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Original Article

Outcomes of cataract surgery: a population-based developing world study in the Bhaktapur district, Nepal

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Abstract

Background: To evaluate the visual outcome after cataract surgery in a population of Nepal.

Design: Population-based cross-sectional study.

Participants: Forty years and above residing in Bhaktapur district.

Methods: Subjects were selected from 30 clusters using cluster sampling procedure. All underwent a detailed examination at the base hospital, including logarithm of minimal angle of resolution visual acuity, refraction, applanation tonometry, cataract grading, retinal examination and perimetry when indicated.

Main Outcome Measures: Visual acuity after cataract surgery.

Results: Out of 4003 subjects examined, 151 had undergone cataract surgery. Pseudophakia was present in 142 (94.0%), aphakia in nine (6%). Presenting and best-corrected visual acuity ≥6/18 was achieved in 123 (54.4%) and 164 (72.4%) eyes, respectively. Among the pseudophakic eyes, at presentation 122 (57.5%), 72 (33.9%), 18 (8.5%) and after best correction 162 (76.2%), 33 (15.8%), 17 (8.0%) had visual acuity of ≥6/18, <6/18–≥6/60 and <6/60, respectively. Retinal disease (35.5%), surgical complications (27.4%) and posterior capsular opacification (14.5%) were the principle causes of visual impairment after best correction in all eyes. There was no significant association in visual outcome based on age, sex, literacy and the duration of surgery.

Conclusion: Correction of refractive errors, preoperative screening of coincidental diseases, reduction in surgical complication rates and monitoring of postoperative follow-up care has to be addressed seriously in order to improve the outcome of cataract surgery to meet standards proposed by the World Health Organization. In the future, longitudinal studies need to be undertaken to provide specific information on the outcomes of cataract surgery in this community.

Key words: cataract surgery, Nepal, population based study, visual outcome.

Introduction

Cataract blindness is the leading cause of blindness in developing countries. The Nepal Blindness Survey (NBS) of 1981 estimated that 0.84% were blind from cataract.[1] Based on data from this nationwide survey, the Nepal Blindness Prevention and Control Project worked to implement eye-care services in Nepal. Several eye hospitals and community eye centres were established throughout the country with the help of governmental and non-governmental organizations. Eye camps were designed to provide eye care to people residing in

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very remote areas. Population-based studies that were conducted in different parts of the country after the NBS of 1981 have estimated cataract blindness to range from 1% to 6% among people 40 years and above.[2–5] In these studies severe bilateral blindness was defined as visual acuity (VA) of less than 3/60 in both eyes. The conclusion derived was that the prevalence of blindness had decreased slightly from that estimated in the 1981 national survey, both overall and cataract-related.

The prevalence of blindness and cataract surgery in Bhaktapur district has been reported in a companion paper.[6] The prevalence of blindness in Bhaktapur was 0.73% at presentation and 0.43% after best correction that was lower than studies conducted in Nepal,[2–5] neighbouring countries[7–10] and the estimate of 3.4% for the South-East Asian region.[11] The prevalence of cataract blindness was lowest (1.5%) with the highest cataract surgical coverage (90.36%) in comparison with all the other studies of Nepal.

Visual outcomes of cataract surgery have been reported by several population-based studies conducted in South Asia.[12–18] In Nepal there are only two studies that have reported the visual outcomes of cataract surgery in a large population.[19,20] In both studies the visual outcome did not meet the standards proposed by the World Health Organization (WHO). A few studies in Nepal have also reported the outcome of cataract surgery under different settings.[21–23]

Bhaktapur district does not have an eye hospital and the delivery of eye-care service is through primary eye-care centres affiliated to tertiary level eye hospitals in the capital city Kathmandu. The main purpose of this paper is to report the visual outcomes after cataract surgery and to investigate factors responsible for poor outcomes among subjects residing in Bhaktapur district of Nepal.

Methods

Bhaktapur district is one of the three districts within Kathmandu valley and is situated approximately 15 km away from the capital city Kathmandu. It is located within the mid-mountainous region of Nepal. Bhaktapur is divided into two municipalities and 16 village development committees (VDC). Although the municipalities are urban areas, the VDCs are rural regions. The municipalities and the VDCs are further divided into wards. A ward is the smallest administrative unit and each generally contains approximately 200 households. According to the 2001 Census, the population of Bhaktapur was 225 461 with a population density of 1895 per square kilometre.[24]

The present study is part of the Bhaktapur Glaucoma Study, the methodology of which has been published earlier.[25] In brief, the survey involved the selection of 4800 subjects aged 40 years and above, using a WHO 30 cluster sampling procedure.[26] In the first stage of sampling, a list of all the wards or clusters (n = 161) from 16 VDCs and two municipalities was obtained from the 2001 Nepal national census data. These clusters were arranged in order of population size and 30 of these clusters were sampled with probability proportionate to the size. Thereafter, field workers conducted a house to house census in the selected 30 clusters and a total of 11 232 eligible subjects were identified and an eligibility list prepared. For the second-stage sampling, the names of all the eligible subjects (n = 11 232) were recorded and a database prepared from which 4800 subjects were selected using EPI-INFO software, version 3.5.1. The selected subjects were then revisited by the field workers and referred to the base hospital in Kathmandu for a comprehensive eye examination.

The VA was measured using logarithm of minimum angle of resolution tumbling E charts placed at 4 m. External eye examination and the pupillary reaction were assessed with a hand-held flashlight and then the anterior segment was examined with a slit-lamp biomicroscopy (Haag Streit BQ 900, Bern, Switzerland). The peripheral anterior chamber depth was graded according to the van Herrick's technique.[27] The intraocular pressure was measured and gonioscopy performed on all subjects. Intraocular pressure was measured using a Goldmann applanation tonometer, and gonioscopy was done with a Zeiss 4 mirror lens. Gonioscopy was carried out in ambient light conditions with a shortened slit beam that did not fall upon the pupil. All subjects had their pupils dilated unless contraindicated because of risk of angle closure. After dilatation, the lens was examined and the cataract graded using the Lens Opacities Classification System II.[28] Stereoscopic fundus examination was done at the slit-lamp using a 90-diopter lens. The clinical examination was carried out by two glaucoma specialists.

This study was approved by the Institutional Review Board and Ethics Committee and conducted in accordance with declaration of Helsinki. Informed consent was obtained from all subjects after being explained in detail about all the procedures to be undertaken. The informed consent was written in the vernacular. The consent form was read out for those unable to read. Upon agreement by the subject, they were asked to sign the consent form. For those unable to sign, thumb impressions were taken.

Data and statistical analysis

The visual outcomes were categorized as 'good' (6/18 or better; logMAR, $\leq$ 0.30), 'borderline' (worse than

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Table 1. Demographics of cataract surgery group

Age (years)	Number	Gender (male : female)	Literate (male : female)	Illiterate (male : female)	Pseudophakia (male : female)	Aphakia (male : female)
40–49	3 (2.0)	2:1	1:0	1:1	2:0	0:1
50–59	19 (12.6)	7:12	4:6	3:6	6:12	1:0
60–69	37 (24.5)	18:19	9:8	9:11	16:18	2:1
70–79	66 (43.7)	27:39	16:20	11:19	25:38	2:1
≥80	26 (17.2)	9:17	1:10	8:7	9:16	0:1
Total	151 (100.0)	63:88	31:44	32:44	58:84	5:4

Table 2. Visual outcome of cataract operated subjects by presenting visual acuity†

Presenting visual acuity	Aphakic unilateral/ bilateral	Pseudophakia/aphakia	Bilateral pseudophakia	Unilateral pseudophakia	All
	No (%)	No (%)	No (%)	No (%)	
6/18	0 (0)	1 (50)	30 (43)	10 (14.2)	41 (27.2)
<6/18 6 ≥ 6/60	2 (22.2)	0 (0)	23 (32.9)	16 (22.9)	41 (27.2)
<6/60 (worst eye)	3 (33.3)	0 (0)	15 (21)	29 (58.6)	47 (31.1)
<6/60 ≥ 3/60 (best eye)	1 (11.1)	0 (0)	0 (0)	1 (1.4)	2 (1.3)
<3/60	3 (33.3)	1 (50)	2 (2.8)	2 (2.8)	8 (5.3)
All	9 (5.3)	2 (1.3)	70 (46.4)	70 (46.4)	151 (100)

†Data are given as number (%) of people

Table 3. Presenting and best-corrected visual acuity outcomes in pseudophakic and aphakic eyes†

	≥6/18	<6/18–≥6/60	<6/60	All
	No (%)	No (%)	No (%)	No (%)
Presenting vision				
Pseudophakic eyes	122 (57.5)	72 (33.9)	18 (8.5)	212 (100)
Aphakic eyes	1 (7.1)	6 (42.9)	7 (50.0)	14 (100)
Best-corrected vision				
Pseudophakic eyes	162 (76.2)	33 (15.8)	17 (8.0)	212 (100)
Aphakic eyes	2 (14.3)	10 (71.4)	2 (14.3)	14 (100)

†Data are given as number (%) of eyes.

6/18 to 6/60; logMAR, >0.30–1.00) and 'poor' (worse than 6/60; logMAR, >1.00) for a given eye. Best-corrected VA was defined as the vision achieved by an eye (or subject) wearing the objective refractive result in the trial frame.

Descriptive statistical measures such as mean, standard deviation, ratios and proportions were computed. Multivariable logistic regression analysis was carried out to see the association of different risk factors with VA. All statistical analysis was carried out by using statistical software STATA 9.0.

Results

The demography of subjects that had undergone cataract surgery is presented in Table 1.

Out of 4003 subjects examined a total of 151 subjects underwent cataract surgery. Pseudophakia was present in 142 (94.0%) subjects, and aphakia in nine (6%). Seventy (49.3%) subjects had pseudophakia in one eye, 70 (49.3%) had in both eyes, and two (1.4%) subjects had aphakia in one eye and pseudophakia in the other. The mean age ± SD of subjects was 70.3 ± 10.2 years. Altogether 89 (58.9%) subjects had undergone surgery 5 years or more before the survey was undertaken.

In Table 2, the visual outcome of the cataract operated subjects based on presenting VA is shown. Forty-three per cent of subjects with bilateral pseudophakia had VA > 6/18 at presentation.

Table 3 presents the visual outcomes after cataract surgery. Among pseudophakics, 122 (57.5%) eyes at presentation and 162 (76.2%) eyes after best correction had VA of ≥6/18. After refractive correction, the vision improved in 40 (18.9%), 39 (18.4%) and 1 (2.9%) eyes in each of the three categories (≥6/18, <6/18–≥6/60 and <6/60), respectively, and altogether 80 (37.7%) eyes had improvement in vision after

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Table 4. Principal cause of visual impairment/blindness in cataract operated eyes by best-corrected visual acuity†

Principle cause	<6/18–≥6/60	<6/60	Total	<6/18–≥6/60	<6/60	Total
	Pseudophakia			Aphakia		
Retinal pathology	9	6	15 (30)	6	1	7 (58.3)
Surgical complication	7	7	14 (28)	3	0	3 (25)
Posterior capsule opacification	7	2	9 (18)	0	0	0 (0)
Corneal pathology	3	1	4 (16)	0	0	0 (0)
Optic atrophy	2	1	3 (6)	0	0	0 (0)
Glaucoma	2	0	2 (4)	1	1	2 (16.7)
Amblyopia	1	0	1 (2)	0	0	0 (0)
Phthisis bulbi	0	0	0 (0)	0	0	0 (0)
Undetermined/others	2	0	2 (4)	0	0	0 (0)
Total	33	17	50 (100)	10	2	12 (100)

†Data are given as number (%) of eyes.

Table 5. Multiple logistic regression for risk factors in first operated pseudophakic eyes with VA < 6/18

	PVA (<6/18) odds ratio (95% CI)	BCVA (<6/18) odds ratio (95% CI)
Age group (years)		
40–59	1	1
60–69	1.74 (0.56–5.47)	0.92 (0.25–3.37)
70–79	1.43 (0.51–3.95)	1.85 (0.59–5.78)
≥80	5.94 (1.32–26.63)	3.66 (1.00–13.32)
Male	1	1
Female	1.32 (0.64–2.75)	1.39 (0.67–2.90)
Duration from surgery		
<5 years	1	1
>5 years	1.31 (0.63–2.74)	1.41 (0.54–2.9)
Literate	1	1
Illiterate	1.03 (0.50–2.13)	1.33 (0.65–2.72)

BCVA, best-corrected visual acuity; CI, confidence interval; PVA, presenting visual acuity.

best correction. Following best correction, there were 17 (8.0%) of 212 pseudophakic eyes and 12 (85.7%) of 16 aphakic eyes with VA of <6/60.

The major cause of visual impairment/blindness among subjects that had undergone cataract surgery is presented in Table 4. Among the 62 eyes with VA < 6/18, coincidental retinal disease, surgical complications and posterior capsular opacification (PCO) were present in 22 (35.5%), 17 (27.4%) and 9 (14.5%) eyes, respectively. Among the 50 pseudophakic eyes, retinal pathology 15 (30%), surgical complications 14 (28%) and PCO 9 (18%) were the most common causes resulting in VA of <6/18. Among the 12 aphakic eyes with VA < 6/18, 10 had VA between <6/18–≥6/60 (6 cystoid macular oedema, 3 surgical complication and 1 secondary glaucoma), and 2 had VA < 6/60 (1 retinal detachment, 1 secondary glaucoma).

The association of age, sex, duration of surgery and literacy with presenting and best-corrected VA (<6/18) was explored by logistic regression modelling on the first operated pseudophakic eyes that is shown in Table 5. Because there were only two patients in the age group 40–49 years, we considered 40–59 years as one age group. A significant association was seen only in the age group ≥80 years.

Discussion

This is the first population-based study to report the outcomes of cataract surgery in one of the districts of Kathmandu valley that is not served by an eye hospital. The visual outcome following cataract surgery in our subjects did not fulfil the standards proposed by WHO. It has been suggested by WHO that 85% of eyes undergoing cataract surgery should result in good outcome (6/6–6/18), 10% borderline outcome (6/18–6/60), and less than 5% poor outcome (6/60).[11] After best correction 76.2% subjects had good visual outcome, and 15.8% and 8% had borderline and poor visual outcomes, respectively.

When compared with the Lumbini zone and Chitwan district population-based study[20] that was conducted in 2006 (the same year as our study), our study had poorer visual outcomes following cataract surgery. The Lumbini study reported a presenting VA of more than or equal to 6/18 in 61.4% of eyes when

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compared with 54.5% from our study. The likely explanation for this disparity is that Lumbini zone is primarily served by one eye hospital and most of the subjects in the study had undergone surgery in that hospital. Whereas, Bhaktapur district does not have an eye hospital and subjects that had undergone surgery probably had attended several eye centres in Kathmandu valley that could have made a difference to the visual outcome. The Lumbini study of 2006 compared their results with a previous study conducted in the same district in 1995 and reported that the visual outcomes of cataract surgery had improved over the past 10 years. The most likely explanation to this was that only 14% of the eyes examined in 1995 had pseudophakic surgery when compared with 90% of eyes in 2006. Our study also had better visual outcomes when compared with the 1995 Lumbini study[19] where presenting VA was 6/18 or better in only 15% of eyes.

Our results were comparable to the Pakistan National Blindness and Visual Impairment survey of 2007.[29] Among the pseudophakic eyes, 55% had presenting VA greater than or equal to 6/18 and 8.7% had less than 6/60 that was similar to our finding of 57.8% and 8.5%, respectively. Our study had poorer visual outcomes compared with the south Indian surveys[17,18] but better than two other studies from India[14,15] and a survey from Bangladesh.[12]The disparity in outcomes between these studies were probably related to the time that they were conducted and the access of visual care.

In our study there were a large number of subjects with pseudophakia (94%). Following the establishment of the Fred Hollows Intraocular Lens Laboratory in Kathmandu in 1994, there has been a reduction in the costs of intraocular lens (IOL)s thus making cataract surgery affordable to a large population. Therefore we are not alarmed by this finding from our study. Similarly, the Lumbini study 2006 also reported a high prevalence of pseudophakia (90%), in contrast to the study conducted in 1995 in Lumbini that reported a large number of aphakic eyes (88.1%).

The commonest cause of visual impairment was uncorrected refractive error following cataract surgery. The VA in a large number of eyes of subjects improved after refraction (18.9% $\geq$ 6/18 and altogether 37.7%). This reiterates findings from studies conducted in this region[14,16–18] for the proper usage of corrective lenses to improve visual outcome following cataract surgery. Although deviation from emmetropia or uncorrected high astigmatism as components of refractive error was not analysed in this study, it can still be stressed that attention has to be drawn towards achieving accuracy while calculating IOL power and adopting techniques to further reduce surgically induced astigmatism.

After best correction, coincident retinal disease (35.5%) was the most common cause of visual impairment and blindness. The average age of 70.3 years of our study subjects and the possibility of incorrect patient selection could have lead to this finding. Among the retinal diseases, age-related macular degeneration was the most common condition that was followed by retinal vein occlusion. Surgical complication (27.4%) was the other major cause of visual impairment and pseudophakic bullous keratopathy was the most commonly encountered surgical complication. The causes for PCO (14.5%) could not be identified in our patients. However, it can be concluded that an improvement in the surgery technique, selection of the type of IOL and careful postoperative follow up after cataract surgery is necessary to lower the incidence of PCO in the future. The vision of nine (4.2%) of the 212 eyes with PCO could have possibly improved to better than 6/18 had they received laser treatment. Our rate of PCO was less than reports from Pakistan (38%),[13] Rajasthan study (38.8%)[14] and Sivangana study (23%).[15]

A study conducted by Shrestha *et al.* in 2001 in Nepal[21] had reported very poor outcomes of cataract surgery (58% uncorrected VA < 6/60) and a high rate of PCO (30%) from studies undertaken in eye camps. Since the time of their report, there has been a significant improvement in the services provided in eye camps with the incorporation of refraction, biometry and with the use of higher quality operating microscopes and IOLs. A study conducted by Ruit *et al.* compared the outcomes of small incision cataract surgery to phacoemulsification in an outreach setting and reported similar visual outcomes between the two types of surgery at the end of 6 months.[22] In fact, the manual sutureless technique was more cost-effective than phacoemulsification and thus could have a more beneficial role in underdeveloped countries. With these advancements and improvement in the quality of eye services, it has now been preferred to replace the terminology of eye camp with 'outreach microsurgical eye clinics' instead.

There were more female and illiterate subjects that had undergone cataract surgery. This is contrary to reports from previous studies in Nepal,[30,31] and we are unable to explain the reasons for our findings. The major strength of our study was that our findings were based from a large population. There were also several weaknesses in our study. We were unable to comment on the visual status of the non-respondents. The principal reason for non-attendance was occupation-related. Hence, it was unlikely that the non-respondents had visual impairment that was less than the respondents. Another weakness of our study was that we were unable to determine the place where the subjects had

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undergone cataract surgery and therefore not able to analyse the visual outcome in relation to place of surgery.

It is apparent from our study that the visual outcome after cataract surgery was poor among subjects residing in Bhaktapur. The visual outcome could have definitely been better had causes such as refractive error and PCO been addressed previously. Eye-care centres in Kathmandu city providing cataract surgery to patients living in Bhaktapur and elsewhere have to find ways of improving the follow up of patients attending their centres. Similarly, eye institutions running the primary eye-care centres in Bhaktapur district have to also adopt strategies in the community to educate people regarding visual rehabilitation and encourage follow up at their affiliated centres. A more comprehensive approach towards providing ophthalmic care through trained ophthalmic staff with the provision of lasers to treat PCO at the primary eye-care centre will in the future be able to improve the overall eye-care services in Bhaktapur district.

In conclusion, cataract programs need to do more than replace the crystalline lens with an IOL and send patients away forever. There must be follow-up refraction, monitoring and treatment for common complications such as PCO and very importantly audit of outcomes to ensure the highest possible quality of surgical service.

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