



Article

COMPARISON OF PAIN PERCEPTION IN CATARACT SURGERY WITH PHACO- HORIZONTAL-CHOP TECHNIQUE VERSUS VERTICAL-CHOP TECHNIQUE IN GRADE 3 CATARACT

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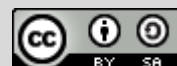
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ABSTRACT

Most cataract surgery is done by phacoemulsification method. Phacoemulsification cataract surgery with horizontal chop and vertical chop techniques is quite effective until now. In cataract surgery, generally used topical anesthetic pantocaine 0.5% (tetracaine 0.5%) to control pain in patients. This research aims to compare pain perception using a numeric rating scale in grade 3 cataracts operated by the phaco-horizontal-chop versus vertical-chop technique. This study is a comparative analytical study with a total of 87 subjects, consisting of 45 subjects undergoing surgery with the horizontal-chop technique, and 43 subjects with the vertical-chop technique. All patients were given the same topical anesthetic, pantocaine 0,5%. After the operation done, each subject will be asked about their pain perception using a numerical rating scale parameter. Then, the data were analyzed using univariate and bivariate analysis using chi-square. Among the 87 patients, mean pain scale in this study was 3.51, with a median value of 3.00. The minimum value of the pain scale was 1 while the maximum value was 6. The results showed that there was no significant relationship to pain experienced by patients undergoing phacoemulsification cataract surgery with the horizontal-chop technique compared with the vertical-chop ($p = 1,000$).

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INTRODUCTION

The global prevalence of cataract reported by Hashemi et al. was 17.20%¹. The most common cataract surgical method at this time is the phacoemulsification method. Phacoemulsification is an operating technique that uses an ultrasonic tipping, before which an

incision is made on the periphery of the cornea, then a nucleus broken and aspiration of cataract components is carried out using an ultrasonic tip tool. The incision made in phacoemulsification cataract surgery is very small, which is a distinct advantage of this surgery². Another advantage of phacoemulsification cataract surgery is that during the surgical process, the depth of the anterior ocular chamber can be controlled, postoperative wound healing is relatively fast, the vision obtained after surgery is also very good, and does not cause complications such as postoperative astigmatism³.

Phacoemulsification techniques are broadly classified into two categories: endocapsular and supracapsular approaches. In supracapsular phacoemulsification, most of the emulsification occurs above the capsular plane, typically at or above the level of the iris. Common nucleotomy techniques employed during phacoemulsification include divide-and-conquer, stop-and-chop, and direct chop (phaco chop). The divide-and-conquer technique involves creating grooves in the nucleus and segmenting it into four quadrants, which are subsequently emulsified and aspirated individually. The stop-and-chop technique begins with the formation of a central crater to facilitate partial nucleus removal, followed by mechanical chopping. In the phaco chop technique, the phaco tip is embedded into the nucleus, which is then mechanically divided into smaller fragments using a chopper. Following nuclear disassembly, the epinucleus and cortical material are removed using bimanual irrigation and aspiration. Subsequently, a posterior chamber intraocular lens (PCIOL) is implanted within the capsular bag.^{4,5}

Phaco-chop, first introduced by Nagahara in 1993, is widely regarded as one of the most efficient techniques for nuclear fragmentation, as it minimizes the need for extensive ultrasound sculpting time. Several modifications of this technique have since been developed and adopted, including the two-dimensional horizontal chop and the three-dimensional vertical chop. The vertical chop technique allows for deeper penetration into the nucleus and is particularly advantageous in the management of dense or hardened cataracts⁶. The study demonstrated that the phaco-chop technique was associated with significantly lower endothelial cell count (ECC) loss, cumulative dissipated energy (CDE), ultrasound time (UST), and overall phacoemulsification time compared to the divide-and-conquer technique. These differences are primarily attributable to the reduced phaco energy required in the phaco-chop approach. According to the literature, this advantage arises from the use of manual chopping to fragment the nucleus into smaller, more manageable pieces⁷.

An optimal anesthetic protocol should ensure a pain-free procedure without inducing systemic or local complications. It should also facilitate surgical performance for both the surgeon and the patient while remaining cost-effective. Topical anesthesia in phacoemulsification cataract surgery has emerged as the preferred approach among

ophthalmologists, as it expands the indications for surgery and eliminates the risks associated with peribulbar injections. This method can be performed in a comfortable surgical environment and is associated with relatively low stress levels in patients undergoing the procedure under local anesthesia^{8,9}.

Survey findings indicate that the most preferred local anesthetic was 2% lidocaine, selected by 57.7% of surgeons. The second most commonly used agent was a 1:1 combination of 2% lidocaine and 0.5% bupivacaine, whereas 0.5% proparacaine was the least utilized. These preferences are likely attributable to the relative ease of administration for surgeons and the level of comfort afforded to patients. Overall, 2% lidocaine remains the most favored local anesthetic agent. Additionally, there appears to be a shift away from sharp-needle anesthesia techniques in cataract surgery, a trend that is supported by survey data, particularly in the United Kingdom¹⁰.

Patient comfort, including postoperative pain during cataract surgery using the phaco-chop technique, has not yet been investigated. This study aims to examine the comparison of pain perception in cataract patients who underwent phacoemulsification cataract with the horizontal-chop technique compared to the vertical-chop.

METHODS

This study uses a comparative analytical research design with a *cross sectional* approach, with a sampling method with *total sampling*. Data collection in this study was carried out at once (*point time approach*) or in other words, each subject was only collected data once. In this study, there were 87 subjects, all of whom were 3rd degree cataract patients, each consisting of 45 subjects who underwent surgery with *the horizontal-chop* technique, while the other 43 subjects underwent surgery with *the vertical-chop* technique. Data collection in this research was carried out in several hospitals spread across the Yogyakarta and Central Java areas, this research was carried out for 2 months, from July to August 2024.

All subjects who have been identified as cataract sufferers, will undergo a thorough eye examination first before surgery, then surgery scheduling is carried out. The operator who performs the surgery is an experienced ophthalmologist. Subjects who will undergo cataract surgery will be given topical anesthesia with 0.5% pantocain before surgery. Next, an incision is made with a 2.75 mm keratom, then a blue trypan is given into the anterior ocular camera, then without rinsing sodium hyaluronate is added. Then the operator performs anterior capsulotomy by means of continuous circular capsulorhexis (CCC). The second port incision was made with a 15-degree knife, then hydrodissection was carried out, followed by

phagoemulsification with horizontal chop and vertical chop techniques at random on each patient. After the surgery was completed, each subject would be asked about the perception of pain they felt using the numeric rating scale parameters, the subjects would score on a scale of 0 to 10 for the perception of pain they felt. A value of 0 for the perception of no pain, while a value of 10 for the perception of maximum pain that a subject has ever experienced⁸. The pain scale is then categorized into mild pain, moderate pain, and severe pain. Subjects who were excluded from this study were those who did not fall into the category of 3rd degree cataracts, were not cooperative, had eye infections or trauma, and subjects who did not understand the pain scale of 0-10.

The data analysis carried out in this study is in the form of univariate analysis and bivariate analysis. The data obtained will be analyzed using SPSS software. Univariate analysis is a method that is carried out to analyze each variable gender in the research. Bivariate analysis is an analysis that is carried out to connect between independent variables and bound variables. In this study, the bivariate analysis used is *chi-square*, because the results of the pain scale classification only produce 2 groups, so a 2x2 table can be made.

RESULTS

The results of the study on 87 research subjects who underwent cataract surgery were obtained as follows: as many as 45 (51.7%) subjects underwent phacoemulsification cataract surgery with the *horizontal-chop* technique, while as many as 42 (48.2%) subjects with the *vertical-chop* technique. The gender distribution of subjects in this study includes: 37 (42.5%) male subjects and 50 (57.4%) female subjects.

Table 1. Characteristics of Phacoemulsification Cataract Surgery Subject and Technique

Characteristics	Sum	Percentage (%)
Surgical Techniques	87	
Horizontal chop	45	51,7
Vertical chop	42	48,2
Gender		
Man	37	42,5
Woman	50	57,4

In this study, there were more female subjects than male subjects, with 50 female subjects and 37 male subjects. This is in line with the research of 13, according to the study in women, especially those who have experienced menopause, there is a decrease in estrogen levels, while estrogen has an antioxidant effect. Antioxidants function to maintain mitochondrial function and ATP levels in the lens during oxidative stress.

The mean value of pain scale from the overall data in this study was 3.51, while the *median* value of pain scale data in this study was 3.00. For the minimum and maximum values of the pain scale based on *the numeric rating scale* in this study, the minimum value of the recorded pain scale is a scale of 1 and the maximum value of the recorded pain scale is a scale of 6. Since the minimum value of the pain scale is a scale of 1 and the maximum value is a scale of 6, there can only be 2 classifications of pain, namely mild pain and moderate pain. Pain is said to be mild if it is on a scale of 1-3, moderate pain on a scale of 4-6, and severe pain on a scale of 7-10.

The data distribution of phacoemulsification surgery techniques and pain scale was carried out using *the Kolmogorov-Smirnov* test (because the number of samples was > 50), which obtained the result of $p = 0.000$ in each data group. Because the p value < 0.05, it can be concluded that the distribution of data on phacoemulsification surgery techniques and pain scales is not normally distributed.

The results of the bivariate analysis in this research are shown in table 2. The test used is *chi-square*, because it meets the requirements of *the chi-square* test, judging from the *expected count* value in the table whose value is less than 5 not more than 50 % of cells, even all *the expected counts* are above 5. The p value obtained was 1,000, where $p > 0.05$, which means that there was no significant relationship between the type of phacoemulsification surgery technique, both *horizontal-chop* and *vertical-chop techniques*, on the pain experienced by the patient.

Table 2. Results of Bivariate Analysis of the Type of Phacoemulsification Surgery Technique with Pain Classification

	Mild pain		Moderate pain		p
	n	%	n	%	
Horizontal Chop	27 (expected count 26.9)	31.03 %	18 (expected count 18.1)	20.68 %	1.000
Vertical Chop	25 (expected count 25.1)	28.73 %	17 (expected count 16.9)	19.54 %	
Total	52		35		87

DISCUSSION

Several studies have demonstrated associations between pain perception, negative intraoperative experiences, and demographic factors such as gender, race, age, as well as clinical characteristics. In addition, various factors may influence pain perception, including surgical

duration and patient-related variables such as age, gender, educational level, systemic and ocular comorbidities, and prior surgical history. These considerations are essential for optimizing surgical protocols to achieve more satisfactory patient outcomes¹¹. Although phacoemulsification is considered a minimal invasive surgery, The surgeon's skill and ability to perform cataract surgery within a short operative time represent important factors influencing the feasibility and applicability of topical anesthesia techniques¹².

The phaco-chop technique has been shown to result in less damage to the corneal endothelium, as it requires lower intraocular ultrasound energy compared to the divide-and-conquer technique. However, other studies have reported that all three nucleotomy techniques in phacoemulsification such as divide and conquer, stop and chop, and phaco chop are equally effective in terms of changes in central corneal thickness (CCT), endothelial cell loss, and complication rates when performed by an experienced surgeon^{5,7,13}.

Topical anesthesia for phacoemulsification cataract surgery offers several advantages over peribulbar or retrobulbar anesthesia, as it eliminates the risks of globe perforation, retrobulbar hemorrhage, and injury to orbital structures. Furthermore, this technique is cost-effective, avoids undesirable cosmetic side effects, and facilitates rapid visual rehabilitation. Most studies have reported that patient-perceived pain under topical anesthesia is generally low and well tolerated compared with that experienced by patients receiving peribulbar anesthesia¹⁴.

Phacoemulsification is the first choice for the treatment of cataracts. the operation also has the advantages of small incision, safe and convenient operation, and is well accepted by patients and doctors. This could avoid the risk of eyeball hemorrhage and blood vessel injury caused by retrobulbar anesthesia. Psychological analysis for each patient, and implement of psychological nursing care could eliminate adverse effects, encourage patients to regain confidence, and cooperate with doctors for treatment¹⁵.

Several techniques are encompassed within the chop method, including stop-and-chop, vertical chop, and horizontal chop. The operating techniques of horizontal-chop and vertical-chop phacoemulsification are in general almost similar, only differing in the lens breaking technique. Despite these variations, the fundamental maneuvers and overall advantages remain consistent. All techniques exploit the natural cleavage planes within the crystalline lens. In the horizontal chop technique, the chopper is maneuvered around the equator of the lens and brought toward the phaco tip in the horizontal plane to create a fracture. In contrast, the vertical chop technique involves embedding the phaco tip into the nucleus and elevating it while the chopper is driven downward to propagate the crack. The stop-and-chop technique, meanwhile, begins with the creation of a central groove to provide space, followed by horizontal chopping of the resulting heminucleus¹⁶.

In this study, no statistically significant difference was observed in pain scores between patients undergoing phacoemulsification using the horizontal chop technique and those treated

with the vertical chop technique. This finding may be attributed to the relatively short operative duration and the use of standard topical anesthesia commonly employed for these surgical techniques¹⁴.

CONCLUSION

There was no significant difference in pain experienced by patients undergoing phacoemulsification cataract surgery with *the horizontal-chop* technique compared to *vertical-chop*.

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