ORIGINAL ARTICLE

Comparison of High and Low Phacoemulsification Parameter in Safety and Patients' Comfort

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ABSTRACT

Background: To compare phacoemulsification (phaco) setting parameters with high (H) and low (L) parameters in Cipto Mangunkusumo (CM) hospitals impacted on corneal endothelial cell and patient's pain perception (PP) during phaco procedure.
Methods: Forty eight outpatients were eligibly selected by RCT at CM hospital in periods of November 2013 to April 2014. Impacts of setting parameter difference were observed by objective measurement of endothelial cell density (ECD), central corneal thickness (CCT). The PP was measured by a JCI approved standard using visual analog scale (VAS) were adapted. A built-in software for phaco US energy count which is cumulative dissipated energy (CDE) used to objectively timed the phaco time, duration of operation (DO) were timed, and standard visual acuity (VA) was also noted. Data analysis was performed using general linear model (GLM) repeated measures.
Results: Increase of CCT and decrease of ECD after 1 month in high and low phaco parameter are not significantly different, respectively 0.23% vs 2.23% and 8.53% vs 6.99% ($p>0.05$). Significant difference were found in CDE between H and L; 15.80 vs 21.29 ($p=0.015$). No statistically significant difference of VAS nor DO and VA.
Conclusion: High and low parameter phacoemulsifications have an equal result in safety and patient's comfort.

Keywords: setting phaco machine, endothelial cell density, central corneal thickness, visual analog scale

Corneal endothelial cell damaged after phaco-emulsification as result of duration of operation, ultrasound (US) energy, bevel phaco tip position, type of viscoelastic, lens material, fluid turbulence in anterior chamber, and inflammation after phacoemulsification. Corneal endothelial cell damaged may be reduced by arranged parameter setting of phacoemulsification. Phacoemulsification surgery safety indicator may be assessed from measurements of central corneal thickness (CCT) and endothelial cell density (ECD). At present, there is no agreement parameter settings used for phacoemulsification set according to operator selection or set in accordance with the degree of cataract.[1,2]

A phacoemulsification parameter setting includes US energy, vacuum, aspiration flow rate (AFR) and bottle height (BH). These parameters are arranged in each phase of phacoemulsification; sculpting, chopping and quadrant removal. Handerson et al[3] used parameter setting of phaco-emulsification in soft cataract use 85% US energy, vacuum of 90 mmHg, AFR of 24

ml/min, and BH of 95 cm at sculpting phase. Chopping and quadrant removal phase use 80% of US, vacuum of 400 mmHg, AFR of 35 ml/min, and BH of 105 cm. These parameter setting were increased following the density of cataract.[3] Phacoemulsification parameter setting is categorized as high and low parameter. The category is based on the use of the magnitude of the vacuum setting. Generally, the use of vacuum above 350 mmHg benchmark called high and low vacuum 200 mmHg minimal parameters. Study by Vasavada et al[4] and Baradaran et al[5] using phacoemulsification high and low parameters was to find the safest parameter for the endothelial cells. Both of these studies have different results: Vasavada et al[4] got a significant difference in the increase in CCT 1 day and 1 week postoperatively for phacoemulsification group of low parameters; while Baradaran et al[5] showed no significant differences in the ECD after phacoemulsification. Different results in these two studies show that the low parameter phacoemulsification is not always better/safer compared to the high parameter phacoemulsification. Phacoemulsification surgeons need to pay attention to the comfort of the patient during surgery. Patient comfort means minimal pain felt by the patient. Uncooperative patients affect patient's comfort during surgery. Patient comfort is also affected by the use of anesthesia, previous operating experience, and intraocular pressure (IOP). Fluctuations of IOP during phaco-emulsification occurred in the anterior chamber and are directly proportional to the height parameter settings bottles.[6,7]

Currently, there are no studies in Cipto Mangunkusumo (CM) Hospital comparing high and low parameters phacoemulsification. Nowadays, in CM hospital phacoemulsification parameter settings are used in sculpting phase US energi 40%, vacuum 80 mmHg, AFR 40 ml/min, and BH 100 cm. Chopping phase uses US energy 40%, vacuum 450 mmHg, AFR 32 ml/min, and BH 89 cm. Quadran removal phase uses US energy 100%, vacuum 350 mmHg, AFR 33 ml/min, and BH 111 cm. The objective of this study is to compare the phacoemulsification parameter used in CM Hospital with lower parameter of safety and patient's comfort.

METHODS

Our study was conducted at Ophthalmology Department, CM Hospital, in periods of November 2013 to April 2014. Randomized control trial double blind study was used as the design of this study. This study was approved by the Health Research Ethics Committee of the Medical Faculty, Universitas Indonesia, CM Hospital. Subjects had been given informed consent and signed operation form. Inclusion criteria includes patient's age of 50-70 years olf with dense cataract (grade 2 and 3) based on Lens Opacification Classification System (LOCS) III. Endothelial cell density was $\geq$2,000 sel/mm^2, axial lengths (AXL) were 22-24 mm, and no history of ocular diseases.

Single phacoemulsification surgeon was assigned and infinity OZIL system Alcon was used as operation machine. Nucleofragsis technique was performed by stop and chop at iris plane. High parameter phacoemulsification setting in this study used in sculpting phase were 40% US energy, vacuum of 80 mmHg, AFR of 40 ml/min, and BH of 100 cm; chopping phase used 40% US energy, vacuum of 450 mmHg, AFR of 32 ml/min, and BH of 111 cm. Compared to low parameters which used 100% US energy, vacuum of 50 mmHg in sculpting phase; chopping phase used 40% US energy, vacuum of 250 mmHg, AFR of 25 ml/min and 40% US energy, vacuum of 200 mmHg in quadrant removal phase. Setting of AFR and BH were fixed at 25 ml/min and 70 cm for all phase of phacoemulsification.

Patient's pain perception measured by a Joint Commision International (JCI) approved standard using Visual Analog Scale (VAS) was adapted. Built-in software

Table 1. Comparison of central corneal thickness (CCT) and endothelial cell density (ECD) in high and low parameter group pre-operation, 1 day, 1 week, and 1 month after phacoemulsification

Variable	Group H Mean±SD (%)	Group L Mean±SD (%)	p Value
CCT (µm)			**0.234**
Pre op	532.46±28.683	537.38±33.834	
1 day	577.46±58.717 (7.19)	585.46±54.220 (7.83)	
1 week	546.25±37.131 (2.39)	564.62±38.070 (4.63)	
1 month	534.71±35.208 (0.23)	550.33±32.749 (2.23)	
ECD (sel/mm^2)			**0.980**
Pre op	2744.46±304.988	2761.17±373.944	
1 day	2599.71±385.856 (-7.42)	2626.54±345.045 (-5.79)	
1 week	2623.46±345.811 (5.53)	2554.88±328.166 (8.51)	
1 month	2556.62±379.790 (8.53)	2590.88±321.233 (6.99)	

Group H: group of high parameter phacoemulsification; Group L = group of low parameter phaco-emulsification; CCT: central corneal thickness; ECD: endothelial cell density

for phaco US energy count which was cumulative dissipated energy (CDE) used for objectively timing the phaco time.

Sample size in each group was 24 patients. Alocation randomization by simple random sampling for both groups. Data analysis used Fisher test for categorical scale (gender, lateralization, and first/second surgery). Mann Whitney test was used for numeric scale (age, dense cataract, AXL, CDE, duration of operation, and VAS). General linear model (GLM) repeated measurement was used for analysis CCT, ECD, and visual acuity preoperation, 1 day, 1 week, and 1 month post-operation.

RESULTS

Forty eight patients with median age of 63.50 years old in high parameter group and 67 years old in low parameter group. Median cataract density of both groups was 3. Comparison of CDE showed significant differences in both groups (15.8 vs 21.29) with p=0.015. Median duration of operation time in both groups were not significantly different (14 vs 15 minutes) with p=0.447. Median VAS was 2 in both groups with p=0.615. CCT and ECD showed no significant difference between both groups (p=0.243 and p=0.980) (Table 1). There was no difference in visual acuity between both groups (p=0.905, showed in Table 2).

DISCUSSION

The result of this study showed CDE less in high parameter phacoemulsification group. Cumulative dissipated energy will automatically appears on the screen of infinity phaco machine. Cumulative dissipated energy becomes the standard for phacoemulsification efficacy evaluation, the less the value of CDE use of energy in the anterior chamber, the less cornea endothelial cell damage. Influence factors of nucleofragsis technique, phaco tip mode, cataract density, phaco-emulsification surgeon, US energy, and

Table 2. Comparison of visual acuity between high and low parameter group pre-operation, 1 day, 1 week, and 1 month post-phacoemulsification

Variable	Group H Mean±SD	Group L Mean±SD	p Value
Visual acuity (logMAR)			**0.905**
Pre op	0.55±0.54	0.50±0.44	
1 day	0.12±0.20	0.11±0.19	
1 week	0.03±0.84	0.05±0.15	
1 month	0.02±0.05	0.03±0.87	

Group H: group of high parameter phacoemulsification; Group L = group of low parameter phaco-emulsification; CCT: central corneal thickness; ECD: endothelial cell density

vacuum are involved in CDE.[8-10] In low parameter phacoemulsification group, US energy and vacuum are lower than higher parameter group. Both need to emulsify nucleus fragment and retract nucleus to phaco tip; in low parameter group, this phase is slower than high parameter group.

Patients' pain perception in phaco-emulsification may be caused by phaco tip insertion and IOP fluctuation in anterior chamber. Important for phacoemulsification surgeon capable to maintain anterior chamber stability to reduce IOP fluctuation.

Limitation of our study, patients' pain perception on each phase phacoemulsification could not be measured. It is not possible to perform VAS while patient is in operation table.

Increase of CCT and decrease of ECD for both group parameter phacoemulsification are possible by phacoemulsification surgeon performing stop and chop nucleofragsis at iris plane. There are no differences in endothel cell loss. Other factors that may influence endothel cell loss had been minimal, such as our study used same the same type visoelastic and irigation fluids. Likewise, result of visual acuity, had no difference since it depends on condition of cornea endothelial cell.

CONCLUSION

Phacoemulsification using high and low parameter have an equal in safety and patient's comfort. Even though, high parameter phacoemulsification group had better efficacy. Both parameters can be recommended for other phacoemulsification surgeons by considering 2-3 dense of cataracts, stop and chop technique and nucleofragsis performed at iris plane, based on our study.

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