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ORIGINAL ARTICLE

Lens Extraction by Phacoemulsification in Management of Acute Primary Angle Closure Glaucoma.

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ABSTRACT

Background: Primary angle closure glaucoma (PACG) is a leading cause of irreversible blindness that need early and effective treatment .Laser Peripheral Iridotomy (LPI) is the standard treatment but the long term intraocular pressure control (IOP) is poor and surgical lens extraction might help avoid this problem. The aim of the work was to compare the effectiveness and safety of lens extraction with LPI in patients with acute PACG in Zagazig University Hospitals.

Methods: Fifty eyes of 50 patients with acute PACG were included in this study. They were treated with either lens extraction by phacoemulsification (Group A) or LPI (Group B) after initial medical control of the acute attack. Pre-operative, intraoperative and postoperative data including uncorrected and best corrected visual acuity , IOP , anterior chamber depth (ACD) and angle width , intraoperative and post-operative complications were recorded. Patients were followed up for 12 months.

Results: Fifty eyes with acute PACG were enrolled randomly in two group (A&B). There was a statistically significant difference between the two groups regarding mean IOP at the 6th and 12th postoperative with less IOP in group A .IOP reduction was higher in group A ($P<0.05$). There was significant improvement of BCVA, ACD and angle width in group A . No serious intra or postoperative complications were reported in either group.

Conclusion: LPI and lens extraction are both safe and effective methods of treatment for PACG , but in the long term lens extraction achieved a more maintained reduction of the IOP and better visual outcom.

Keywords : Lens extraction; phacoemulsification; laser iridotomy; angle closure; glaucoma.

INTRODUCTION

The World Health Organization (WHO) ranks glaucoma as the leading cause of irreversible blindness. There are two types of glaucoma: open angle and closed angle. Although primary open angle glaucoma is more common, primary angle closure glaucoma (PACG) is the more likely to result in irreversible blindness if not properly and early treated [1].

The standard care for PACG is laser peripheral iridotomy to open the drainage pathways and medical management with eye drops to reduce intraocular pressure(IOP). If the disease remains uncontrolled, surgery, often trabeculectomy, is indicated, which is associated with potentially serious complications. [2].

Another line of treatment that is believed to have better IOP lowering effect on the long term is cataract extraction by phacoemulsification . [3-4]. Cataract surgery in acute PACG has had promising results and may result in less peripheral anterior synechiae (PAS) formation in the long term and reduces the need for further glaucoma filtering surgery [5,6].

Accordingly , early lens extraction can be used as an alternative approach for the early management of acute primary angle closure glaucoma without cataract. This is expected to help reduce IOP, decrease incidence of PAS and decrease the need for subsequent glaucoma surgery with its possible complications . Moreover , lens extraction may help maintain good visual acuity by correcting the hypermetropia commonly present in patients with PACG [7,8] .

The aim of the study was to compare the effectiveness and safety of lens extraction versus

standard peripheral laser iridotomy in the management of acute primary angle closure glaucoma in Zagazig University Hospitals, describing intraocular pressure (IOP), post-operative visual outcome, anterior chamber (AC) depth and angle width , possible intra and post-operative complications.

PATIENTS AND METHODS

This was a prospective interventional study (ZU-IRB #4361-12-03-2019) that was performed in the Ophthalmology Department, Zagazig University Hospitals, Egypt; between May 2019 and March 2021. It included patients with acute primary angle closure glaucoma, in whom, gonioscopy , after initial medical control of high IOP, revealed that less than 180 degrees of AC angle was closed.

Patients were considered as having acute primary angle closure glaucoma based on reported symptoms and clinical signs. Symptoms including : acute ocular discomfort or pain, blurring of vision or an antecedent episode of intermittent blurry vision with haloes, and nausea, vomiting, or both. Signs including : conjunctival injection, corneal epithelial edema, mid-dilated pupil , shallow anterior chamber depth (ACD), elevated IOP, an occludable angle on gonioscopy.

Written informed consent was obtained from all participants, the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University . The study was done according to the Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Fifty eyes of 50 patients, 25 eyes in each group, were collected from the inpatient unit of Ophthalmology Department of Zagazig University Hospitals and were assigned randomly (using simple randomization by closed envelope technique) to receive either lens extraction by phacoemulsification and intraocular lens(IOL) implantation (Group A) or Peripheral Laser Iridotomy (Group B) after initial medical control of high IOP . Patients who were less than 50 years old , with closed AC angle more than 180 degrees , with previous intraocular surgical or laser procedure , and patients with anterior segment complications such as corneal opacity or active inflammation were excluded from the study; Also patients missed from follow-up(less than 6 months) evaluation were excluded. All surgical or Laser procedures were performed by the same surgeon.

Initially, patients with APAC were treated medically. The treatment was standardized to the following: oral acetazolamide 250 mg 3-4times daily with potassium 1.2 g ; topical B-blocker (timolol 0.5%) combined with topical carbonic anhydrase inhibitors (Dorzolamide 2%) and brimonidine 0.05% twice daily if needed; topical pilocarpine 2-4% 4 timed; topical steroid eye drops; intravenous mannitol 20% at 1–2 g/kg at 4 hours after initiation of treatment if IOP wasn't reduced by 20% from initial IOP unless contraindicated.Topical pilocarpine 1% 4 times daily was used as a prophylactic measure for the other eye .

After control of the IOP, a full history was taken from each patient. Complete ophthalmic examination was performed including UCVA, BCVA, slit lamp biomicroscopy to evaluate clarity of the cornea and to exclude causes of secondary glaucoma or previous intraocular interventions.

Intraocular pressure measurement using applanation tonometer , gonioscopy using Goldmann 3-mirror lens to assess extent of angle closure and measure angle width using Shaffer's grading system; the iridocorneal angle was graded on a scale of 0 (closed), I (about 10 degrees), II (20 degrees), III (30 degrees) and IV (40 degrees or more) [9] , and fundus examination using indirect ophthalmoscope were done.

Accurate PC-IOL calculation, for eyes in group A, was done using SRK-II (for average axial length AL) or Haigis formula (for short AL) , and central AC depth , for patients of both groups, was calculated using IOL master (Carl Zeiss Meditec, Jena , Germany).

In group A, the surgery was done under local anaesthesia (Lidocaine Hydrochloride 2%). Application of antiseptic povidone-iodine 10% to the surgical site was done, draping and application of eye speculum, then application of povidone-iodine 5% drops into the conjunctival sac,washed after 2 minutes. A clear corneal incision was done temporally using a 3-mm Keratome and two side ports were done at right angles to the main incision using MVR.A soft shell technique(Archinoff technique)[9].using both cohesive(Sodium hyaluronate 1.6%) and dispersive(Hydroxypropyl methylcellulose 2%w/v) viscoelastic agents was used to fill the AC and coat the corneal endothelium. A continuous curvilinear capsulorhexis was done using capsulorhexis forceps and gentle hydrodissection was then performed using a special hydro dissection 25G cannula connected to a 5 ml syringe containing Lactated Ringer's solution .Phacoemulsification of the nucleus followed by irrigation-aspiration of the cortical matter was completed followed by intrabagal implantation of posterior chamber soft hydrophilic acrylic IOL (Eyecryl, Biotech.Visioncare , Gujarat , India). Finally, viscoelastic agents were aspirated and incisions were hydrated followed by application of topical

Moxifloxacin 0.5% antibiotic eye drops (Fortymox , Orchidia,Obour, Egypt) and eye patching. After surgery, the patients were given topical antibiotic (Moxifloxacin 0.5%) 4 times daily and steroid Prednisolone Acetate 1% eye drops (Optipred, Jamjoom, Jeddah, KSA) 4 times daily , for 7 days and Oral Levofloxacin 500mg (Levoxin , Amoun, Obour, Egypt) once daily for 5 days ,while the antiglaucoma treatments were discontinued according to the IOP during the first week.

In group B, patients were given topical pilocarpine and alpha2 agonist (Brimonidine 0.05) eye drops and topical anaesthesia(Benoxinate hydrochloride 0.4%) drops to apply the 66D- Abraham lens. Nd-YAG laser was chosen at an energy of 2-4mJ. As minimal as possible shots of Laser were applied to the peripheral superior iris targeting an iris crypt or an area of thin iris to create the iridotomy hole. Perforation of the iris was demonstrated by gush of iris pigments into the AC and visualization of red reflex through the hole. After the procedure , the patients were given topical Prednisolone acetate 1% steroid eye drops (3 times daily) and alpha2 agonist eye drops(twice daily) for 5 days to control any inflammation or IOP spikes ,while other antiglaucoma treatments were discontinued during the first week.

Follow up visits were scheduled daily during the first week , then weekly during the first month, and then monthly for up to 12 months.At each visit, eyes were subjected to a complete ophthalmic examination as done before the procedure. Gonioscopy to assess width of the AC angle was done at the 3rd,6th and 12th months, while measurement of central AC depth by IOL master was done at the 6th and 12th months.

During the follow-up period, if a rise of IOP occurred (defined as IOP between 22 and 24 mmHg on 2 occasions [readings taken within 1 month of each other] or IOP > 25 mmHg on 1 occasion after week 3), IOP-lowering medications were started. Success was defined if IOP is maintained at or below 21 mmHg during follow up , a complete success if this was achieved without the use of ocular hypotensive medications, and a qualified success if achieved with medications(one or two antiglaucoma treatment). Failure of IOP control was defined as IOP between 22 and 24 mmHg on 2 occasions (readings taken within 1 month of each other) or IOP >25 mmHg on 1 occasion after week 3 and not controlled with two antiglaucoma treatments.

The collected data were coded, entered, presented and analysed by computer using a database software program, Statistical Package for Social Science (SPSS) version 20. Mean ± SD, chi-square and t-test were used for determination of significance (P value). P <0.05 was considered significant.

RESULTS

The study included 50 eyes of 50 patients,each group included 25 eyes. There was no statistically significant difference between both groups regarding the preoperative characteristics of the patients as shown in table (1).

Pre and postoperative IOP levels are shown in table (2) showing significant difference between the two groups at the 6th and 12th postoperative months (Figure 1). Table (3) shows the magnitude and percentage of IOP change , comparing the 12th month postoperative IOP to the baseline level and the results were better in group A . There was higher success rates in group A as shown in Figure 2 .The results were statistically significant ($p<0.05$).

Postoperative Visual outcome was better in group A; 12th month postoperative BCVA range was from 0.2 to 1 with a median of 0.7 in group A , and 0.03 to 0.6with a median of 0.3 in group B with a statistically highly significant difference between the two groups (p=<0.001**). (figure 3)

Regarding postoperative central AC depth (ACD) measured by IOL master , there was statistically highly significant difference between the two group by the end of the 12th month (p=<0.001**) as shown in table (4)

Significant postoperative improvement of AC angle width measured by Shaffer measuring system was noted in group A while there was non-significant change in angle within group B.

In group A , there were no serious intra or postoperative complications . intraoperatively , two cases of intraoperative posterior capsule rupture with vitreous prolapse (managed by anterior vitrectomy with successful implantation of posterior chamber IOL) and another case of AC shallowness were reported (Managed by filling of the AC with cohesive viscoelastic material , insertion of 23G vitrectomy trocars through the pars plana and performing gentle core vitrectomy to deepen the AC) . Postoperative mild AC inflammatory reaction was noticed in most cases ;Two cases developed papillary membranes Severe postoperative corneal edema happened in one case and late decreased visual acuity occurred in two cases due to development of posterior capsule opacification (PCO). In group B, hyphema occurred in 5 cases during the procedure that did not obscure the visualization nor last long after the procedure.. 4 cases of lately developed visually significant cataract and 4 cases of failure (high IOP despite two or more medications).

Figure (1) Multiple line chart showing comparison between the studied groups regarding IOP pre and postoperatively

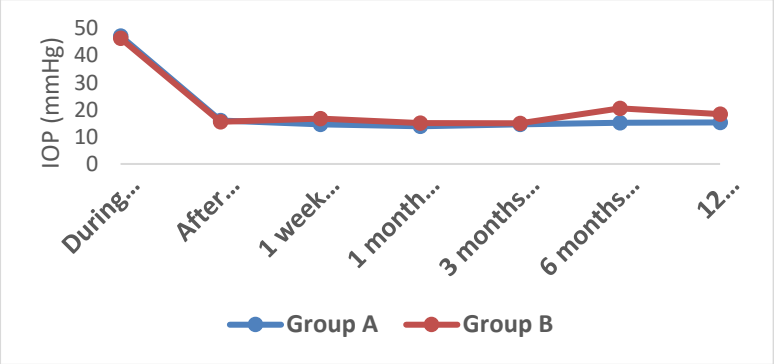

Figure (2) Multiple bar chart showing comparison between the studied groups regarding outcome

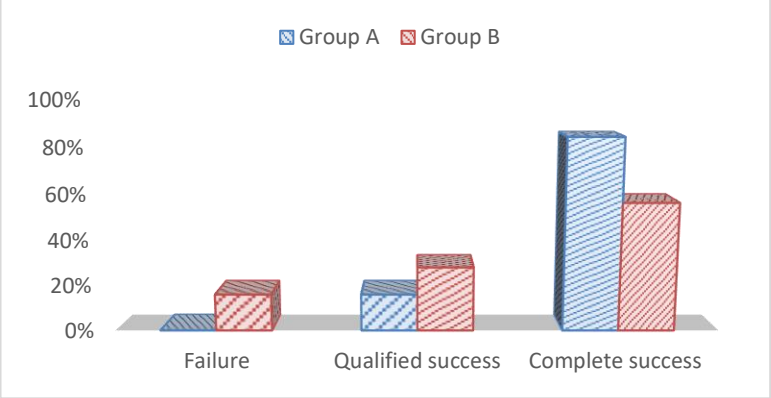

Figure (3) Multiple line graph showing change in BCVA among the studied groups

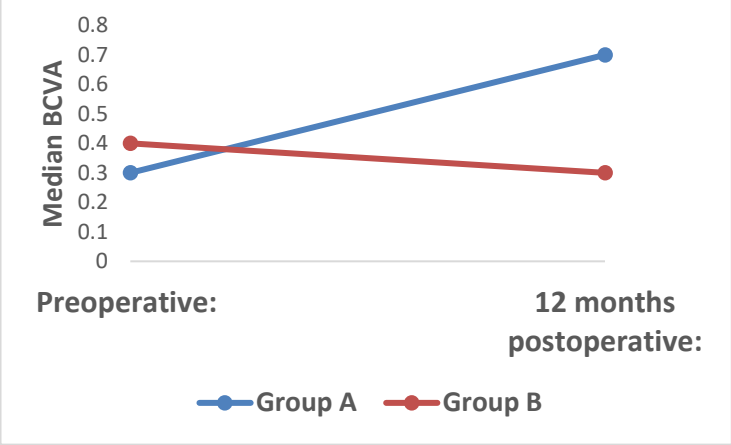

Table (1): Preoperative characteristics of the patients in both groups

Parameter	Group A N=25 (%)	Group B N=25 (%)	χ2/t	p
Gender: Female Male	 14 (56) 11 (44)	 16 (64) 9 (36)	0.333	0.564
Age (in years): Mean ± SD Range	 57.56 ± 5.71 50 – 67	 57.6 ± 4.14 50 – 65	-0.028	0.978
Laterality: Right	 14 (56)	 16 (64)	0.333	0.564

Parameter	Group A N=25 (%)	Group B N=25 (%)	χ2/t	p
Left	11 (44)	9 (36)		
Lens: Clear Cataract	 8 (32) 17 (68)	 8 (32) 17 (68)	 0	 >0.999

χ^2Chi square test t independent sample t test

Table (2):Comparison between the two groups concerning change in IOP using t test.

	Mean ± SD	Mean ± SD	t	p	95%confidence inteval
During attack	47.28 ± 4.7	46.4 ± 4.95	0.707	0.483	(-1.881 - 3.641)
After control of attack	16.0 ± 2.02	15.6 ± 1.98	0.641	0.525	(-0.737 - 1.537)
1 week postop	14.6 ± 5.94	16.8 ± 5.27	-1.385	0.172	(-5.394 - 0.994)
1month postop	13.92 ± 2.23	15.12 ± 3.4	-1.476	0.146	(-2.834 - 0.434)
3 months postop	14.64 ± 3.37	15.04± 2.95	-0.447	0.657	(-2.200 - 1.400)
6 months postop	15.24 ± 3.71	20.6 ± 5.97	-4.055	<0.001**	(-8.018 - -2.702)
12 months postop	15.4 ± 1.83	18.4 ± 5.36	-2.648	0.011*	(-5.278 - - 0.722)
p¥	0.318	0.006*			

P¥ the difference between IOP baseline and that 12 months postoperatively using paired sample t test. t Independent sample t test *p<0.05 is statistically significant **p≤0.001 is statistically highly significant

Table (3): magnitude and percentage of IOP change :

Parameter	Group A N=25 (%)	Group B N=25 (%)	Z	p
Magnitude of change: Median : Range :	 -1 -6 to +4	 +1 -5 to +14	 -2.728	 0.006*
Percentage of change: Median : Range :	 -6.26% -33.3% to +25%	 +6.67% -29.4% to +78.5%	 -2.713	 0.007*

Z Mann Whitney test *p<0.05 is statistically significant , (minus means reduction of IOP, plus means increase of IOP at the 12th postoperative month compared to baseline level)

Table (4): Comparison between the two groups concerning central depth of AC measured by IOL master, pre and postoperatively:

Depth of AC	Group A N=25	Group B N=25	t	p	95%Confidence interval
	Mean ± SD	Mean ± SD			
Preoperative:	2.02 ± 0.198	2.104 ± 0.261	-1.284	0.206	(-0.215-0.0476)
6months postoperative	2.408 ± 0.307	2.112 ± 0.321	3.336	0.002*	(0.117-0.474)
12months postoperative:	2.352 ± 0.307	1.964 ± 0.334	4.276	<0.001**	(0.206-0.570)
P¥	<0.001**	0.507			

P¥difference between ACD 12 months postop compared to preop using paired sample t test t independent sample t test **p≤0.001 is statistically highly significant *p<0.05 is statistically significant

DISCUSSION

PACG can lead to irreversible blindness if not early and properly treated. Although Laser Peripheral Iridotomy is a safe , easy and effective way of management, long-term IOP control could be poor, with a lot of subjects developing a rise in IOP that usually requires treatment that may end in surgery(trabeculectomy) which carries a high incidence of complications [10].

Surgical lens extraction, as used in managing age-related cataract, is an alternative approach for the management of PACG [11 , 12].However, the efficacy and safety of this treatment in people with PACG without cataract has not been fully assessed. [7]If lens extraction could control the condition, the need for medications and subsequent glaucoma surgery should be reduced. Furthermore, lens extraction could help to maintain good visual acuity by correcting hypermetropic refractive error, which frequently affects these patients [13].

In the current study we compared lens extraction to Laser Peripheral Iridotomy in patients with acute PACG in Zagazig University Hospitals monitoring the change in IOP , AC depth and angle width , visual outcomes, as well as intra and postoperative complications.

On comparing mean IOP 12 months post op. with baseline IOP after control of attack, there was non-significant change in group A. However, there was significant increase in group B .

On comparing the postoperative mean IOP between the two groups , there was non significant difference at the 1st postoperative week , 1st and 3rd postoperative months . IOP was controlled in both groups in the early postoperative period with no need for further antiglaucoma treatment.

On the other hand , the difference was significant at the 6th and 12th postoperative months with the mean IOP at the 12th month was 15.4 ± 1.83 mmHg in group A, and 18.4 ± 5.36 mmHg in group B . In group A . 4 eyes (16%) needed one or two antiglaucoma medications to control IOP (qualified success) with no cases of failure (0%). However , in group B , 7 eyes (35%) needed antiglaucoma medications (one or two) to control IOP (qualified success) with 4 cases (16%) of failure throughout the follow up period since IOP was not controlled with at least two antiglaucoma after LPI; 3 cases needed more antiglaucoma treatment to control IOP and one case needed surgery (combined phacotrabeculectomy).

This was consistent with the results of Azuara-Blanco et al (EAGLE Study) where IOP at 36 months significantly favoured the clear-lens extraction group with a mean IOP of 16.6± 3.5 in lens extraction group, and17.9 ±4.1 in laser iridotomy with medical treatment group (up to 4 medications). [14]

The magnitude of pressure reduction was calculated in each group and it showed a statistically significant difference between both groups where reduction was higher in group A [median of IOP change in group A was -1 compared to + 1 within group B].

Similarly, there was a statistically significant difference between the two groups regarding percentage of reduction of IOP (median of percentage of IOP change in group A was -6.26% versus +6.67% within group B)

There was significant improvement in BCVA 12 months postoperatively as compared to preoperative level in group A, whereas there was non-significant change in group B. In group A , improvement of BCVA is expected to be due to the refractive correction of the hypermetropia that as present in most of the patient preoperatively and as corrected by the IOL implantation while in group B , there was no refractive correction as a part of the procedure. In Azuara-Blanco et al (EAGLE study), no statistically significant difference was reported in the BCVA between pre and postoperatively in both groups..[14] However, VA improved in 72% of eyes underwent phacoemulsification for ACG in Shams et al study. [15]

Statistically significant increase in depth of anterior chamber (ACD) was observed in group A of our study , while depth of anterior chamber non-significantly decreased in group B. Similarly , there was significant change in ACD in Zhuo et al study. [16]

In the present study , Significant postoperative improvement of AC angle was noted in group A but not in group B , while in Azuara-Blanco et al (EAGLE study) , the available data suggested that angle closure did not differ significantly between groups. [14]

No serious intra or postoperative complications were reported in either group . In group A , two cases of posterior capsule opacification developed after the 6th postoperative months and they needed Nd-YAG capsulotomy. In Group B , 4 cases developed cataract after the 6th postoperative months and they needed phacoemulsification with IOL implantation , and among the 4 cases of failure , one case needed combined phacotrabeculectomy.

CONCLUSION

LPI and lens extraction are both safe and effective in treatment of patients of primary angle closure and primary angle closure glaucoma . Lens extraction may have favourable long term outcomes when compared to the standard treatment which is Laser Peripheral Iridotomy as regarding

IOP , visual outcome , AC depth and angle width decreasing the need for further glaucoma filter surgeries which carry high risk of complications in such patients.

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All authors contributed to data analysis, drafting or revising the article, have agreed on the journal to which the article will be submitted , gave final approval of the version to be published, and agreed to be accountable for all aspects of the work.

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