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Magnitude and factors associated with refractive outcome among patients who undergone cataract surgery at boru meda hospital, South wollo, Ethiopia, 2021.

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Abstract

Background: *Cataract, the opacification of the lens, is one of the commonest causes of blindness in the world. The only treatment of cataract is surgery with implantation of an intraocular lens. However, there are limited data on the refractive outcome and its associated factors with postoperative refractive correction in the study area.*

Objectives: *To assess the magnitude and factors associated with refractive outcome among patients who undergone cataract surgery at Boru Meda General Hospital, South Wollo, North eastern Ethiopia.*

Methods: *an institutional-based cross-sectional study was conducted at Boru Meda General Hospital on 398 patients undergone cataract surgery, selected by simple random sampling technique. Data entry was done by EPI -data version 4.6 and exported to STATA version14 statistical analysis. Ordinal logistic regression proportional odds model were used to determine associated factors with post operative refractive outcome by considering the p-value of <0.05 and 95% confidence interval.*

Results: *The magnitude of refractive outcome after cataract surgery was 44.3% (95% CI: 39.2, 49.2), 35.2% (95%CI: 30.5, 39.8) and 20.6% (95%CI: 16.9, 24.7) of the level of refraction outcome was good, fair and poor respectively. The respondents age ≥70 years (AOR=1.45, 95% CI 1.21, 2.96), rural residence (AOR=1.16 (95% CI: 1.06-2.23), difference intraocular lens power >1.00diopter (AOR=1.25 (95% CI: 1.05, 2.83) and history of comorbidity (AOR=14.2(95%CI: 7.85-25.54) were significantly associated with refractive outcome.*

Conclusion: *This study revealed that the magnitude of good refractive outcome was lower than WHO recommendation refractive outcomes after cataract surgery. Age of patients, residence, educational status, number of intraocular lens inserted, the difference between calculated and implanted intraocular lens, site of incision and history of comorbidity were found to be significantly associated with refractive outcome.*

amplitudes that enable one to cope with the change in the position of the eyes. This concept is of basic importance for the understanding of binocular cooperation and of the neuromuscular anomalies of the eyes [2].

Keywords: Accommodation; Convergence; AC/A Ratio; Presbyopia; Fusional amplitudes

Introduction

Cataract, the opacification of the lens, is one of the commonest causes of loss of useful vision in the world. The main cause of visually significant cataract is increasing age. Also, have been identified genetic composition, exposure to ultraviolet light, trauma and diabetes [1]. According to the World Health Organization, cataracts are the leading cause of blindness worldwide, affecting about 20 million people, and are responsible for 51% of blindness [2,3].

Cataract Surgery with small incision and implantation of intraocular lens (IOL) is the only effective treatment for managing

cataract using local anesthesia by peribulbar or retrobulbar injection is most commonly used; facial block is less common. Topical anesthesia has recently become more widely used. The choice of anesthesia is determined by the surgeon. Based on safety and efficacy, it should allow completion of surgery with the least pain and lowest risk to the patient [4].

Cataract surgery with intraocular lens (IOL) implantation is the most frequently undertaken operation with significant patient benefit [5]. In Sweden, 41% of patients who underwent routine cataract surgery still needed new spectacles correction after surgery. At present, with the rapid development of surgical and IOL technology, the goal of cataract surgery has changed from simply blindness relief to accurate refractive correction [6].

If cataract surgery is not done properly, it leads to hyper mature and morgagnian cataract, there are risks of visual disability and blindness. The disability from cataract affects or alters an individual's activities of daily living, and the cause of poverty in the countries [7]. When the patient was conducting cataract surgery we receive timely postoperative care and proper monitoring of both overall ocular health and vision status. Surgical lens removal with intraocular lens implantation is generally the preferred means of treating the functional limitations.

Post-operative refraction is one of the best measures of cataract surgery outcome [8]. The post-operative refractive error occurred after cataract surgery to correct spectacle enhancing visual acuity is important for both patients and the surgeon who wants happy patients. Refractive error after cataract surgery manifests with blurred vision at distances and near where the patient was expecting to have clear vision after surgery. But the patients and surgeon are unhappy with uncorrected visual acuity [9].

A postoperative refractive error is one of the most significant risk factors for poor visual and functional outcomes after cataract surgery. The amount of post-operative refractive error is 99.1% of operated eyes and the median of spherical equivalent refractive error was ±0.25 D [10].

The difference between expected and final post operative refraction after cataract surgery within ±0.50 D and within ±1.00 D are 58.4% and 83.8% of patients respectively [9].

The possible factors of refractive outcome after cataract surgery are the patient's age, operated eye, comorbidities – glaucoma and diabetes mellitus, corneal incision, measurement of the ocular parameters (keratometry, axial length), the selection of IOL calculation formula, the position of IOL implantation, the difference between calculated IOL power and during cataract surgery implanted IOL power [11].

Post-operative refractive error after cataract surgery can cause blurred or impaired unaided vision with disappointment from patients increasingly of spectacle dependence [12].

Poor refractive outcomes have an impact of vision unable to perform daily living activity post-operative patient. The amount of achieving a spherical equivalent (SE) within ±0.50 diopter (D) needed spectacle correction was 75% of patients [13].

The refractive corrections in postoperatively RE of 9 to 20% patients are needed more than 1 dioptre (D). in this study, approximately 50% of post-operative refractive error caused by incorrect position of IOL and difference between calculated & inserted IOL during cataract surgery [14].

Studies in the developed countries indicated that 58.4-99.1% (2, 6, 15, 16) of cataract surgery were conducted using sophisticated instruments, pre-operative assessment tools, Availability of well trained specialists/professionals and others. However, post-operative refractive outcomes in these countries are so common. In developing countries like Ethiopia, there are limited data on the refractive outcome and its associated factors with postoperative refractive correction after cataract surgery. Also, they are inconsistently studies about refractive outcome in different countries.

The World Health Organization (WHO) recommends that good refractive outcome greater than 90%. but, the poor and fair refractive outcome after cataract surgery should not be greater than 10% and 20% respectively [7,33].

Therefore, this study aims to determine the magnitudes of refractive outcome and associated factors of post-operative refraction after cataract surgery patients attended at Boru Meda Hospital in routine cataract surgery services. Overall, the postoperative refractive outcome of this study provides a baseline information for the physicians and researchers to design a standardized protocol to maximize good outcome.

Method and Materials

Study area and Period

The study was conducted at Boru Meda General Hospital department of Ophthalmology. Boru Meda Hospital ophthalmic department was the only referral eye care unit in the east Amhara. There are 3 Ophthalmologist, 1 Cataract surgeon, 6 Optometrists, 1 ophthalmic nurse and 7 assistance nurses working in the department. Annually, an average of 38,000 to 40,000 eye patients visits the hospital for outpatient and inpatient services. The hospital provides services for a total of 2.5 million catchment population of South wollo, North Wollo, Oromia Special Zone, Wag Hemra Zone and some parts of Afar Region. In this hospital there were more than 8000 cataract surgeries conducted per year.

Study design

An Institutional- based cross-sectional study was conducted.

Inclusion and exclusion criteria

Inclusion criteria

- Patients who underwent cataract surgery and attend post-operative refraction were included in the study
- Exclusion criteria
- Patients with history of diseases affecting refraction, such as lacrimal duct diseases, corneal pannus, keratoconus, corneal edema, pterygium, intraocular surgery.

- Patients who had prior visually impairing other ocular co-morbidity.
- Patients with post-operative complication like endopthalmitis, Retinal detachment and vitreous hemorrhage.
- Patients with uncooperative subjective refraction

Sample size and Sampling technique

Sample size determination

The sample size was obtained by using a single population proportion formula by taking the prevalence of refractive outcome was 82% at 95% CI by assuming a margin of error 5% (0.05) and adding 10% for possible non-response rate based on the conducted in Gondar teaching hospital [33].

$$N=\underline{398}$$

Sampling procedure

A simple random sampling technique was used to select study participants. Select the first study subject was used to table of random numbers. Initially list of patients who had cataract surgery from January to march 2021 was obtained from medical record room of Boru Meda General Hospital. Then all patients who had cataract surgery fulfilled the inclusion criteria during the given period and appointed for checkups were included in the study. The principal investigator and the trained research assistants were responsible for client recruitment and enrolment. After obtaining informed consent, clients who agreed to participate in the study. The research assistants were face to face interviewed socio-demographic data and examined the full-refraction procedure after 3 months of conducted cataract surgery to collect clinical data and capture quantitative data.

Data collection tool and procedures

The data was collected using questionnaires and observation by face to face interview, review of patient chart and physical examination. Six Optometrists as data collectors and one Ophthalmologist as a supervisor working at Boru Meda Hospital were involved in the data collection process after 3 days of training by the principal investigator. The data collectors gathered the data initially by interviewing the patient and then conducting physical examination. The examination was done by using slit lamp bio microscope to check the status of the retina, vitreous body and macula. Tonometry was used to measure intra ocular pressure (IOP). The refraction procedures was performed using autorefraction and trial set then the best corrected visual acuity was measured using Snellen chart at 6 meter.

Study variables

Dependent variable

- Refractive outcome (poor, fair, and good)

Independent variables

Socio-demographic variables

- Age, sex, residence, occupation, religion and educational status

Clinical variable

- Comorbidity, Preoperative visual acuity, IOL power, Axial length

Professional variable

- Biometry technique (Axial length& keratometry measurement), Site of incision, Rank of surgeon, IOL difference and position,

Patient factors

- Post-operative follow-up visit

Data quality control

A pretest was done 5% of sample size (20 participants) at Dessie Referral Hospital before the actual data collection. The questionnaire was prepared in English and then translated to Amharic (local language) by a language expert and retranslated to English by another language expert to check its consistency. Training was also given for the data collectors and supervisor regarding the purpose of the study, ethical issues, and interview and measurement techniques. Strict supervision was undertaken throughout the data collection. The supervisor and principal investigator daily checked the questionnaire for accuracy and completeness.

Data processing and analysis

The collected data were entered using Epi-data version 4.6. Then the data was exported to STATA software version 14 for cleaning, coding, categorizing to check completeness and consistency were summarized and analyzed accordingly.

Ethical considerations

Ethical clearance was obtained from Wollo University, college of medicine and health science, ethical review committee. The permission letter was obtained from the Boru Meda General Hospital administration office.

Result

Socio-Demographic Characteristics of the Respondents

A total of 384 patients were participated in the study, with an overall response rate of 96%. The majority 194(50.5%) of participants were Muslims by religion. Regarding educational status, 192 (50%) of participants can-not read and write. Occupationally 136 (35.4%) of the respondents were farmers. The median age of respondents was 61.6, regarding the sex of the study participants of them are male 207(53.9%). Two hundred thirty one (60.2%) of respondents of reside in rural areas (table2).

Clinical Characteristics of the respondents

In assessments of clinical characteristics 181(47.14%) of respondents were operated on the right eye. The axial length of the majority 278(72.4%) of the respondent was 22-24.5mm and 327(85.2%) of the respondents inserted IOL number 18-25.00D. Two hundred thirty six 236(61.5%) of the respondent had <3/60 preoperative visual acuity (table3).

Professional Characteristics of the respondents

Majority 347(90.36%) of study participants were the difference between inserted &calculated IOL power ≤1.00D. Most of 267(69.5%) cataract surgery of the study participants was conducted by ophthalmologists and 256(66.7%) of surgical incision was scleral (table4).

Magnitude of Refractive Outcome

Of the total 384 participants, 170(44.3%) (95%CI: 39.3, 49.2) had good refractive outcome, 135(35.2%) (95%CI: 30.5, 39.8) fair refractive outcome, and 79(20.6%) (95%CI: 16.9, 24.7) had poor refractive outcomes (figure2). A majority, 233(60.68%) of participants needed refraction correction had less than and equal to ±0.5D best vision sphere power.

The patients living in rural areas were fair and poor refractive outcomes with 82(36.36%) and 52(22.5%) respectively. The magnitude of poor and fair refractive outcomes among patients who were educational status unable to read & write was 49(25.5%) and 68(35.4%) respectively. The highest percentage of poor refractive outcomes was 38(46.9%) patients who were not attended properly follow-up visits. Similarly, the patients who had a history of systemic/ ocular comorbidity were poor refractive outcomes 60(55%). The highest percentages of poor refractive outcome 64(27.11%) and fair refractive outcome 79(33.47%) was found poor preoperative visual acuity (<3/60). The prevalence of poor refractive outcome for male were 42(20.3%) and female 37(20.9%) (table5). The prevalence of BVS correction among patients had post-operative refractive error 233(60.68%) cases were ≤±0.50D, 67(17.45%) cases were ±0.75-1.00D and 84(21.87%) of cases were >1.00D.

Factors Associated with the refractive outcome

Determination of the factors for the presence of refractive outcome was made by ordinal logistic regression model with the assumption that it helps to predict the extent to which this outcome variable could be explained by independent variables. All variables which had p<0.25 (25% level of significance) on the bivariate analysis were entered into the multivariable analysis. Brant test was used to check parallel line test assumption and model selection criterion to select the better model among the fitted multivariable analysis ordinal logistic regression model. The significant variables were included in the multivariable analysis of proportional odds model (POM) technique was applied to analyze associated factors of the refractive outcome within variables. On Bivariable analysis age, address, occupation, educational status, operated eye, follow up visit, inserted IOL number, the difference between inserted & calculated IOL power, placements of IOL, the position of IOL, a rank of the surgeon, site of incision, and history of comorbidity were a significantly associated with refractive outcome.

Multivariable analysis POM revealed that age of patient, address, educational status, numbers of IOL inserted, the difference between calculated and implanted IOL power, site of incision, and history of comorbidity were significantly associated with refractive outcome among the patients were after 3 months of cataract surgery.

For the patients age ≥70 years, the risk of having poor refractive outcome was found increase by 45% (AOR=1.45, 95% CI 1.21, 2.96) for patients age less than 50 years when the other variable was constant.

Regarding the residence of patients who were living in rural areas, the risk of having poor refractive outcome was found to increase by 16% (AOR=1.16, 95% CI 1.06, 2.23) for the patients living in urban areas. The odds of poor refractive outcome vs. fair or good refractive outcome the educational status was (decreased by 21%) 0.21 (AOR=0.21, 95%CI 0.053, 0.85) times lower than poor refractive outcome able to read and write educational status compared to unable to read and write. Regarding to the number of IOL power inserted during surgery greater than 25.00D, the risk of having poor refractive outcome was found increase by 20% (AOR=1.2, 95% CI 1.11, 2.75) for inserted number of IOL power less than18.00D. Compared with the diference between calculated and inserted IOL number greater than 1.00D, the risk of having poor refractive outcome was found to increase by 25% (AOR=1.25, 95% CI: 1.05-2.83) for the difference between less than or equal to 1.00D. The odds of poor refractive outcome vs. fair or good refractive outcome patients who had the site of limbal incision was 0.6(AOR=0.6, 95% CI: 0.36-0.987) times lower than the odds of poor refractive outcome patients who had to scleral incision. The odds of poor refractive outcome vs. fair or good refractive outcome patients who had a history of comorbidity was 14.2(AOR=14.2, CI: 7.85-25.54) times higher than the odds of poor refractive outcome patients those who had no comorbidity. The odds of poor refractive outcome vs. fair or good refractive outcome patients who had others comorbidity (AMD, DM etc.) were 0.57 (AOR=0.57, CI: 0.07-0.87) times lower than the odds of poor refractive outcome patients who had a history of glaucoma.

Table 6: Result POM of refractive outcome among patients who underwent cataract surgery at Boru Meda Hospital, Ethiopia, 2021.

Associated factors that satisfied parallel line assumption

ACIOL=Anterior Chamber IOL, PCIOL=Posterior Chamber IOL, OD=Right eye, OS Left eye, OU= both eye, CI= Confidence Interval, ref= Reference category and *= identify significant categories variables.

Discussion

This study was attempted to identify the magnitudes and associated factors of refractive outcomes among patients who underwent postoperative refraction services after cataract surgery at Boru Meda General Hospital, Ethiopia, 2021. The finding revealed that 44.3%, 20.6% and 35.2% of the study participants were developed good, poor and fair refractive outcomes respectively.

In this study, the magnitude of good refractive outcome was higher than other study was conducted at Gondar university tertiary eye care and training center (26.6%). Due to the fact that the previous study, preoperative evaluations were performed by residents and to measure the outcome without postoperative refractive correction [7].

The finding of this study, postoperative refractive outcome with subjective refraction was lower than other difference cycles of studies. Due to this reason the previous studies were done the quality of their biometry services like, the used of appropriate

IOL formula and axial length measurement techniques could reduce the dependency of many distance spectacle corrections [25].

In this study, the magnitude of good refractive outcome was lower than the studies conducted in Liverpool University 95%, South India 75.2%, Bangladesh 2007 60.1%, Bangladesh 2015 50%, and University of Gondar 82% [11,15,29,33]. The discrepancy might be due to the previous studies conducted on a selection case for surgery; they have been many trained (senor) ophthalmologists performed greater quality and quantity surgery to improved postoperative refractive outcome. It might be also due to performed screening test for early treatments of cataracts and was used to different types of cataract surgery, i.e. phacoemulsification cataract surgery was the higher good refractive outcome. Another possible justification for the difference in operational definition of good refractive outcome (BCVA 6/24 or better) also, was used Laser vision correction after surgery and using standard IOL power calculation formula to increasing outcome.

In this finding, the prevalence of postoperative refractive error was lower than other studies [16, 20]. This was due to the fact that the previous studies were done in a rural community, was used the average IOL number inserted rather than biometry calculated number of IOL power and subjective refraction performed by an ophthalmologist. It might be also due to the majority participants have been short axial length (<22mm) were significantly associated with high refractive error.

In this study, the magnitude of good refractive outcome was similar to other study conducted on Chinese 42.6% [22]. The finding of this study revealed that the difference between IOL inserted & calculated greater than 1.00D and the scleral site of an incision during surgery were significantly associated with the developed poor refractive outcome. The finding of this study the numbers of IOL power greater than 25.00D implanted was significantly associated with refractive outcome and had higher poor outcome relative to lower IOL numbers. This finding is consistent with other studies, Tanzania, American [6,23].

The finding of this study showed that patients who had a history of ocular comorbidity like, glaucoma were significantly vulnerable to poor refractive outcomes than those who had not history of comorbidity. This finding is consistent with other studies [21, 27, 30].

Conclusion

The magnitude of good refractive outcomes was lower than WHO recommendation refractive outcomes after cataract surgery. Age, residence, educational status, numbers of IOL inserted, the difference between calculated and implanted IOL, site of incision, and a history of comorbidity were found to have a statistically significant association with refractive outcome. Poor and fair refractive outcomes are common after cataract surgery. However, the effect should be made to reduce their occurrence by giving especially training for professionals, creating awareness, and enhancing knowledge about patients utilization of refraction services to improve surgical outcome.

Recommendations

Based on the study findings, the following actions are recommended to improve refractive outcomes

Policy makers:

- Emphasis on design and implementation of preventive polices for poor refractive outcome to enhancing utilization of quality cataract surgery services in district areas.

Boru Meda General Hospital:

- Collaboration with non-governmental organizations (NGO) like Himalayan Cataract Project (HCP) that are working in patients who have cataracts to improving outcomes by conducted quality cataract surgery services.
- Give opportunity for special training about the ophthalmic professions.
- Making a wide range of IOL power should be available at the center.
- Physicians:
- Should be implanted the only calculated IOL power during surgery.
- Better preoperative evaluation, early treatment and postoperative care for patients with history of comorbidity.

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