

The Pattern of Intraocular Pressure After Phacoemulsification Surgery In Senile Cataract

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Abstract: Phacoemulsification is a surgical procedure for cataracts, which can increase intraocular pressure (IOP) and cause blindness due to glaucoma. It was known that the pattern of IOP changes after phacoemulsification surgery in senile cataracts. This study was an observational analytic study without a control group design. The study population was male and female senile cataract patients over 40 years of age who underwent phacoemulsification surgery at Kebumen Eye Centre Clinic in 2020. Intraocular pressure measurements using a Noncontact Tonometry by a nurse were carried out before surgery (D-0) and postoperatively on day 2 (D-2), day 9 (D-9), day 16 (D-16), and day- 23 (D-23). The data were analyzed using the Friedman test followed by the Post Hoc LSD test. The Friedman test results showed significant differences ($p < 0.05$) in the IOP measurement at D-0, D-2, D-9, D-16, and D-23. Wilcoxon post hoc test showed IOP measurements on D-2 increased and then decreased normally. There was a change in the IOP pattern after phacoemulsification surgery, in which the IOP increased significantly on D-2 and then decreased normally.

Keywords: intraocular pressure; senile cataract; phacoemulsification

INTRODUCTION

A cataract is a condition in which the eye's lens becomes cloudy, resulting in poor light entering the eye. One of the causes of cataracts is a factor of degeneration (aging) and is called senile cataracts.^{1,2} Cataracts cause visual disturbances ranging from blurred vision to blindness. WHO estimates that in the world, 18 million people are blind due to cataracts. Based on data from the Ministry of Health of the Republic of Indonesia, the number of cataract sufferers in Indonesia reached 1.8 million people and 81,2% total blindness in Indonesia.³ In addition, the Ministry of Health of the Republic of Indonesia estimates that the incidence of cataracts in Indonesia is 0.1% per year or every year among 1,000 people and that there is a new cataract sufferer. The prevalence of cataracts in Indonesia in the 2013 Riskesdas was 1.8%, the highest in North Sulawesi and the lowest in DKI Jakarta.⁴

Cataract surgery is the most common surgical procedure performed worldwide.^{5,6} Phacoemulsification surgery is the current treatment modality available for cataracts.⁷ Using viscoelastic materials in phacoemulsification surgery helps protect the corneal endothelium from surgical trauma. However, in addition to their benefits in protecting the corneal endothelium, viscoelastic materials can cause an increase in intraocular pressure (IOP) due to retention in the eye's anterior chamber. The duration of the increase in intraocular pressure due to the retention of viscoelastic material depends on the amount of viscoelastic residue left in the anterior chamber and the viscoelastic used because the higher the viscosity is, the more difficult it is to expel it through the anterior chamber. However, the increase in intraocular pressure due to viscoelastic material is not severe and only temporary.^{8,9}

Causes of this elevation in IOP include retained lens material, postoperative inflammation, and retention of viscoelastic substances within the anterior chamber. Postoperative increases in IOP are transient and benign. It is, therefore, important to continuously monitor the effect of new cataract surgical techniques on postoperative IOP and the impact of increased IOP on visual outcomes. Postoperative inflammation also

plays a role in the transient increase in intraocular pressure. It is supported by research data demonstrating an increase in the average intraocular pressure on the first day after surgery from 13.53 mmHg to 16,358 mmHg.⁸ After phacoemulsification, a 22% increase in intraocular pressure exists more than 23 mmHg and can cause glaucoma.^{9, 11, 12}

Several study designs were reported using a retrospective design and a cohort design, with varying results, namely an increase in IOP on the first day and a decrease in IOP in the second week after cataract surgery.^{8,11,12,14} The sample used varied widely with a younger and more comprehensive age range, namely 20-83 years.¹⁰ The sample distribution was a control sample of the glaucoma patient group and secondary data were taken from hospital medical records.^{10,11,13} Follow-up post-cataract surgery IOP examinations were carried out variously from short-term follow-ups, namely 1 day post cataract surgery to several months of post-cataract surgery, namely 12 months.^{11,14}

Based on this description, the researchers felt the need to research changes in intraocular pressure at pre and post-phacoemulsification surgery in senile cataract patients with a novelty value using a cross-sectional design, samples aged more than 40 years, without a control group, direct data collection (primary data) and follow-up several times for up to 23 days. This study aims to identify the specific pattern of IOP changes after phacoemulsification surgery, especially in Indonesian people. Is there a change in the pattern of intraocular pressure pre and post-phacoemulsification surgery in senile cataract patients, and what is the pattern of changes? This study aims to determine the changes in intraocular pressure patterns pre and post-phacoemulsification surgery in senile cataract patients. Specifically, This study identifies the pattern of IOP changes after phacoemulsification surgery in senile cataracts.

MATERIAL AND METHOD

This study was an observational analytic study without a control group design. The population of this study was senile cataract patients who underwent phacoemulsification surgery at the Kebumen Eye Center Clinic and met the inclusion and exclusion criteria. The sampling technique used consecutive non-random sampling. The inclusion criteria included male and female senile mature and immature cataract patients who will undergo phacoemulsification surgery of more than ≥ 40 age. The exclusion criteria were patients with complicated cataracts due to uveitis, trauma, Diabetes Mellitus, a history of glaucoma, suffering an eye infection, and subjects who are not cooperative and refuse to continue participating in the research. The dependent variable of this study was intraocular pressure, and the independent variable was the time of the day pre and post-phacoemulsification in senile cataracts. The operational definition of intraocular pressure is the eye's fluid pressure with the measurement of non-contact tonometry. Phacoemulsification is a type of cataract surgery in which the lens is broken up by ultrasound, irrigated, and suctioned out, while senile cataract is an age-related, vision-impairing disease characterized by the opacity of the lens fibers.

Intraocular pressure measurements using a Noncontact Tonometry by a nurse were carried out before surgery (D-0) and postoperatively on day 2 (D-2), day 9 (D-9), day 16 (D-16), and day 23 (D-23). The data were analyzed by using the Friedman test to identify the difference between groups, followed by the Post Hoc LSD test to identify where the difference is.

RESULT

A total of 50 probands comprised 26 males (52%) and 24 females (48%). The mean age was 64.10 ± 10.17 years, and 26% were 66-70 years old (Table 1). Table 1 shows that the male probands were higher than the female. The distribution of aged 66-70 was the highest frequency compared to the others.

Table 1. Distribution frequencies of subject characteristic

Characteristic	Amount	Percentage (%)
Gender		
Male	26	52
Female	24	48
Age (year)		
40-45	3	6
46-50	4	6
51-55	3	6
56-60	9	18
61-65	4	8
66-70	13	26
71-75	6	12
76-80	8	16
Total	50	100

Table 2. Distribution frequencies of type of cataract and visual acuity

Type Visual Acuity	Ocular Dextra (%)	Ocular Sinistra (%)
Mature	6 (12%)	7 (14%)
Immature	8 (16%)	10 (20%)
1/300	1 (2%)	1 (2%)
1/60	1 (2%)	3 (6%)
2/60	2 (4%)	0 (0%)
3/60	0 (0%)	1 (2%)
4/60	7 (14%)	1 (2%)
5/60	1 (2%)	0 (0%)
6/60	1 (2%)	0 (0%)
6/48	1 (2%)	0 (0%)
6/38		
Total	27 (54%)	23 (46%)

Table 2 shows two types of senile cataracts; mature and immature. An immature cataract is higher than a mature one due to the patient's condition starting to suffer from vision impairment and disturbing work. Only 12% (ocular extra) and 14 % (ocular sinistra) of patients underwent phacoemulsification surgery in senile mature cataracts and the other in senile immature cataracts.

Furthermore, table 3 shows that the IOP D-0 is normal, the highest IOP in the D-2, and the other days after that, it becomes normal. Previously, normality was tested using Shapiro Wilk as the number of respondents was 50. The normality test results showed $p > 0.05$, indicating that the IOP data from D-0 to D-23 was not normally distributed. The Friedman test was conducted as the data were not normally distributed and were paired data (more than one measurement) with more than two groups. The results of the Friedman test analysis showed that the value of $p = 0.001$ ($p < 0.05$) (table 3). It was concluded that there was at least a significant difference in IOP in the two measurements.

To find out where the difference lies, a post hoc analysis of the Wilcoxon test was carried out (Table 4). There were significant differences in IOP in groups D-0 vs D-2, D-0 vs D-16, IOP D-2 vs D-9, D-2 vs D-16, and D-2 vs D-23.

Table 3. Intraocular Pressure Difference Test on certain days based on the Friedman test.

Group	N	IOP Median (Min-Max)	p
IOP D-0	50	12,00 (8-20)	0,001*
IOP D-2	50	13,00 (6-30)	
IOP D-9	50	11,50 (7-20)	
IOP D-16	50	11,00 (7-18)	
IOP D-23	50	11,00 (7-24)	

*) significant differences 1 %.

Table 4. Intraocular Pressure Difference Test between groups on Wilcoxon posthoc test.

Between groups	p
IOP D-0 vs D-2	0,013*
IOP D-0 vs D-9	0,390
IOP D-0 vs D-16	0,043*
IOP D-0 vs D-23	0,664
IOP D-2 VS D-9	0,004*
IOP D-2 VS D-16	0,001*
IOP D-2 VS D-23	0,002*
IOP D-9 VS D-16	0,322
IOP D-9 VS D-23	0,995
IOP D-16 VS D-23	0,066

*) significant differences 5 %.

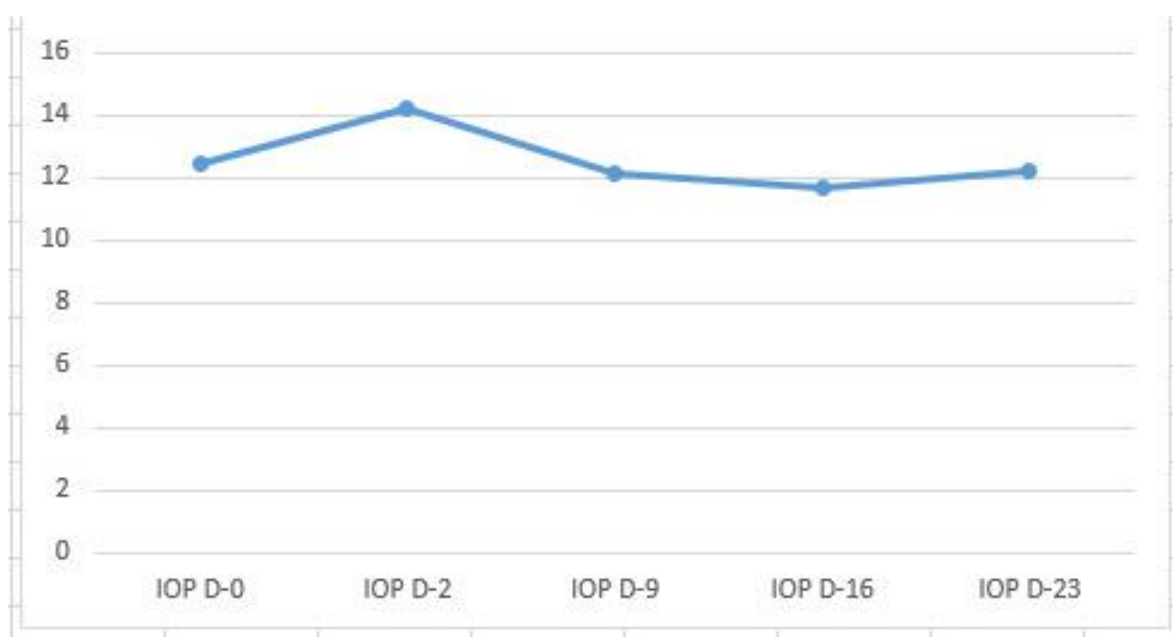


Figure 1. The pattern of IOP Pre and Post Phacoemulsification Surgery on D-0, D-2, D-9, D-16, and D-23

Figure 1 shows the pattern of IOP pre and post-phacoemulsification. The pattern was normal IOP in pre-phacoemulsification (12 mm Hg), increased IOP in D-2, and decreased to become normal after that.

DISCUSSION

This study showed that there was a specific intraocular pattern after phacoemulsification surgery. The IOP increased significantly ($p < 0.05$) on D-2, and it sloped toward the initial IOP before surgery (D-0) and then decreased slowly to the normal IOP. Another study revealed that in most of the patients (86%), intra-ocular pressure became normal (< 21 mm hg) within 7 days.¹⁰ In this study, intra-ocular pressure at D-9, D-16, and D-23 was not significantly different from pre-surgery (D-0). It is essential to follow up on increased IOP post-op phacoemulsification as surgery is one of the complications that can cause glaucoma if chronically.¹⁵

Although there is an increase in intraocular pressure immediately after phacoemulsification surgery and the long-term effect of phacoemulsification in patients without glaucoma, glaucoma and cataracts cause a slight decrease in intraocular pressure.^{11,16} Intraocular pressure decreases for up to 5 years after cataract surgery.¹⁷ After phacoemulsification, a 22% increase in intraocular pressure exists at more than 23 mmHg and can cause glaucoma.¹⁶

The initial incidence of postoperative IOP elevation is reported to be around 2.3-8.9% in all types of cataract extraction.^{8,18,19} The increase will peak 3-7 hours after surgery and up to the first 24 hours. This increase is related to anterior chamber inflammation and prostaglandin release.^{8,18,20} Besides, early increased

postoperative IOP is associated with glaucoma and ocular hypertension, higher preoperative IOP, and longer axial length¹⁹. In cataract surgery, the phacoemulsification technique performs an incision that causes damage to the corneal endothelial cells, resulting in inflammation that can cause corneal edema. When corneal edema occurs, it will cause increased corneal thickening. Corneal thickening causes narrowing of the eye's anterior chamber, resulting in increased intraocular pressure.^{14,21}

Increased IOP postoperative might be due to the retention of viscoelastic material. Therefore, postoperative intraocular pressure checks are highly recommended.⁵ The critical aspect for reducing intraocular pressure after phacoemulsification is cleaning the trabecular meshwork.⁸ Cortical remnant is a frequent complication. When the remaining cortex is not too much, no additional action is needed because the cortex will be absorbed slowly. However, expulsion is necessary when the rest of the cortex is too much and obstructs the visual axis. This procedure should be performed several days after surgery so that the remaining cortex can be more easily aspirated from the eye's anterior chamber. If there is residual lens mass in the anterior chamber, it must be removed as the lens mass in the form of both the nucleus and epinucleus is difficult to absorb and can cause chronic inflammation, especially in patients with a previous history of uveitis; thus, it is easier to experience excessive inflammation. This inflammation can increase intraocular pressure due to the accumulation of inflammatory cells in the aqueous humor and trabecular meshwork.¹⁸

Furthermore, a decrease in IOP after cataract surgery has been reported. Long-term studies (3 months) have shown a drop in IOP of about 4 mm Hg in primary open-angle glaucoma (POAG) patients and non-glaucomatous patients.²¹ One of the mechanisms that cause a decrease in intraocular pressure is anatomical changes in the form of widening the iridocorneal angle, thereby increasing the flow of aqueous humor to the trabecular meshwork.²² In addition, an anatomical theory proposed by Berdal et al in 2009 was that the posterior lens shifted after cataract surgery, causing the anterior tendon of the ciliary muscle to relax. It also changed the trabecular meshwork's arrangement, facilitating the flow of aqueous humor.

CONCLUSION

There was a change in the IOP pattern after phacoemulsification surgery, in which the IOP increased significantly on D-2 and then decreased normally.

CONFLICT OF INTEREST

There is no conflict of interest.

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