



Evaluation of visual outcome after cataract surgery in patients with legal blindness

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Background: To investigate the outcome of cataract surgery in patients with legal blindness defined as best-corrected visual acuity (BCVA) of 20/1,000 or lower and to determine factors influencing the visual outcome in these patients.

Methods: Medical records of 68 eyes of 62 patients diagnosed with legal blindness and underwent cataract surgery were reviewed. The study population was divided into 3 groups based on types of cataracts (Group A: posterior subcapsular cataract, Group B: mature or brunescant cataract, and Group C: cataract combined with other ocular diseases). Data including demographics, predisposing factors, BCVA before and 6 months after surgery and post-operative complications were collected and analyzed.

Results: Mean preoperative logMAR BCVA was 1.88 ± 0.24 , 2.24 ± 0.26 and 1.96 ± 0.31 in Groups A, B and C, respectively ($P=0.003$). The postoperative BCVA was 0.49 ± 0.35 , 0.51 ± 0.47 and 0.90 ± 0.53 in Groups A, B and C, respectively ($p=0.003$). Significant improvement in BCVA was shown in all 3 groups ($P<0.001$ in Groups A and B and, $P=0.001$ in Group C). There was significant difference in the amount of visual improvement among the 3 groups, $P<0.001$). Although there was no significant difference in the amount of visual improvement between group A and C ($P=0.379$), significantly higher visual improvement was achieved in group B compared with group A ($P=0.012$) and C ($P=0.001$).

Conclusions: Cataract surgery should be encouraged for patients with legal blindness, even in the presence of other ocular disease. Significant visual recovery was observed in all the groups, particularly in those with mature or brunescant cataract.

Keywords: Cataract surgery; legal blindness; postoperative outcome

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Introduction

Legal blindness in Korea is defined as best-corrected visual acuity (BCVA) of 20/1,000 or worse in the better-seeing eye using Snellen visual acuity (VA) chart. In the United States, legal bilateral blindness is defined as BCVA of 20/200 or worse in the better eye (1,2). In the United Kingdom, there is no legal definition of sight impairment. However, national registry of the blind is issued to patients with VA

of 3/60 or worse than 3/60 or 6/60 with severely restricted visual field (3). In Germany, blindness is legally defined as a BCVA of 20/1,000 in the better eye, or an equivalent disturbance of vision (4). In 2010, 32.4 million people were reported to be blind (VA <20/400) and 10.8 million people (33.4%) were blind due to cataract worldwide (5). The overall prevalence of legal blindness in Korea was 0.26%, and cataract caused 39% of the legal blindness with operable cataract being probable cause of vast majority

(6-8). Several studies have evaluated the outcome of cataract surgery in patients with low vision, suggesting favorable surgical outcomes (9-11). Nevertheless, decision for cataract surgery in legal blindness remains difficult, and special consideration should be given for visual prognosis of the patients. To our best knowledge, no studies have been published on the topic of surgical outcome of cataract surgery of the legal blindness in Korea. Evaluating surgical outcomes and predictive factors for visual restoration would be beneficial for decision of cataract surgery as well as patient consultation.

In this study, we evaluated the visual outcome of cataract surgery in patients with legal blindness in Korea, and investigated factors influencing the outcome. We present the following article in accordance with the STROBE reporting checklist (available at <https://aes.amegroups.com/article/view/10.21037/aes-22-5/rc>).

Methods

This study was approved by the Institutional Review Board of Kangwon National University Hospital (No. 2021-03-010) and adhered to the tenets of the Declaration of Helsinki (as revised in 2013). Informed consent was waived by Institutional Review Board of Kangwon National University Hospital because this is a retrospective study that involves only retrospective review of medical records and does not include data that can identify patients.

This retrospective study included 68 eyes of 62 patients with preoperative legal blindness which was defined as BCVA of 20/1,000 or worse among who received cataract surgery at Kangwon National University Hospital from June 2011 to May 2015 and had follow-up visits for at least 6 months. The study population was divided into 3 groups based on types of cataract; Group A (29 eyes): posterior subcapsular cataract, Group B (25 eyes): mature or brunescant cataract, and Group C (14 eyes): cataract with ocular morbidities [glaucoma (6 eyes), proliferative diabetic retinopathy (4 eyes), age-related macular degeneration (ARMD) (3 eyes) and retinitis pigmentosa (1 eye)].

Medical records were reviewed and analyzed for data including pre- and post-operative BCVA, type of cataract surgery, ocular comorbidity and complications. Postoperative BCVA was defined as the BCVA at 6 months postoperatively. BCVA was converted to logarithm of minimal angle resolution (logMAR) for statistical analysis. Based on University of Freiburg study group result, no light perception was replaced by a logMAR acuity of 2.90, light

perception (LP) by a logMAR acuity of 2.60, hand motion (HM) by a logMAR acuity of 2.30 and counting finger (CF) by a logMAR acuity of 1.85 (logMAR) (12).

Statistical analysis

All data are presented as mean \pm standard deviation (SD), or as number and percentage, as appropriate. Comparisons within groups were made using paired *t*-test, Pearson's chi-square test, or Fisher's exact test, as appropriate. Comparisons between all 3 groups were performed using one-way ANOVA. Values of $P < 0.05$ were considered significant. SPSS for Windows (version 18.0, SPSS Inc., Chicago, IL, USA) was used for statistical analysis.

Results

Mean age was 74.5 ± 12.0 years (range, 43 to 91 years), and male to female ratio was 36 (58.1%): 26 (41.9%). Phacoemulsification was done in 94.1% (64/68) of the eyes, extracapsular cataract extraction (ECCE) was performed in 4.4% (3/68) and intracapsular cataract extraction (ICCE) was done in 1.5% (1/68), respectively. Postoperative BCVA improved in 97.1% (66/68) and BCVA of 20/40 or better was achieved in 42.6% (29/68) of eyes. In group A (29 eyes of 27 patients), the mean age was 80.1 ± 9.8 years and male to female ratio was 16 (59.3%): 11 (40.7%). Diabetes mellitus was reported in 6 patients (22.2%) and hypertension was reported in 8 patients (29.6%). In group B (25 eyes of 22 patients), the mean age was 67.7 ± 11.6 years and 68.2% were male. Diabetes mellitus was reported in 7 patients (31.8%) and hypertension was reported in 13 patients (59.1%). Group B included 19 eyes of mature cataract and 6 eyes of brunescant cataract. In group C (14 eyes of 13 patients), the mean age was 76.4 ± 8.6 years and male to female ratio was 5 (38.5%): 8 (61.5%). Diabetes mellitus was reported in 3 patients (23.1%) and hypertension was reported in 6 patients (46.2%). Details of demographics are shown in *Table 1*. Types of the cataract are summarized in *Table 2*. Regarding the types of cataract, posterior subcapsular cataract was the most common, followed by mature and brunescant cataract.

Table 3 shows the BCVA before and 6 months after cataract surgery in the 3 groups. Mean preoperative logMAR BCVA was 1.88 ± 0.24 , 2.24 ± 0.26 and 1.96 ± 0.31 in groups A, B and C, respectively ($P = 0.003$, one-way ANOVA). Mean postoperative BCVA was 0.49 ± 0.35 , 0.51 ± 0.47 and 0.90 ± 0.53 in groups A, B and C, respectively

Table 1 Baseline characteristics of patients

Characteristics	Group A	Group B	Group C
Number, patients [eyes]	27 [29]	22 [25]	13 [14]
Age (year) (mean \pm SD)	80.1 \pm 9.8	67.7 \pm 11.6	76.4 \pm 8.6
Sex (male:female)	16:11	15:7	5:8
Diabetes mellitus	6 (22.2%)	7 (31.8%)	3 (23.1%)
Hypertension	8 (29.6%)	13 (59.1%)	6 (46.2%)
Surgical methods (PE/ECCE/ICCE/scleral fixation)	28/0/1/2	22/3/0/1	14/0/0

PE, phacoemulsification; ECCE, extracapsular cataract extraction; ICCE, intracapsular cataract extraction.

Table 2 Types of the cataract

Diagnosis	Number (%)
PSCO	38 (55.9)*
Mature	19 (27.9)
Brunescent	6 (8.8)
Traumatic	3 (4.4)
Pre-senile	2 (2.9)
Total	68 (100.0)

*, 9 cases with PSCO were included in group C due to ocular comorbidities. PSCO, posterior subcapsular opacity.

($P=0.003$, one-way ANOVA). Postoperative logMAR BCVA was significantly worse in group C compared with group A ($P=0.030$) and B ($P=0.003$). There was no significant difference in group A and group B ($P=0.812$). Significant improvement in BCVA was shown in all 3 groups after surgery ($P<0.001$ for all 3 groups, paired t -test). There was significant difference in the amount of visual improvement among three groups ($P<0.001$, one-way ANOVA). Although there was no significant difference between group A and C ($P=0.379$), the amount of visual improvement was significantly higher in group B compared with group A ($P=0.012$) and C ($P=0.001$) (Table 4).

Regarding the complications, corneal edema was the most common complication present in 3 eyes (10.3%) in Group A and 6 eyes (24%) in Group B. Posterior capsular rupture (PCR) was the second most common complication (3 eyes: 2 eyes in group A and 1 eye in group B), and zonular dialysis was reported in 2 eyes (1 eye in group A and 1 eye in group B). Intraoperative complications are summarized in Table 5.

Discussion

In the present study, we evaluated clinical outcomes of cataract surgery in patients with legal blindness including age and sex distribution, predisposing factors, pre- and post-operative BCVA and surgical complications. Our results suggest a favorable visual outcome for most patients with legal blindness.

According to the Forth Korea National Health and Nutrition Examination Survey (KNHANES) undertaken from 2008 to 2010, the visual impairment and blindness rate increased with advancing age, low educational status, living in rural area and being unemployed (13). With the increase in the life expectancy due to improved socioeconomic conditions and easy access to health services, cost and access are less likely to be the obstacle for cataract surgeries in Korea. However, despite easy access to health services, un-operated cataracts are thought to be responsible for higher rate of blindness. Studies have shown that cataract is still one of the major causes of low vision and even blindness worldwide, particularly in areas with low cataract surgical coverage (14-29). According to previous study using data from KNHANES 2008-2012, estimated prevalence of cataract in patients of 40 years of age or older was higher in Gangwon province compared with other regions in South Korea (6). These results could be explained by the fact that Gangwon province is a rural area with relatively low medical service accessibility.

Our results indicate that cataract surgery can significantly improve VA in most patients in all the 3 groups. The results are in agreement with previous studies that low vision patients with debilitating cataract can predominantly benefit from cataract surgery (9,10).

However, the visual outcome in the present study might

Table 3 Best-corrected visual acuity (logMAR) before and after cataract surgery

Variables	Group A	Group B	Group C	P value*
Preoperative BCVA	1.88±0.24	2.24±0.26	1.96±0.31	0.003*
Postoperative BCVA	0.49±0.35	0.51± 0.47	0.90±0.53	0.003*
LogMAR improvement [†]	1.40±0.47	1.73±0.43	1.06±0.51	<0.001*
VA improvement (eyes, %)	29/29 (100%)	24/25 (96%)	14/14 (100%)	
Postoperative BCVA ≥20/200 (eyes, %)	24/29 (83%)	24/25 (96%)	10/14 (71%)	

Values are expressed as mean ± SD or frequency. *, P values were calculated using one-way ANOVA; [†], logMAR improvement: the amount of mean visual improvement in logMAR. BCVA, best corrected visual acuity; logMAR, logarithm of the minimum angle of resolution; VA, visual acuity

Table 4 Post Hoc analysis of BCVA before and after cataract surgery

(I) Group vs. (J) Group	Mean difference (I-J)	Standard error	P value
Preoperative BCVA			
A vs. B	-0.28246	0.07951	0.002
A vs. C	-0.09716	0.09481	0.928
B vs. C	0.18530	0.09725	0.183
Postoperative BCVA			
A vs. B	0.12237	0.11016	0.812
A vs. C	-0.34817	0.13136	0.030
B vs. C	-0.47054	0.13474	0.003
LogMAR improvement			
A vs. B	-0.40482	0.13588	0.012
A vs. C	0.25101	0.16203	0.379
B vs. C	0.65584	0.16620	0.001

BCVA, best corrected visual acuity; logMAR, logarithm of the minimum angle of resolution.

Table 5 Intraoperative complications

Complications	Group A (eyes)	Group B (eyes)	Group C (eyes)
PCR	2	1	0
ZD	1	0	1
Iris prolapses	0	0	0
Corneal edema	3	6	0
Total	6	7	1

PCR, posterior capsular rupture; ZD, zonular dialysis.

be suboptimal compared with cases with preoperative VA of >20/1,000, as the mean postoperative BCVA was 20/60 (logMAR 0.5) in patients in groups A and B, who had no ocular comorbidities. The results could be explained by the fact that, despite the advances in phacoemulsification techniques and technologies, cases with severe or dense cataract with weak zonule are associated with increased risk of complications, such as, PCR, vitreous loss, lens drop, zonular dialysis and corneal endothelial decompensation, which might lead to decreased visual outcome (30). In the present case, 3 patients received ECCE, 1 patient received ICCE, and 3 patients received scleral fixation of intraocular lens implant in groups A and B, which might contribute to suboptimal visual outcome. Studies in areas with limited cataract surgery coverage in other countries also showed that the visual outcome of cataract surgery was suboptimal, although the surgery improved VA in most cases with both mild and severe visual impairment (14,18,24,25,27).

In the present study, patients with cataract with other comorbidities (Group C) showed worse postoperative visual outcome as well as less improvement in VA among the 3 groups, although the BCVA improved in most cases. It is conceivably due to the fact that not only cataract but also ocular comorbidities contribute to the patients' visual impairment. Monestam *et al.* (10) conducted similar study about visual results of cataract surgery on low vision patients and they divided patients into maculopathy group, glaucoma group, and retinitis pigmentosa group. Postoperative mean improvement of logMAR VA after 4–5 months was 0.71±0.67 in maculopathy group, 0.49±0.82 in glaucoma group, and 0.03±0.35 in retinitis pigmentosa group. In our study, of the three patients with ARMD, the BCVA improved from

HM, CF and CF to 20/100, 20/100 and 20/600, respectively. The result might be explained by the fact that patients lose vision in the late stages when complications, such as, development of subretinal neovascular membranes or patches of geographical atrophy affect the fovea, although ARMD can impair macular function from the early stages of the disease (31,32). A randomized controlled trial including 1939 eyes that had cataract surgery also revealed that patients with varying severity of AMD showed an increase in postoperative VA, and the amount of visual improvement was closely correlated with the severity of ARMD (33). In this study, eyes with mild, moderate and advanced ARMD gained 6.1, 3.9 and 1.9 letters, respectively, whereas those without ARMD gained 8.4 letters (33). Armbrecht *et al.* (34) reported patients with mild and moderate degrees of ARMD benefit from cataract surgery and the benefits are greater in patients with moderate degrees of lens opacity. Dikopf *et al.* (35) also reported that the average BCVA improved from 20/340 to 20/129 at 3 months after cataract surgery in patients with retinitis pigmentosa, although the mean BCVA of eyes with a preoperative VA of 20/200 or better improved from 20/81 to 20/43. These results suggest that cataract surgery can be beneficial for even advanced cases of retinitis pigmentosa, although the visual prognosis is associated with severity of the retinal disorder (35). Kuo *et al.* (9) revealed that cataract surgery offered both subjective and objective benefits to patients with low vision due to ARMD, retinitis pigmentosa, rod-cone dystrophy, oculocutaneous albinism and cerebrovascular accident, many of whom might have been dissuaded from the surgery. These findings, along with the results of the present study, suggest that cataract surgery should be encouraged even in patients with severe cataract with ocular comorbidities.

The rate of corneal edema was 13.2% in this study, which appears to be higher compared with a previously reported rate of 5.18% (36). It might be due to the fact that most of the cases in the present study were severe or dense cataract. A previous study revealed that postoperative corneal edema is strongly associated with a clinically significant corneal endothelial cell loss (37), which could also account for, at least in part, the suboptimal visual outcome in the present study as well as those in other studies (14,18,24,25,27). PCR was reported in 2 eyes (6.9%) in Group A and 1 (4%) in Group B. All three patients underwent scleral fixation of the intraocular lens. These results might be due to the fact that the cases included in this study were mostly surgically challenging cases, such as, dense or severe cataract with weak zonule, which is associated with increased risk of

capsular complication. Other studies also reported an increased risk of PCR (8%) in cataract surgery in patients in high-risk groups (38,39).

This study has a limitation that follow-up period was relatively short because majority of patients enrolled were elderly with impaired mobility with low vision. However, we believe BCVA at postoperative follow-up of 6 months may represent visual outcome after cataract surgery. In addition, the study mainly focused on BCVA, but subjective satisfaction analysis as well as objective visual function such as contrast sensitivity and glare disability would provide more information for further studies. Prospective studies including larger population with long-term follow-up are needed for more informative data. However, we believe that this study still provides significant and valuable data of visual outcome of cataract surgery in patients with legal blindness in Korea, which has never been reported to the best of our knowledge. Further studies on the results of cataract surgery in eyes with low vision or blindness in other countries would be of value to provide information that can be used when recommending surgery for those patients.

In conclusion, BCVA at 6 months after cataract surgery in patients with legal blindness significantly improved in all patient groups, although the visual outcome might be suboptimal compared to usual cataract cases, and patients with other ocular comorbidities might show reduced improvement. The results suggest that cataract surgery should be encouraged even for patients with legal blindness.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at <https://aes.amegroups.com/article/view/10.21037/aes-22-5/rc>

Data Sharing Statement: Available at <https://aes.amegroups.com/article/view/10.21037/aes-22-5/dss>

Conflicts of Interest: Both authors have completed the ICMJE uniform disclosure form (available at <https://aes.amegroups.com/article/view/10.21037/aes-22-5/coif>). SBH serves as an unpaid editorial board member of *Annals of Eye Science* from September 2020 to August 2022. The other author has no

conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was approved by the Institutional Review Board of Kangwon National University Hospital (No. 2021-03-010) and adhered to the tenets of the Declaration of Helsinki (as revised in 2013). Informed consent was waived by Institutional Review Board of Kangwon National University Hospital because this is a retrospective study that involves only retrospective review of medical records and does not include data that can identify patients.

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