

Cost effectiveness analysis between small incision cataract surgery and phacoemulsification

by Ernawaty Ernawaty

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COST EFFECTIVENESS ANALYSIS BETWEEN SMALL INCISION CATARACT SURGERY AND PHACOEMULSIFICATION

Wulandari A¹, Dahlui M^{2,3}, Ernawaty³, Wulandari RD³, Rochmah TN³

¹Faculty of Medicine, Universitas Lambung Mangkurat, South Kalimantan, Indonesia

²Centre of Population Health, Dept. of Social and Preventive Medicine, Faculty of Medicine, University of Malaya, Malaysia

³Faculty of Public Health, Universitas Airlangga, Surabaya, Indonesia

Corresponding author:

Thinni Nurul Rochmah

Faculty of Public Health, Universitas Airlangga,

60115 Surabaya, East Java, Indonesia

Email: thinni_nurul@fkm.unair.ac.id

Abstract

Background: Cataract is the second priority eye disease in the world and this case in Indonesia occupies the third-highest position in Southeast Asia. There are two methods for cataract treatment that can be expensive, small incision method (SICS) and Phacoemulsification method, and it is important to know the cost-effective comparison of those two methods.

Objective: This study aims to conduct Cost-Effectiveness Analysis (CEA) between cataract surgery; Small Incision Cataract Surgery (SICS) and Phacoemulsification, at Undaan Eye Hospital Surabaya.

Materials and Method: A prospective study following up patients from before surgery up to 21 days' post surgery. A total of 155 cataract patients had undergone surgery; 25 patients and 130 patients had SICS and Phacoemulsification, respectively. Quality-Adjusted Life Years (QALYs) was used as the outcome measure. The assessment of utility using 'Visual Function 25' (VF-25) was the quality of life regarding visual function before surgery, 7 days, and 21 days post-surgery.

Result: The average cost of Phacoemulsification technique was Rp 10,821,038 and the average cost of SICS technique was Rp 10,443,544. QALYs at day7 post-surgery of Phacoemulsification and SICS was 9.49 and 8.95, respectively. While QALYs at day21 post- surgery of Phacoemulsification and SICS was 10.37 and 10.15, respectively. ICER values for Phacoemulsification versus SICS at day7 post-surgery was Rp 696,360 (USD 49,74) while at day 21 was Rp 1,723,559 (USD 123,11).

Conclusion: Phacoemulsification and SICS are effective ways to improve the quality of life related to visual function. The incremental cost per QALYs obtained via Phacoemulsification from SICS at D7 and day21 post- surgery were less than Indonesia's GDP per capita income of USD 3,347, means that Phacoemulsification is more cost effective than SICS technique for cataract surgery.

Keywords: Cataract surgery, Cost-effectiveness, Small incision, Phacoemulsification, Quality of life

Introduction

Cataract is the second most common cause of visual impairment in the world at 33% and causes 51% of blindness in the world (1). Cataract is in the second position of eye disease which becomes a priority in the world. This shows that cataract is still a priority problem for eye diseases which must be addressed. Around 20 million people suffer from blindness caused by cataracts, 90% of which are found in the developing countries, including Indonesia (1,2).

The rate of blindness caused by cataracts in Indonesia is the highest in Southeast Asia and is ranked the third in the world at 1.47% (3). In Indonesia, it is estimated that in every minute, one person becomes blind. This number will be doubled by 2020

in relation to increasing life expectancy (4,5). Visual impairments due to cataracts

have negative impacts on mobility, participation in social activities, work productivity, leisure activity, reduced ability to conduct daily activities to become dependent, and may cause depression (5).

The treatment for cataracts is only by surgery which can be expensive (6). There are several techniques for performing cataract surgery, each with different resource utilization and cost. In view of the limited budget especially in developing countries, there is a need to perform an economic evaluation to decide on which intervention to select. Cost-Effectiveness Analysis (CEA) is an economic evaluation tool that compares the health benefits and measures the cost of each intervention with the same goal to determine which intervention would be more cost-effective (7, 8).

As for the methods of cataract surgery at Undaan Eye Hospital Surabaya, there are small incision methods (SICS) and Phacoemulsification. SICS is a conventional technique which does not depend on machines, does not require expensive equipment investment, and the transfer of

skills to novice operators may also be conducted well. Therefore, the SICS technique has been considered as a safe and effective technique for cataract surgery especially in the developing countries (9). Phacoemulsification has been the method of choice for cataract extraction in the developed countries over the past few years. Phacoemulsification is a minimal suture cataract surgery technique which uses ultrasonic vibrations to destroy the lens nucleus. Phacoemulsification is much more dependent on technology than other surgical techniques.

Boughton (2009) stated that in relation to the cost of treatment incurred using the Phacoemulsification technique, policy analysts had questioned the feasibility of utilizing it in the low and middle-income countries. Phacoemulsification is preferred in developed countries with a large health budget but not for developing countries due to financial constraints (10). However, it is necessary to do something to make health services more effective, efficient, and economical as well as to allocate resources such as conducting economic evaluations related to the available treatment alternatives through a cost-effectiveness analysis (11). Therefore, in order to know whether Phacoemulsification can be more cost-effective compared to SICS, we need to perform CEA.

Method

This was a prospective study following up patients from before surgery up to 21 days post surgery. The patients had their cataract procedure at the Undaan Eye Hospital Surabaya. The inclusion criteria were all cataract patients with mature cataracts, without complications of glaucoma, retinal detachment, and traumatic cataracts. All patients who had undergone the cataract procedure via Phacoemulsification and SICS between January 2019 -March 2019 were recruited. A total of 155 patients with 25 patients and 130 patients had SICS and the Phacoemulsification technique, respectively.

The cost of both techniques being compared was from the patient's perspective. The costs consisted of direct costs such as payment made by patients for hospital bills and indirect costs such as costs due to lost productivity, transportation costs, and expenditure for companions. Lost productivity costs were measured by calculating work time lost (in hours or days), then multiplied with income (per hours or days) for salaried patients, or the number of products which were not successfully produced or sold multiplied by the product unit price for self-earning patients. Hospital billings imposed on patients had been obtained from the hospital record while the indirect costs were obtained through interviews with patients.

Quality-Adjusted Life Years (QALYs) was used as the outcome measure, with the formula $QALYs = Utility \times Years \text{ of Benefit}$. QALYs measure health as a combination of the Years of Benefit and the quality of life (QoL). The 'Visual Function 25' questionnaire (VF-25) which is QoL questionnaire regarding visual function was used to assess the effectiveness of cataract surgery which was applied before surgery, at 7 days, and 21 days' post surgery. The VF-25 questionnaire was developed by the National Eye Institute Visual Function and has been used in a variety of large population-based eye surveys which have been validated into several languages (12). NEI VFQ has good multidimensional, reliability, and validity content and can be completed in the shortest possible time (12–15).

The cost-effectiveness analysis applied in this study was to show how much the cost per QALYs gained via phacoemulsification is compared to SICS. The formula used in this study was the incremental cost effectiveness ratio between cataract surgery via Phacoemulsification versus SICS:

$$ICER = \frac{Cost_{Phacoemulsification} - Cost_{SICS}}{QALY_{Phacoemulsification} - QALY_{SICS}}$$

Ethics Statement

Ethics approval (ref number: 1265-KEPK) was obtained from the Health Research Ethics Committee, Faculty of Nursing, Universitas Airlangga.

Results

Characteristics of Respondents

The characteristics of respondents in this study is as shown in Table 1. Age categorization in this study was conducted based on age classification according to the Indonesian Ministry of Health in 2009 which are 36-45 years (final adults), > 45-55 years (early elderly), > 55-65 years (final elderly), and > 65 years (elderly) (16). The characteristics of family income in this study are based on the Governor's Decree of East Java Number 188/665/KPTS/013/2018 regarding Regency/City Minimum Wages in East Java 2019 (17). The categorization of education levels is based on the Indonesian Ministry of Education (2003) which is low education (no school-graduating junior high school) and higher education (> graduating high school) (18).

Table 1: Distribution Frequency Characteristics of Respondents

Characteristic respondent	Surgery technique			
	SICS (n=25)		Phacoemulsification (n=130)	
	Total n	%	Total n	%
Age (years)				
36-45	1	4,00	6	4,61
>45-55	6	25,00	37	28,46
>55-65	9	36,00	44	33,85
>65	9	36,00	43	33,08
Sex				
Male	1	48,00	65	50,00
Female	1	52,00	65	50,00
Work				
Housewives	8	32,00	40	30,76
Farmer	3	12,00	12	9,23

Characteristic respondent	Surgery technique			
	SICS (n=25)		Phacoemulsification (n=130)	
	Total n	Total %	Total n	Total %
Civil servants	0	0,00	9	6,92
Entrepreneur	9	36,00	29	22,31
Traders	1	4,00	7	5,38
Private employees	1	4,00	14	10,76
Retired	1	4,00	8	6,15
Not work	2	8,00	11	8,46
Family income (Rp)				
≤3,871,052	0	0,00	11	8,46
>3,871,052-7,742,104	1	52,00	42	32,31
>7,742,104-11,613,156	3			
>11,613,156	7	28,00	48	36,92
Education				
No school	1	4,00	11	8,46
Graduating elementary school	8	32,00	22	16,92
Graduating junior high school	6	24,00	26	20,00
Graduating high school	8	32,00	49	37,69
Diploma	1	4,00	0	0,00
Bachelor	1	4,00	18	13,84
Post graduate	0	0,00	4	3,08

Costs of Cataract Surgery ¹

All the costs incurred at pre-surgery, during surgery procedure and at post-surgery were totaled. The minimum direct cost of cataract surgery with the SICS technique was Rp 4,479,000 and the minimum direct cost of cataract surgery with the Phacoemulsification technique was Rp 6,127,000. The maximum direct cost of cataract surgery with the SICS technique was Rp 12,039,000 and the maximum direct cost of cataract surgery with the Phacoemulsification technique was Rp

18,237,000. The average direct cost of cataract surgery with the SICS technique and Phacoemulsification technique was Rp 9,332,000 and Rp 9,479,319, respectively (Table 2).

Table 2: Distribution Frequency of Direct Costs Cataract Surgery

	Phacoemulsification	SICS
Minimum Direct Cost (Rp)	6,127,000	4,479,000
Maximum Direct Cost (Rp)	18,237,000	12,039,000
Average Direct Cost (Rp)	9,479,319	9,332,000

The minimum indirect cost of cataract surgery with the SICS technique was Rp 26,742 while by Phacoemulsification technique was Rp 33,034. The maximum indirect cost with the SICS technique is Rp 4,333,330 and by Phacoemulsification technique is Rp 16,264,666. The average indirect cost of cataract surgery with SICS technique and Phacoemulsification was Rp 1,111,544 and Rp 1,341,719, respectively (Table 3). The overall average patient's cost of cataract surgery with the SICS technique and Phacoemulsification was Rp 10,443,544 and Rp 10,821,038, respectively.

Table 3: Distribution Frequency of Indirect Costs Cataract Surgery

	Phacoemulsification	SICS
Minimum Indirect Cost (Rp)	33,034	26,742
Maximum Indirect Cost (Rp)	16,264,666	4,333,330
Average Indirect Cost (Rp)	1,341,719	1,111,544

Thus, the incremental cost of Phacoemulsification from SICS techniques was Rp 377,494, (range between Rp 751,659 and Rp 12,468,336 (Table 4).

Table 4: Incremental Cost Effectiveness Ratio (ICER)

	Phacoemulsification	SICS	Incremental (Phacoemulsification-SICS)
Minimum Cost (Rp)	6,432,326	5,680,667	751,659
Maximum Cost (Rp)	27,423,666	14,955,330	12,468,336
Average Cost (Rp)	10,821,038	10,443,544	377,494
QALY Day 7 post-surgery	9,49	8,95	0.54
QALY Day 21 post-surgery	10,37	10,15	0.22

$$\text{ICER D+7} = (10,821,038 - 10,443) / (9.49 - 8.95) = \text{Rp } 696,360 \text{ (USD } 49,74)$$

$$\text{ICER D+21} = (10,821,038 - 10,443) / (10.37 - 10.15) = \text{Rp } 1,723,559 \text{ (USD } 123,11)$$

Outcome Measurement

The average QALYs of cataract surgery patients with the Phacoemulsification technique was higher than the QALYs for

SICS technique at Day 7 post-surgery. Similarly, the average QALYs at Day 21 post-surgery was higher via the Phacoemulsification technique compared to the SICS technique although the difference was not much (see Table 4).

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Incremental Cost Effective Ratio (ICER)

The incremental cost of cataract surgery via Phacoemulsification compared to SICS was Rp 377,494 (range between Rp 751,659 and Rp 12,468,336). The incremental QALYs at Day 7 and Day 21 post-surgery were 0.54 and 0.22, respectively (see Table 4).

The ICER between Phacoemulsification and SICS at Day 7 post-surgery was Rp 696,360 (USD 49,74), while ICER at Day 21 post-surgery was Rp 1,723,559 (USD 123,11). The Indonesia per capita GDP of the same year of study (2015) was USD 3,347 (22).

Discussion

In this study, the financial implications of having cataract surgery from the patient's perspective had been determined. In addition to cost, the QALYs comparison had been made between cataract surgeries via the high technology Phacoemulsification technique and the conventional SICS technique.

Both the average direct and indirect costs of cataract surgery by the Phacoemulsification technique was more expensive than by SICS. QALYs were also higher among cataract surgery patients who went for the Phacoemulsification technique compared to SICS at Day 7 post-surgery. This could be due to the more surgical incisions made on the cornea of the eye when applying the conventional SICS technique compared to the use of high technology equipment by the Phacoemulsification technique which only involves small incisions. At Day 7 post-surgery, the healing process took longer and the patient suffered from a pain condition longer via SICS compared to the Phacoemulsification technique. The incremental QALYs at Day 21 post-surgery were small since by then patients who had undergone both techniques would have recovered.

In this study the ICER of cataract surgery by Phacoemulsification from SICS technique was Rp 696,360 (USD 49,74) at Day 7 post surgery and Rp1,723,559 (USD 123,11) at Day 21 post-surgery. WHO had defined that for an intervention to be considered as cost-effective, ICER should be compared with the

country's ¹ gross domestic product (GDP) per capita income (very cost-effective if ICER < GDP per capita; cost-effective if ICER equals to 1-3 times GDP per capita; not cost-effective if ICER > 3 times GDP per capita) (19–21). According to the World Bank Data in the year of study (2015), Indonesia's GDP per capita income was USD 3,347 (22). Thus, since the ICER value was less than one Indonesia GDP per capita income, cataract surgery by Phacoemulsification was a more cost effective technique than the SICS technique. ² (19–21). This study should have considered cost from the hospital or provider's perspective so that a true cost-effective technique of cataract surgery could be determined. Nevertheless, doctors and patients could be encouraged to use the Phacoemulsification technique since it provides better QALYs and is cost-effective.

Conclusion

Phacoemulsification and SICS are effective ways to improve QALY related to visual function. However, compared to SICS, Phacoemulsification is a cost effective technique for cataract surgery.

Conflict of interest

The authors declare that they have no conflict of interest.

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Author Contributions

Conceptualization: AW, E, RDW, TNR. Data curation: AW, E, RDW, TNR. Formal analysis: AW, E, RDW, TNR. Funding acquisition: None. Methodology: AW, E, RDW, TNR. Project administration: AW. Visualization: AW, MD, E, RDW, TNR. Writing – original draft: AW, MD, E, RDW, TNR. Writing – review & editing: AW, MD, E, RDW, TNR

ORCID

Anggun Wulandari ⁴ <https://orcid.org/0000-0003-3947-9269>

Maznah Dahlui <https://orcid.org/0000-0003-4923-9410>

Ernawaty ⁴ <https://orcid.org/0000-0001-9786-2456>

Ratna Dwi Wulandari <https://orcid.org/0000-0003-4365-5747>

Thinni Nurul Rochmah <https://orcid.org/0000-0001-8845-1153>

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