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Effect of diabetes, hypertension, and obesity management on visual acuity in geriatric cataract surgery patients

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Abstract

Method *: Using annual statistics of major surgeries provided by the National Health Insurance Corporation, it figured out what changes come in visual acuity by the number of cataract surgeries nationwide plus age, gender, and geriatric disease every 3 years from 2013 to 2019 through joint point regression for statistics.*

Objective *: This study is intended to identify the relationship between geriatric diseases (diabetes, hypertension, obesity) and visual acuity in geriatric cataract surgery patients.*

Result *: First, geriatric diseases of cataract surgery patients were closely related to diabetes, hypertension, obesity, smoking, and drinking. In particular, diabetes, hypertension, and smoking had a high prevalence rate. There was no difference in gender and age. Second, 72% of all geriatric cataract surgeries were performed at the clinic level, and intraocular lens that was used after geriatric cataract surgery accounted for the majority of monofocal intraocular lens as 96.6%. Third, the visual acuity in geriatric cataract surgery patients improved from an average of 0.40 before surgery to 0.06 after surgery, and visual acuity improvement was found in 95% of them. These results suggest that geriatric cataract patients can expect visual acuity stabilization and positive visual acuity improvement through early surgery.*

Keywords: *Geriatric, Cataract, Diabetes, Hypertension, Obesity, Visual Acuity*

1. INTRODUCTION

Aging is a part of normal human growth and development, and research on the human aging phenomenon requires a multidimensional approach. This is because there is a striking difference between individuals in the time when the change of old age begins, and the start of aging by each organ is different even in the same individual.[1] Geriatrics have cataracts, glaucoma, or macular degeneration, which cause visual acuity loss due to this aging phenomenon. As a result, the number of cataract patients visiting ophthalmic hospitals is steadily increasing every year.[2] Cataract is a disease that causes physical disability next to arthritis and cardiovascular disease in geriatrics, and is an important cause of undermining the quality of their life. It can be, however, easily cured through the most frequently performed cataract surgery in ophthalmology.[3] It is an important problem that lowers the healthy lives of them as it is the biggest cause of blindness with an increase in their population. Visual impairment resulting from a long-standing geriatric disease of them is closely related to cataracts, which cause physical dysfunction, latent cognitive dysfunction, and independent living impairment by lowering the quality of their life.[4]

Recently, as Korea has entered an aging society, the high prevalence of chronic degenerative diseases and geriatric diseases among them has greatly increased the economic burden on patients, families and the country.

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Therefore, management of geriatric diseases in them requires early detection, treatment, and prevention beyond the level of simple treatment services.[5][6][7]

The neglect of diabetes, hypertension, and obesity, which a majority of them currently suffer from[8][9][10], depends greatly on the degree of geriatric diseases such as physical dysfunction and visual impairment in geriatric patients.[11][12][13] In particular, the surgical neglect of cataract patients has a close relationship with decreased visual acuity. Despite the importance of close relationships between their visual acuity and geriatric diseases (diabetes, hypertension, and obesity), research on this has been limited to studies related to individual ophthalmic surgery in them, and the change and state of visual acuity depending on the health status of them and the degree of geriatric diseases have not been studied.[14][15][16]

The objective of this study is to suggest implications for improving the quality of their life by identifying the relationship between geriatric diseases (diabetes, hypertension, obesity) and visual acuity in geriatric cataract surgery patients.[17][18]

2. RESEARCH METHOD

2.1 Research Data

Using 7-year data from 2013 to 2019, this study analyzed the number of cataract surgeries among major health insurance surgery statistics provided by the National Health Insurance Corporation. Using this data provided under the disclosure of information within the Health Insurance Corporation, it applied attributes of age, gender, medical institution, and surgical disease.

2.2 Subject and Method

It divided the age group of patients who underwent surgery into three groups (60 to 69, 70 to 79, over 80), and analyzed the number of cataract surgeries per unit population by age to identify a change in their condition.

In addition, it analyzed the number and rate of cataract surgeries performed at tertiary general hospitals, general hospitals, hospitals, and clinics over the past 7 years in the status of cataract surgery to figure out if there were any changes in the surgical rate by type of medical institution.

The joint point regression program 4.7.0.0 (Statistical Research and Applications Branch, National Cancer Institute, Bethesda, MA, USA) was used for statistical analysis. The joint point regression is a statistical method that calculates the ratio by dividing the number of cataract surgeries in the year into the number of medically covered populations or the total number of cataracts to determine whether there is a trend of change in the ratio as the years go by, which was used to identify the trend of increase or decrease in cataract surgery by year. Annual percent change (APC), the main indicator used in this study, is a value indicating the degree of such a trend.

2.3 Data Analysis

Data analysis was carried out through the approval of the Clinical Research Review Committee at 00 University, where this researcher is working. For statistical analysis, a t-test was used to compare the relationship with postoperative logMAR visual acuity by age, and one-way analysis of variance (ANOVA) was used to compare the difference between groups. The SPSS for window 18.0 (SPSS Inc, Chicago, IL, USA) was used for statistical processing, and the significance level of p-value was set to less than 0.05.

3. RESEARCH RESULT

3.1 General Characteristics

This study redivided men and women into two groups to determine the cataract factors by gender and age with 5,024 geriatrics (2,163 males, 2,861 females) aged 60 to 94 years old who underwent cataract surgery. Among the total subjects, 1,467 and 696 men were included, respectively, and 1,890 and 971 women were included, respectively.

Table 1. Mean Age and Frequency of Study Samples by Gender and Age

Gender	Age	N(unit: persons)	Mean age±SD (yrs)
Men	Group1	1,467	51.41 ± 7.29
	Group2	696	72.34 ± 5.47
	Total	2,163	58.15 ± 11.89
Women	Group1	1,890	51.05 ± 7.03
	Group2	971	72.74 ± 5.60
	Total	2,861	58.41 ± 12.20

For IOLs used in cataract surgery, 2,145 monofocal IOLs (96.6%) was the highest, followed by 46 multifocal IOLs (2.0%), 17 accommodative IOLs (0.8%), and 14 toric IOLs (0.6%). (Table 2)

Table 2. Type of Intraocular Lens

IOL TYPE	YEAR			TOTAL
	2013	2016	2019	(unit: persons)
Monofocal	501	780	864	2,145(96.6)
Multifocal	13	15	18	46(2.0)
Accommodative	3	6	8	17(0.8)
Toric	7	4	3	14(0.6)
Total	524	805	893	2,222

There were no gender differences in the prevalence of diabetes, hypertension, and obesity. The prevalence of obesity in the group 1 and 2 of men, and the group 1 and 2 of women was 22.4% and 23.6%, and 21.9% and 28.9%, respectively. The prevalence of diabetes in the group 1 and 2 of men, and the group 1 and 2 of women was 5.5% and 6.8%, and 5.4% and 5.9%, respectively. The prevalence of hypertension in the group 1 and 2 of men, and the group 1 and 2 of women was 14.7% and 17.0%, and 14.5% and 16.4%, respectively. There was no significant difference in the frequency of smoking and drinking according to gender and age. (Table 3) There was no gender and age difference regarding triglyceride.

Table 3. Characteristics of Study Samples by Gender and Age(%)

Variables	Men		Women	
	Group1	Group1	Group1	Group1
Diabetes	5.5	6.8	5.4	5.9
Hypertension	14.7	17.0	14.5	16.4
Obesity	22.4	23.6	21.9	28.9
Smoking	31.3	26.6	29.0	27.6
Drinking	7.0	4.9	5.9	4.6
Triglyceride	21.5	24.3	21.2	20.4

The frequency of cataract surgery by type of medical institution showed a change from 8.8% in 2013 to 8.6% in 2019 at tertiary hospitals, from 6.2% to 6.7% at general hospitals, from 10.0% to 10.2% at hospitals including ophthalmology, and from 74.9% to 74.2% at clinics. (Table 4)

Table 4. Distribution of Age and Gender

Age Group	2013 (%)	2016 (%)	2019 (%)
Tertiary General Hospital	8.8	8.7	8.6
General Hospital	6.2	6.5	6.7
Hospital	10.0	10.1	10.2
Clinic	74.9	74.5	74.2

3.2 Comparison Before and After Cataract Surgery

The group 1 and 2 classified above were subdivided into A (60 to 69 years old), B (70 to 79 years old), and C (over 80 years old) to compare the trend of eye diseases before and after cataract surgery.

For preoperative ocular disease in group A, diabetic retinopathy (16 eyes) was the highest, followed by glaucoma (4 eyes), ARMD (2 eyes), posterior synechiae (2 eyes), BRVO (1 eye), retinal tear (1 eye), and corneal opacity (1 eye).

Table 5. Ocular Comorbidities

Eyes	Group A	Group B	Group C	p-value
Diabetic retinopathy	16	10	3	
Glaucoma	4	6	9	
ARMD	2	6	12	
posterior synechiae	2	0	2	
Corneal opacity	1	1	0	
Granular corneal dystrophy	0	2	0	
Bullous keratopathy	0	0	1	
BRVO	1	0	2	
CRVO	0	0	1	
BRAO	0	0	1	
CRAO	0	0	1	
Retinal tear	1	0	2	
Asteroid hyalosis	0	2	2	
Opic atrophy	0	0	5	
ERM	0	0	1	
Macular hole	0	0	1	
Total	27	27	43	0.958*

ARMD = age-related macular degeneration; BRVO = branch retinal vein occlusion; CRVO = central retinal vein occlusion; BRAO = branch retinal artery occlusion; CRAO = central retinal artery occlusion; ERM = epiretinal membrane.

*p-values were calculated using one-way analysis of variance (ANOVA). The one-way ANOVA was used to check if there is the difference of visual acuity after cataract surgery in accordance with ocular comorbidities among the three groups. Comparisons of patients with and without ocular comorbidities were done among the 3 groups.

For preoperative ocular disease in group B, diabetic retinopathy (10 eyes) was the highest, followed by glaucoma (6 eyes), ARMD (6 eyes), asteroid hyalosis (2 eyes), granular corneal dystrophy (2 eyes), and corneal opacity (1 eye). For preoperative ocular disease in group C, ARMD (12 eyes) was the highest, followed by

glaucoma (9 eyes), opic atrophy (5 eyes), diabetic retinopathy (3 eyes), asteroid hyalosis (2 eyes), posterior synechiae (2 eyes), retinal tear (2 eyes), BRVO (2 eyes), BRAO (1 eye), CRVO (1 eye), CRAO (1 eye), macular hole (1 eye), ERM (1 eye), and bullous keratopathy (1 eye). (Table 5)

The comparison of visual acuity before and after surgery showed that the logMAR visual acuity of group A was improved from a preoperative mean of 0.40 to a postoperative mean of 0.06 (P<0.001). Visual acuity improvement was observed in 82 eyes (95%), and postoperative visual acuity was over 20/40 in 77 eyes (91%). The logMAR visual acuity of group B was observed from a preoperative mean of 0.50 to a postoperative mean of 0.16 (p<0.001), and visual acuity improvement was observed in 74 eyes (87%) and postoperative visual acuity was over 20/40 in 72 eyes (85%). The logMAR visual acuity of group C was improved from a preoperative mean of 0.75 to a postoperative mean of 0.31 (p<0.001), and visual acuity improvement was observed in 116 eyes (81%) and postoperative visual acuity was over 20/40 in 96 eyes (67%).

Table 6. Preoperative and postoperative best corrected visual acuity (logMAR)

	Group A	p-value
Preoperative BCVA	0.40 ± 0.47 (-0.08-3.00)	
Postoperative BCVA	0.06 ± 0.19 (-0.18~0.82)	
		<0.001*
log MAR improvement	0.34 ± 0.42 (0.00-3.00)	
VA improvemen (eyes, %)	82/86 (95%)	0.792*
Postoperative BCVA ≥ 20/40, (eyes, %)	77/86 (91%)	0.384‡

	Group B	p-value
Preoperative BCVA	0.50 ± 0.51 (0.00~3.00)	
Postoperative BCVA	0.16 ± 0.24 (-0.18~1.22)	
		<0.001*
log MAR improvement	0.34 ± 0.45 (0.00~2.70)	
VA improvemen (eyes, %)	74/85 (87%)	0.710*
Postoperative BCVA ≥ 20/40, (eyes, %)	72/85 (85%)	0.295‡

	Group C	p-value
Preoperative BCVA	0.75 ± 0.62 (0.05~3.00)	
Postoperative BCVA	0.31 ± 0.29 (-0.08~1.52)	
		<0.001*
log MAR improvement	0.44 ± 0.57 (-0.82~2.78)	
VA improvemen (eyes, %)	116/143 (81%)	0.698*
Postoperative BCVA ≥ 20/40, (eyes, %)	96/143 (67%)	0.522‡

Values are presented as mean ± SD unless otherwise indicated. In each group, pre- and postoperative BCVA were compared. Comparisons of pre- and postoperative BCVA, respectively, were also done among the 3 groups.
BCVA = best corrected visual acuity; VA = visual acuity.
*p-values were calculated using Pearson's chi-square test. The Pearson's chi-square test was used to check if the age have affected to improve visual acuity of each group. In each group, improved and not improved postoperative visual acuity were compared; ㅗ-values were calculated using one-way analysis of variance (ANOVA); ^-values were calculated using Pearson's chi-square test The Pearson's chi-square test was used to check if the age have affected the postoperative BCVA of each group. In each group, above 20/40 postoperative BCVA was compared a under 20/40 postoperative BCVA.

For the preoperative mean logMAR visual acuity, there was a significant difference between three groups (p<0.001, One-way ANOVA), but there was no significant difference in groups A and B (p=0.454). Group C was significantly worse than group A (p<0.001) and group B (p=0.005). For the postoperative mean logMAR visual acuity, there was a significant difference between three groups (p<0.001, One-way ANOVA). there was no significant difference in groups A and B (p=0.454). Group C was significantly worse than group A (p<0.001) and group B (p=0.005). Group A showed significant visual acuity compared to group B (p=0.034), and group C was worse than group A (p<0.001) and group B (p<0.001). (Table 5 and 6)

For the proportion of patients with improved visual acuity, there was a significant difference between three groups (p=0.009, One-way ANOVA), but there was no significant difference between group A and B (p=0.276) and group B and C (p=0.438). Group C was significantly lower than group A (p=0.009). For the proportion of patients with postoperative visual acuity over 20/40, there was a significant difference between the three groups (p<0.001, One-way ANOVA). There was no significant difference between groups A and B (p= 0.736), but group C was significantly lower than group A (p<0.001) and group B (p=0.007). (Table 6, 7)

Table 7. Post hoc analysis of BCVA before and after cataract surgery

Age Group	Mean Digfference	Standard error	p-value
Preoperative logMAR			
A* and B†	-0.10573	0.08404	0.454
A* and C‡	-0.35519	0.07498	<0.001
B* and C‡	-0.24947	0.07525	0.005
Postoperative logMAR			
A* and B†	-0.10103	0.03855	0.034
A* and C‡	-0.25342	0.03440	<0.001
B* and C‡	-0.15239	0.03452	<0.001
BCVA improvement (eyes, %)			
A* and B†	0.08290	0.05152	0.276
A* and C‡	0.14230	0.04597	0.009
B* and C‡	-0.05940	0.04614	0.438
Postoperative BCVA (> 20/40)			
A* and B†	0.04829	0.06171	0.736
A* and C‡	0.2402	0.05505	<0.001
B* and C‡	0.17573	0.05526	0.007

BCVA = best corrected visual acuity.
*Group I; ‡Group J.

4. DISCN SSIONS

Overall, as the average life expectancy is gradually growing due to the development of medical technology in modern society, the geriatric population is also increasing. As a result, the number of geriatric cataract surgeries in people over the age of 60 is increasing. Compared to other age groups, geriatrics have a higher prevalence of geriatric diseases such as diabetes, hypertension and obesity, and have a tendency to take a long period of recovery due to their low healing ability.[24][25][26]

Cataract surgery in geriatrics who recently visited an ophthalmologist has shown a high trend.[21][22] This

trend is evidenced by the growing number of patients hospitalized for cataracts among the most frequent diseases in the medical cost statistics indicators published by the Health Insurance Review and Assessment Service from 2013 to 2019.

Based on this trend, the results of analysis on the effect of diabetes, hypertension and obesity management on visual acuity in geriatric cataract surgery patients are be summarized as follows.

First, diabetes, hypertension, obesity, smoking and drinking as geriatric diseases of cataract surgery patients had a close relationship with visual acuity. In particular, diabetes, hypertension and smoking among these had a high prevalence, and there was no difference by gender or age.

Second, 74.2% of all surgeries for geriatric cataract patients were performed at the clinic level, and the monofocal intraocular lens used for geriatric cataract surgery accounted for the majority of intraocular lens with 96.6%. This is consistent with what cataracts was reported to show an increase in prevalence with systemic diseases such as UV exposure, smoking, pregnancy, diabetes and hypertension, and the prevalence of cataracts was generally reported to increase along with age in studies by Song et al.[19][20] In particular, the frequency of cataract surgery increased along with age until 70, and the number of cataract surgeries decreased sharply in those aged over 80, requiring early surgery and management of geriatric cataract patients aged between 60 to 69.

For preoperative and postoperative visual acuity changes, the proportion of patients with visual acuity over 20/40 was significantly lower in group C than group A ($p<0.001$) and group B ($p=0.007$). Monestam and Wachmeister[21] in a study of patients aged under 80, between 80 to 89, and over 90 reported that 97% of patients aged under 80, 90% of patients aged between 80 to 89, and 94% of patients aged over 90 showed improvement in visual acuity after cataract surgery. They also reported in another study of patients aged over 96 that 70.59% of patients aged over 96 showed improvement in visual acuity after cataract surgery.[22] The existing published literatures showed that visual acuity improvement can be expected in more than 80% of geriatrics aged over 80 when cataract surgery in them is performed.

Westcott et al. revealed that age is a factor of postoperative visual acuity prognosis, and reported that the likelihood of postoperative visual acuity over 20/40 was 4.6 times higher in the low-age group between 60 to 69 than in the high-age group over 80.[23] Michalska-Malecka et al. reported in a study of 122 patients aged between 90 to 100 that improvement in the best-corrected visual acuity was observed in 82% (100/122 eyes), and postoperative visual acuity over 20/25, between 20/40 and 20/30, and between 20/100 and 20/50 at 3 months was observed in 18% (23 eyes), 22.3% (28 eyes), and 27.1% (33 eyes), respectively. So we can infer in these results These results showed that although the degree of visual acuity recovery is lower in the low-age group than in the high-age group, improvement in visual acuity can be expected after cataract surgery than before cataract surgery, which is consistent with the results of this study.[24]

As can be seen from the results of this survey, cataract surgery using monofocal intraocular lenses is still frequently performed, and the use frequency of special intraocular lenses is low. As Korea enters an aging society, the social activities of geriatrics are increasing, and they are showing a lot of interest in improving near visual acuity rather than being satisfied with simple distance visual acuity. In a survey of interest in special IOLs by Paik et al. [25], 72%, 54%, and 65% among all respondents responded that they have more than average interest in multifocal IOLs, toric IOLs, and accommodative IOLs. This inclination can also be seen in the trend of increasing interest in special intraocular lenses every year.

Third, the change of preoperative and postoperative visual acuity in geriatric cataract patients showed that their visual acuity improved from an average of 0.04 before surgery to an average of 0.06 after surgery, and that visual acuity improvement was found in 95% of them. There is a report that the number of cataract surgeries for the very geriatrics aged over 80 not seen much in Korea in the past is increasing, and postoperative visual acuity improvement is also observed in 87%.[26][27] An overseas study of patients aged over 85 reported that postoperative visual acuity improvement was observed in 84.3% of them, and that visual acuity improvement of over 0.5 was observed in 71.4% of which. Another study of patients aged over 70 reported that postoperative visual acuity improvement was observed in 88% of them.[26][27]

The above results proved that geriatric diseases of geriatric cataract surgery patients have a close relationship with their visual acuity, and their cataract surgery has a positive effect on their visual acuity. This suggests that the neglect of geriatric diseases and the suppression of surgery can lead to the worsening of cataracts and other

complications even if they are geriatrics. Consequently, long-term exposure patients in the high risk group for geriatric diseases should strive for cataract surgery and geriatric disease management, recognizing that diabetes, hypertension and obesity, which are closely related to cataracts, are important factors for visual acuity protection and maintenance of healthy eyes.

5. CONCLUSION

Cataracts cause a decrease in water-soluble protein and an increase in insoluble protein with increasing age, leading to lens opacity. Subsequently, lens opacity causes a decrease in visible light transmittance and a decline in visual acuity. Therefore, the number of geriatrics trying to prevent and treat geriatric diseases is increasing due to a recent increase in the prevalence of cataract along with an increase in geriatric diseases among geriatrics.[18] Visual acuity improvement and change were confirmed after cataract surgery in all age groups aged over 60 who suffered from a decline in visual acuity function due to the degree of geriatric diseases (diabetes, hypertension, obesity). There was no significant difference between the ages. In other words, positive visual acuity improvement can be expected in the prognosis of visual acuity when cataract surgery is performed even in geriatrics, contributing to visual acuity improvement. In particular, it was suggested that geriatrics are more likely to have ophthalmopathy such as age-related maculopathy and diabetic retinopathy, which may adversely affect the prognosis of postoperative visual acuity.

In conclusion, the prognosis of visual acuity after cataract surgery was significantly poorer and the rate of visual acuity improvement was significantly lower in the patient group aged over 60 than in other age groups due to geriatric diseases. However, visual acuity improvement and statistically significant visual acuity recovery were observed in more than 80%. Consequently, additional studies need to be done through long-term tracking observation including more patients in the future.

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