|| ISSN(online): 2589-8698 || ISSN(print): 2589-868X ||
International Journal of Medical and Biomedical Studies
Available Online at www.ijmbs.info
NLM (National Library of Medicine ID: 101738825)
Index Copernicus Value 2019: 79.34
Original Research Article
Volume 5, Issue 9; September: 2021; Page No. 291-295

STUDY OF CUMULATIVE DISSIPATED ENERGY IN PHACOEMULSIFICATION CATARACT SURGERY WITH RESPECT TO PHACO TECHNIQUES - A PROSPECTIVE RANDOMIZED INTERVENTIONAL STUDY.

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Article Info: Received 15 July 2021; Accepted 18 August 2021
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Conflict of interest: No conflict of interest.

Abstract

Background: Phacoemulsification surgery is being increasingly used as a method of choice in developing countries for cataract. It can be done by different methods viz. phaco chop technique and divide and conquer technique. Cumulative dissipated energy (CDE) is used to monitor the energy delivered during the process of cataract surgery by phacoemulsification process. The less is the CDE, better is the corneal impact. We conducted a prospective interventional study to evaluate effectiveness of different phacoemulsification surgery techniques in various grades of cataract and its impact on cornea, effective phaco time and intraoperative complications in cataract surgery.

Patients and methods: This was a prospective interventional study in patients with age related cataract visiting a tertiary care hospital during a period of 1year. Patients aging more than 40 years having cataract were randomly divided in two groups. Group A was operated by phaco chop technique of phacoemulsification surgery while Group B was operated by divide and conquer technique. CDE, effective phaco time (EPT), best corrected visual acuity (BCVA) and intra/ post-operative complications were compared amongst the two groups.

Results: 216 patients were included in the study which were randomly allocated to Group A (n=108) and Group B(n=108). Both the groups were comparable with respect to age and gender ($z= 0$, $p> 0.05$). The mean CDE for phaco chop technique was 0.631 ± 0.1 min while for divide and conquer technique was 0.909 ± 0.3 min ($Z= 8.78$, P value = 0.01). Mean effective phaco time (EPT) for phaco chop technique was 38.65 seconds while for divide and conquer technique was 54.55 ($Z = 7.91$, P value = 0.01). Most common intra operative complication was posterior capsular rent seen in 1.8% of phaco chop technique while 2.7% in divide and conquer technique ($z=0.9$, p value> 0.05). Post operatively corneal clarity On day 7 was 46 % for phaco chop and 40.7 % for divide and conquer technique (Z test = 3.2, P value < 0.05). There was no statistically significant difference in best corrected visual activity (BCVA) at the end of 45 days in two groups.

Conclusions: Effective phaco time and Cumulative dissipated energy was lower in phaco chop technique compared to divide and conquer technique. Divide and conquer technique was associated with decreased early postoperative best corrected visual acuity however, no difference was found in final best corrected visual acuity between the two techniques. Phaco chop technique was associated with same incidence of post-operative complication as compared to divide and conquer however, it did not affect final visual outcome.

Keywords: BCVA (Best corrected visual acuity), EPT (Effective phaco time), NS(Nuclear sclerosis) , DM(Descemet's membrane)

Introduction

Cataract is the commonest cause of avoidable blindness worldwide[1] and cataract surgery is the commonest procedure performed in ophthalmology[2]. Cataract surgery have changed significantly over the past several decades from Intracapsular cataract extraction (ICCE), Conventional Extracapsular cataract extraction (ECCE) to Small incision cataract surgery (SICS) and finally to more advanced Phacoemulsification which is now considered as the gold standard for cataract surgery[3]. Phacoemulsification is a technique of cataract surgery in which ultrasonic device is used to break and then remove the cloudy lens and implant the artificial intraocular lens to improve the vision. The goal of emulsification of lens is to remove the cataractous lens with small incision. Cumulative dissipated energy (CDE) is used to monitor the energy delivered during the process of cataract surgery by phacoemulsification process. The less is the CDE, better is the corneal implant[4].The various techniques of phacoemulsification surgery are phaco chop method, divide and conquer etc[5].All the surgery were performed by single surgeon on same phaco machine and phaco tip.

Complications of phaco surgery include Descemets membrane tear, Corneal edema, Corneal Endothelial damage, Posterior displacement of iris, Lens diaphragm, Deepening of anterior chamber and Pupillary dilatation and Astigmatism due to faulty incision closure[6].

Objective

Present study aims to evaluate effectiveness of various phacoemulsification techniques in cataract surgery and its

impact on cornea, effective phaco time and intraoperative/ postoperative complications in cataract surgery.

Study Design

This was a prospective interventional study in patients with age related cataract visiting a tertiary care hospital during a period of one month. Only patients more than 40 years of age of either sex were included in the study. Patients with preexisting corneal opacity, corneal dystrophy, corneal degeneration, pterygium, uveitis or posterior segment pathology like diabetic retinopathy, maculopathy, optic neuropathy, retinal detachment were excluded from the study. Patients less than 40 years or having glaucoma, complicated cataract or phacodonesis were also excluded from the study. Finally, 216 patients were included in the study which were randomly allocated to two different groups: Group A comprised of 108 cataract patients operated with phaco chop technique while Group B included 108 Operated with divide and conquer technique. Intraoperative effective phaco time (EPT), cumulative dissipated energy (CDE) and complications were noted in each group. Postoperatively patients were examined on Day 1, Day 7, Day 30, Day 45, 6 months for best corrected visual acuity and status of cornea.

Results

Mean age of the patients operated with phaco chop technique was 64.04 years while 67.85 years for patients operated with divide and conquer technique. Gender wise, there was no statistically different difference in two groups. The mean CDE for phaco chop technique was 0.631 ± 0.1 min while for divide and conquer technique was 0.909 ± 0.3 min (z= 8.78, p value = 0.01) **(Table 1).** Mean effective phaco time (EPT) for phaco chop technique was 38.65 seconds while for divide and conquer technique was 54.55 (z = 7.91, p value = 0.01) **(Fig 1).** Most common intra operative complication was posterior capsular rent seen in 1.8% of phaco chop technique while 2.7% in divide and conquer technique (z=0.9, p value> 0.05) **(Table 2).** Post operatively corneal clarity was seen in 37 % for phaco chop technique on day 1 while it was 25.9 % for divide and conquer technique (z test = 2.3, p value < 0.05) **(Table 3)**. On day 7 was 46 % for phaco chop and 40.7 % for divide and conquer technique (z test = 3.2, p value < 0.05).

Table No 1: mean CDE for phaco techniques

Phaco Technique	Phaco Chop	Divide and Conquer	z Test	P Value
MEAN CDE	0.631 ± 0.1 min	0.909 ± 0.3 min	8.78	0.01

Analysis of best corrected visual activity (BCVA) by minimum angle of resolution (MAR) scaling showed that 60 patients had > 1log MAR grading, 48 had ≤ 1 -≥ 0.3 and none of the pts had ≤ 0.18 – 0.0 on DAY 1 amongst patients operated by phaco chop technique while on day 7, 37 patients had > 1logMAR grading, 71 had ≤ 1 -≥ 0.3 and no patient had ≤ 0.18 – 0.0 logMAR grading.

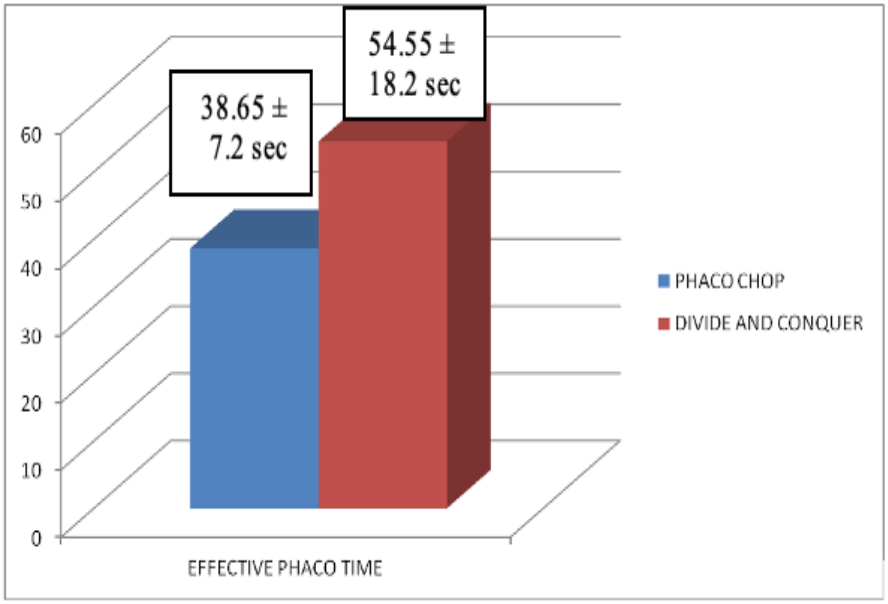

Figure No 1: Mean EPT for phaco techniques

Table No 2: Intra operative complications in various phaco techniques

	PHACOEMULSIFICATION TECHNIQUE				Z TEST	P VALUE
	PHACO CHOP		DIVIDE AND CONQUER			
Intra operative complications	No of Pts	%	No of Pts	%		
Posterior Chamber rupture	2	1.80%	3	2.70%	0.9	>0.05
Descemet's membrane Detachment	2	1.80%	2	1.80%	0	>0.05
Iris Capture	1	1%	1	1%	0	>0.05
Zonular Dialysis	1	1%	1	1%	0	>0.05
Vitreous Loss	1	1%	1	1%	0	>0.05

Table 3: Post-operative corneal clarity for various phaco techniques

	PHACOEMULSIFICATION TECHNIQUES		Z TEST	P VALUE
	PHACO CHOP	DIVIDE AND CONQUER		
DAY 1	37%	25.90%	2.3	<0.05
DAY 7	46%	40.70%	3.2	< 0.05
DAY 30	100%	100%	0	> 0.05
DAY 45	100%	100%	0	>0.05
6 MONTH	100%	100%	0	>0.05

Amongst patients operated by divide and conquer phaco technique, 80 patients had > 1 logMAR grading, 28 had ≤ 1 -≥ 0.3 and none of the pts had ≤ 0.18 – 0.0 on day 1 while on day 7, 80 pts had > 1logMAR grading, 28 had ≤ 1 -≥ 0.3 and no patient had ≤ 0.18 – 0.0.

Discussion

Phacoemulsification is the gold standard for cataract surgery and is preferred technique for cataract surgery[5]. Two different techniques of phaco surgery i.e. phaco chop and divide and conquer have different impact on best corrected visual acuity, cornea and intraoperative complications[6,7].

In the present study, we have compared EPT, CDE, visual outcome and corneal impact in phacoemulsification method of cataract surgery with phaco chop and divide and conquer technique.

Clinically, hardness of nucleus grading is based on lens opacity classification system (LOCS) III classification after full pupil dilatation on slit lamp examination[8]. Higher grade of cataract requires the higher ultrasound energy for phacoemulsification which may be responsible for corneal damage. For this purpose, present study included various grades of nuclear sclerosis. Both phacoemulsification techniques were done under peribulbar block by two different surgeons. Intra operatively EPT, CDE and intra operative complications were noted. Post operatively; all patients were examined on Day 1, Day 7, Day 30, Day45 and 6 months for BCVA, corneal status and post-operative complications. All the patients were followed up without any drop out. Patients were operated with clear corneal phacoemulsification, 108 with phaco chop technique in group A while 108 using divide and conquer technique in group B. In the present study, most patients were in age group of 57 – 81 years. Mean age for group A was 64.04 years and for group B was 61.85 years. There was no statistical difference between two groups by Z test. (p = 0.34, z> 0.05). This means that age factor that reflects status of cornea and endothelial count was same in both groups.

In present study, we found that EPT was 38±7.2 min for group A and 54.55±18.2 sec for group B (z= 7.91, p=0.01). This indicates higher energy is required for divide and conquer technique compared to phaco chop technique. Increased corneal damage was found to be due to increased phaco energy used to emulsify the lens which shows that, phaco chop technique was better than the divide and conquers technique.

Intra operatively CDE was noted in each group. It was 0.631±0.1 sec for group A and 0.909±0.3 sec for group B (z= 8.78, p= 0.01). There was statistical difference between the two groups indicating phaco chop technique being better than divide and conquers technique. This is in line with the findings of **Tsorbatzoglou A et al**[8], who found that, phaco energy decreases with phaco chop technique compared to divide and conquer technique.

Park J et al[9], in a study to compare phaco techniques for CDE and UST, found that both the technique i.e. Phaco chop and divide and conquer technique are effective in mild to moderate cataract. With hard cataract, phaco chop technique

is better than divide and conquer technique. Corneal endothelial changes were less with phaco chop technique than divide and conquer technique. **DeBry et al**[10], studied various phaco technique to compare phaco chop technique and found that mean phaco energy was significantly lower in phaco chop technique than divide and conquer technique. No intra operative complications were seen in either group.

Most common intra operative complication in both the groups was posterior capsular rupture. his might be due to difference in of techniques used for phacoemulsification surgery which results in phaco through plate with instant rupture of posterior capsule. Complications like descemets membrane detachment were seen in 1.8% of patients in group A and group B respectively. Iris capture was seen in 1% of patients in group A and group Beach. Zonular dialysis was seen in 1 % in group A as well as group B. Vitreous loss were found in 1% of patients in group A and group B. No statistical difference was seen between the two groups in each of the complications ($z=0$, $p> 0.05$).

Using various phaco chop and divide and conquer technique, **Storr Paulsen A et al**[11] found that phaco chop technique is less harmful to corneal endothelium than the divide and conquer technique because it uses less phaco power.

In the present study, most common post-operative complication was striate keratopathy on day 1 was seen in 55.5% of group A and 64.81%% of group B pts ($z = 2.76$, $p< 0.05$). This was mainly due to reduced distance between phaco tip and the posterior surface of the cornea as of fear of to touch the posterior capsule leading to PC rupture.

Tina Wong et al[12], in a study to compare phaco technique for phaco time and power required, significant advantage was seen with phaco chop technique over divide and conquer technique. It was observed in the study that the intra operative as well as post-operative phaco complication were similar in both the cases.

In the present study, post operatively on Day 1, visual outcome depending on log MAR scale > 1 was 55.5% in group A and 74% in group B ($z= 2.74$, $p= 0.005$). Similarly, on Day 1, clear cornea was seen in 37% of group A and 22% in group B. Post operatively on Day 7, visual outcome depending on log MAR scale >1 was 34.2% in group A and 74% in group B ($z= 1.99$, $p=0.04$). Similarly, on Day 7, clear cornea was seen in 40.7% in group A and 27.7% in group B.

Post operatively on Day 30, visual outcome depending on log MAR scale >1 was 32.4% in group A and 0% in group B ($z= 0$, $p>0.05$). Similarly, on Day 30, clear cornea was seen in 100% in group A and 100% in group B ($z= 0$, $p> 0.05$).

Post operatively on Day 45, visual outcome depending on log MAR scale > 1 was 0 %in group A and 0% in group B ($z= 0$, $p> 0.05$). Similarly, on Day 45, clear cornea was seen in 100% in group A and 100% in group B ($z= 0$, $p> 0.05$).

Post operatively on 6 months, visual outcome depending on log MAR scale > 1 was 0% in group A and 0% in group B ($z= 0$, $p> 0.05$). Similarly, on 6 months, clear cornea was seen in 100% in group A and 100% in group B ($z= 0$, $p> 0.05$).

Conclusion

Divide and conquer technique was associated with decreased early postoperative visual acuity however, no difference was found in final best corrected visual acuity between phaco chop and divide and conquer technique. Phaco chop technique was associated with same incidence of post-operative complication as compared to divide and conquer however, it did not affect visual outcome. Effective phaco time and Cumulative dissipated energy was less in phaco chop technique compared to divide and conquer technique.

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