Retrospective pharmacoeconomic evaluation of two types of cataract surgeries in a private hospital: cost effectiveness analysis

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Abstract

Objective: Cataract surgery is performed by two methods; small incision cataract surgery (SICS) and topical phacoemulsification (TPE) with intraocular lens (IOL) implantation. SICS is a widely used method but technological advances have led to increasing use of TPE. Both procedures require different capital investment. Pharmacoeconomic evaluation tends to investigate the selection and use of treatment program to make the patient medication efficient, safe and economical. The objective of the present study was to evaluate the economics and effectiveness of SICS and TPE.

Materials and Method: Records of 800 patients in a private hospital over last 5 years were retrospectively analyzed. Patients were selected with inclusion and exclusion criteria and divided into two groups; SICS (n= 350) and TPE (n=450). Follow up was done after day 1; 1, 4, 8 weeks and 2 years. The cost was calculated including direct and indirect medical and non-medical costs. Outcomes were determined according to economical benefit, surgical benefits and humanistic outcomes as per SF-36 questionnaire with slight modifications. The cost effectiveness ratio (CER) was calculated with the help of QALY and utility values.

Results: Average cost of SICS and TPE over the period of 5 years was approximately Rs. 21220 and Rs. 30670 respectively. The QALY scores of patients in TPE group were significantly higher as compared to SICS group. CER was found to be lesser with TPE.

Conclusion: Retrospective pharmacoeconomic study revealed that TPE, although having higher cost, was clinically superior and cost effective than SICS as indicated from the analysis of consequences and CER.

Keywords: Pharmacoeconomic evaluation, small incision cataract surgery, topical phacoemulsification, cost effectiveness analysis.

Introduction

Cataracts are the major cause of blindness and of severe visual impairment leading to bilateral blindness.[(1)] Modern cataract surgery aims to achieve a better unaided visual acuity with rapid post surgical recovery and minimal surgery related complications. Early visual rehabilitation, better unaided visual acuity and surgical safety can be achieved in a great measure by reducing the incision size. Incision size depends on the mode of nucleus delivery and the type of intraocular lens used. It is a leading cause of unilateral and more often bilateral blindness. The only effective means of its treatment is surgery – extraction of diseased lens and its replacement by an artificial intraocular lens (IOL).[(2)]

Small incision cataract surgery with IOL implantation (SICS) involves the expression of entire lens out of the eye through a self-sealing scleral tunnel wound. Phaecoemulsification with IOL implantation (TPE) is a modern cataract surgery in which the eye's natural crystalline lens is emulsified with ultrasound energy and aspirated from the eye. Aspirated fluids are replaced with irrigation of balanced salt solution, thus maintaining the anterior chamber, as well as cooling the handpiece.[(2,3,4)]

The two types of surgeries have different capital investment although the outcomes are almost similar with few exceptions. Hence the objective of the present study was to analyse the cost and consequences of these cataract procedures and to evaluate cost effectiveness by pharmacoeconomic evaluation methods.

Materials and Method

The patients who have been operated for cataract in a private hospital in Nagpur were included in the study. They were selected on the basis of inclusion and exclusion criteria[(5)] as shown in Table 1. The selected patients were divided in two groups according to the surgical procedure; SICS group and TPE group.

Table 1: Inclusion and exclusion criteria for selection of patients

Criterion	Parameters
Inclusion	Visual acuity less than 6/60
Exclusion	Traumatic cataract, Preexisting ocular conditions like pterygium, corneal opacities, glaucoma, diabetic retinopathy, retinal detachment

Estimation of cost: The cost of each type of surgery was calculated including direct medical, direct non-medical and indirect non-medical cost.

The direct medical cost included preoperative consultation and investigations, intraoperative

consumables and machinery, postoperative medicines, cost of surgeon's professional time, hospitalization etc as discussed with the surgeon. The direct non-medical costs including lodging, boarding and transportation charges etc. and indirect non-medical costs were calculated for each patient through questionnaire.

Assessment of outcomes

1. Economical outcomes: Outcomes related to direct and indirect monetary benefit and loss were evaluated considering the reimbursement through third party payer or managed care organization, policy makers or insurance companies, production gain by returning to work and reduction in resources respectively.
2. Clinical outcomes: The primary clinical outcome measures analysed were visual acuity (with best or minimal spectacle correction) and refraction, subconjuctival hemorrhage, level of astigmatism, capsule rupture and/or vitreous loss as a complication during surgery, incidence of capsule opacity, globe perforation as a complication of anaesthesia block, lid edema and chemosis lasting for 1-2 days, wound healing and post operative rehabilitation.[4]
3. Humanistic outcomes: The Quality of Life (QOL) parameters were evaluated as per SF-36 questionnaire with slight modifications.[6] The questionnaire was filled by the patient at the last follow up after two years.
4. Pharmacoeconomic evaluation: In order to allow a comparison of the costs and effectiveness of two selected cataract surgeries, the likely resource inputs and outcome measures were identified as mentioned above. Depreciation according to National Health Service agreement of 6% and discounting were incorporated into the calculations where relevant.[4] The set of spreadsheets was incorporated for overall cost analysis and subsequent sensitivity analyses. This allowed the following to be calculated: Unit costs of inputs, Average cost per procedure including follow up and post-surgical laser treatment if required.

By measuring costs per quality-adjusted life year (QALY) conferred from interventions, it provides evidence for policy makers to decide specific priorities with which to allocate medical resources.[7]

QALY (Quality Adjusted Life Years) = years lived in perfect health (y) x utility value

Y=2 was considered for calculations as the follow up was taken for 2 years. The utility values for various clinical outcomes were decided as per discussion with ophthalmologist in the hospital and are shown in Table 2.

The cost effectiveness ratio (CER) was calculated as[8]

CER= Net cost/ net health benefit or Cost/ QALY gained

Table 2: Utility value for clinical outcomes of cataract surgery

Clinical outcome	Measure	Utility value
Unaided visual acuity	6/6	1.0
	6/9	1.0
	6/12	0.9
	6/24 and above	0.5
Surgically induced astigmatism	No	1.0
	Yes	0.5
Spectacle dependency	No	1.0
	Less	0.5
Postoperative rehabilitation	Fast	1.0
	Slow	0.5

Results

Records of 800 patients over last 5 years were chosen and analysed for inclusion and exclusion criteria. All the cases having visual acuity less than 6/60 due to matured cataract were included in the study. But the cases with Traumatic cataract, preexisting ocular conditions like pterygium, corneal opacities, glaucoma, diabetic retinopathy, retinal detachment were excluded from the study and the selected patients were divided into two groups; SICS (n= 250) and TPE (n=350). Post surgical follow up was done after day 1; 1, 4, 8 weeks and 2 years. Average cost of each type of surgery was calculated which included preoperative consultation and investigations, intraoperative consumables and machinery, IOL (rigid or foldable),[9] postoperative medicines, cost of surgeon's professional time, hospitalization and postoperative follow up (Table 3). The cost of SICS can be further increased if the laser correction is needed in case of capsule opacity which further reduced the patients preference. The direct non-medical costs including lodging, boarding and transportation charges etc. and indirect non-medical costs were calculated for each patient through questionnaire but not included in the study since it varied individually.

Similarly, economical cost for each patient varied significantly hence were not considered for the pharmacoeconomic evaluation. The percentage of patients with various clinical outcomes is shown in Table 4.

The QALY for both the types of surgeries was calculated by multiplying utility value and years lived in

perfect health according to the table 1 and the results are shown in Table 5.

Table 3: Average cost of two types of cataract surgeries

Particulars	SICS (Rs.)	TPE (Rs.)
Preoperative consultation	300	300
Preoperative investigations-		
A scan	500	500
Hematological analysis	700	700
Physicians checkup ECG etc.	500	500
Intraoperative-		
Block (Xylocaine and hyaluronidase)	120	-
Topical anaesthetic (Proparacaine/ lignocaine)	-	70
Consumables(methyl cellulose, ophthalmic blades, balanced salt solution, IV set, gloves etc.)	800	800
Consumables (disposable kit/ cassatte for machine/ cost of machine)	-	3000
Hospital stay	1500	1500
Operation Theatre charges	3000	3000
Surgeon's charges	8000	8000
Anaesthetist (stand by)	1000	1000
Assistants/ staff	1000	1000
Post operative medicines	300	300
IOL rigid- foldable	3000	10000
Indirect cost (relatives' stay, food and transportation)	Not included	Not included
Total	20720	30670

SICS- Small Incision Cataract Surgery; TPE- Topical Phaecoemulsification

Table 4: Percentage of patients with clinical outcomes in two types of cataract surgeries

Clinical outcome	SICS (n=250) %	TPE (n-=350) %
visual acuity		
6/6	82.0	90.28
6/9	15.2	9.14
6/12	2.8	0.57
6/24 and above	Nil	Nil
Surgically induced astigmatism		
Yes	98.0	0.005
No	2.0	99.995
Spectacle dependency		
Yes	96.4	1.5
Less/ No	3.6	98.5
Subconjuctival hemorrhage	95.8	15.28
Wound healing		
Upto 7 days	-	99.0
Upto 14 days	56.2	1.0
Upto 21 days	43.8	-
Postoperative rehabilitation		
Fast (1 week)	-	99.0
Slow (3-4 weeks)	100	
Surgical complications		
capsule rupture and/or vitreous loss	Nil	Nil
capsule opacity with laser correction	4.89	0.5
globe perforation	70.5	Nil
lid edema and chemosis	90.45	Rare

SICS- Small Incision Cataract Surgery; TPE- Topical Phaecoemulsification

Percentage of each outcome = (Number of cases/ Total number of patients) X 100

CER and Incremental CER were calculated according to the given formula.

Table 5: Results showing QALY and cost effectiveness ratio

Clinical outcome	QALY	
	SICS	TPE
Unaided visual acuity	2	2
Surgically induced astigmatism	1	2
Spectacle dependency	1	2
Postoperative rehabilitation	1	2
Total	5	8
Cost	21220	30670
CER=Cost/ QALY	4244.0	3833.75**
Incremental cost (IC)	9450	
Incremental QALY (IQ)	3	
Incremental CER	3150	

SICS- Small Incision Cataract Surgery; TPE- Topical Phaecoemulsification

Incremental cost IC = (cost $_{TPE}$- cost $_{SICS}$); Incremental QALY IQ = (QALY $_{TPE}$- QALY $_{SICS;}$ Incremental CER= IC/ IQ

** $p \leq 0.01$

Discussion

Out of 800 records chosen for the study, only 600 records were considered since 200 cases were excluded on the basis of exclusion criteria as per Table 1. The number of patients for SICS group was 250 and for TPE was 350. The difference in the number may be because of the patients' preference and more specifically surgeon's preference. The average cost of each types of surgery was calculated, considering the increase cost per year and depreciation. The main difference is in the cost was due to type of intraocular lens machine charges, anaesthetic drug and disposable kit for phaeco machine (Appaswamy GalaxyPro). The direct and indirect non-medical cost was not included in cost estimation since it was different for individual patient. It was obtained by the questionnaire given to the patients. Then the reports of followed up after day 1; 1, 4 and 8 weeks and 2 years were analysed for the clinical outcomes. SICS have larger scleral incision which can lead to subconjunctival hemorrhage and surgically induced astigmatism. This leads to delay in wound healing and postoperative rehabilitation. Due to astigmation SICS patients have more spectacle dependency. The surgically induced complications like globe perforation can result in sight threatening complications. Lid edema and chemosis can occur in SICS patients due to injection of block which may result in increased intraorbital pressure giving rise to difficulty in surgery. SICS patients may experience anxiety and pain of peribulbar block injection. The preference of SICS procedure depends upon age of patient, status of cornea, cataract density and affordability. In contrast TPE is cosmetically better since there is a no corneal incision and no hemorrhage. Surgically induced complications are less. Healing is fast since wound is small and rehabilitation is rapid and stable. Uncorrected or unaided visual acuity with 6/6 vision is better in TPE with less spectacular dependency as it is astigmatic neutral. The percentage of clinical outcomes for two procedures is given in table 4. Hence clinically the TPE is superior than SICS.

However the cost input in TPE is higher as compared to SICS. Hence it was necessary to evaluate the economical aspect of these two procedures. The cost of two procedures were Rs. 21220 and Rs. 30670 for SICS and TPE respectively. Cost-effectiveness analysis is a method of comparing alternative medical interventions with regard to their resource utilisation (costs) and outcomes (effectiveness).

The present analysis provides broad description of the cost effectiveness of cataract surgeries. The years lived in perfect health were taken as 2 since the follow up was taken upto 2 years. The utility was defined in the range of 0-10 (worse-best) for clinical outcomes as shown in table 1. The CER for SICS and TPE were 4244 and 3833.75 respectively. Lower the CER, better is the option when compared with the others.[10] The incremental CER is an informative measure generated from such an analysis and represents the ratio of the difference in cost between two medical interventions to the difference in outcomes between the two interventions. Thus, the incremental cost-effectiveness ratio summarizes the additional cost per unit of health benefit gained in switching from one medical intervention to another. The cost effectiveness ratio was calculated by estimating net cost and net benefits in terms of QALY gained. It was found to be Rs.2983.33 per unit additional health benefit.

Conclusion

The study revealed that TPE is clinically superior procedure than SICS and is highly preferred by the patients as well as surgeon. Although the cost of TPE was higher, the clinical and humanistic outcomes score were also more for TPE. TPE was cost effective since CER was less with TPE than SICS. The pharmacoeconomical evaluation by cost effectiveness analysis is the key that affects the clinical decision about the choice amongst the available alternatives.

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