could be partially attributable to endothelial cell loss induced by the surgical procedure; moreover, there was a statistically significant difference in preoperative ECD between both groups. However, no statistically significant differences were found when comparing ECD at each postoperative measurement point between groups. On postoperative day 35 visit, overall ECL% was 8.15% in group I and 9.01% in group II. Therefore, no significant differences were demonstrated in ECL% between both groups.

Intracameral injection of TAAC or dexamethasone can be used effectively and safely to control postoperative inflammation. However, intracameral dexamethasone has a slightly better result.

The main shortcoming of this study was a small sample size owing to incomplete recruitment, unequal randomization, and patients lost to follow-up. Another limitation of our study was the short follow-up time. Larger sample size and longer follow-up time for 6 months can provide much more credibility to the results.

Conflict of Interest
Not available

Financial Support
Not available

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