· Original article ·

Outcomes in 334 cases of Millions of Poor Cataract Patients' Extraction Project in Shanxi Province

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中国山西334例"百万贫困白内障患者复明工程"手术效果分析

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摘要

目的:了解中国山西省贫困白内障患者术后视力、视功能和生存质量的变化,分析贫困白内障患者手术成本/效果。

方法:采用回顾性方法,对334例334眼接受贫困白内障复明手术的患者进行基本情况、术前及术后1wk视力、术中并发症、术后并发症的病历采集及现场调查,对其中83例进行视功能和生存质量调查,225例贫困白内障患者和120例非贫困白内障患者进行手术成本/效果的对比分析,使用多重线性回归模型及Logistic回归模型进行术后视力影响因素分析。

结果:患者术后1wk视力明显高于术前视力($P<0.05$),其中术后1wk视力≥0.5的为235例(70.4%)、视力<0.05的为16例(4.8%)。多重线性回归分析显示,眼部其他疾病、白内障分类是术后视力的影响因素。logistic回归分析显示,术前视力低、眼部有其他疾病是术后低视力的危险因素,其*OR*值及其95%*CI*依次为6.5(2.8-14.8)和1.3(1.0-1.6)。术后视功能以及生存质量均高于术前。贫困白内障患者手术成本/效果低于非贫困白内障。

结论:贫困白内障患者术后视力、视功能明显提高,且手术成本低,显著改善了生活质量。

关键词:百万贫困白内障患者复明工程;术后视力和视功能;生存质量分析

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Abstract

• AIM: To evaluate the visual acuity, visual function, quality of life, and cost/effectiveness of cataract surgery in patients with low socioeconomic status (LSES) who received government subsidies for free cataract surgery.

• METHODS: Retrospectively, 334 eyes of 334 patients were reviewed. Visual function and quality of life questionnaires were available in 83 patients. The cost/effectiveness of cataract surgery was analyzed in 225 patients with LSES and 120 patients who received standard cataract surgery. Multiple linear regression analysis and logistic regression analysis were used to assess the factors affecting the postoperative visual acuity.

• RESULTS: At 1wk postoperatively, uncorrected visual acuity (UCVA) was improved significantly compared to these preoperatively ($P<0.05$), 235 eyes (70.4%) had UCVA of 20/40 or better, and 16 eyes (4.8%) had UCVA worse than 20/400. Multiple linear regression analysis revealed that other ocular diseases and cataract classification were factors contributing to postoperative UCVA. Logistic regression analysis showed that low preoperative visual acuity and other ocular diseases were risk factors of postoperative low vision, and the odds ratio (95% confidence interval) values were 6.5 (2.8-14.8) and 1.3 (1.0-1.6), respectively. Visual function and quality of life were significantly improved after the surgery. The cost/effectiveness of cataract surgery in patients with LSES was lower than that in standard cataract patients.

• CONCLUSION: Visual acuity and visual function were significantly better after the surgery in cataract patients with LSES, and the operation cost was low. Quality of life in these patients was significantly improved.

• KEYWORDS: Millions of Poor Cataract Patients' Extraction Project; postoperative visual acuity and visual function; analysis of quality of life
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INTRODUCTION

Shanxi is a low-income province in China. In 2009, the Chinese government implemented a special program (Millions of Poor Cataract Patients' Extraction Project) using specific fund, in which cataract patients with low socioeconomic status (LSES) received free cataract surgery. The purpose is to eliminate the blindness caused by cataract. Surgical treatment is the main approach to prevent blindness in cataract patients[1]. Between 2009 and 2012, in Shanxi Province, 45 034 free cataract surgeries were performed in patients with LSES in 115 hospitals using this government fund. Of these cases, 19 802 (44%) cases were performed in county (district) level general hospitals, 20 321 cases (45%) in specialized ophthalmic hospitals, and 4911 cases (11%) in large general hospitals.

In a previous study, we investigated the eye care status in Millions of Poor Cataract Patients' Extraction Project[2]. In this study, we evaluated the visual acuity, visual function, and quality of life in these patients with LSES following the cataract surgery, preoperative factors contributing to postoperative visual acuity, and the cost/effectiveness of cataract surgery in patients with LSES.

SUBJECTS AND METHODS

Subjects Retrospectively, we reviewed consecutive patients who participated in the special program Millions of Poor Cataract Patients' Extraction Project between Apr. 2011 and Sep. 2014.

Before the surgery, ocular biometry was measured using the partial coherence interferometer (IOLMaster, Carl Zeiss Meditec Inc., Oberkochen, Germany), immersion A-scan, or applanation A-scan. Intraocular lens (IOL) power calculation was done using SRK/T formula. Small incision cataract surgery with phacoemulsification and spherical IOL implantation was performed in 334 eyes of 334 patients. Of the 334 eyes, 179 (53.6%) eyes were operated in specialized ophthalmic hospitals and 155 (46.4%) eyes had surgery in general hospitals. All cataract surgeries were performed by certified cataract surgeon.

Survey Methodology This research was approved by the ethics committee and the study adhered to the tenets of the Declaration of Helsinki. Patients' charts were reviewed and demographic characteristics were recorded, including name, gender, age, etc. Before and 1wk after the surgery, patients received detailed binocular eye exam, including visual acuity, anterior segment and fundus examination. Visual acuity was tested using the international standard Snellen decimal visual acuity chart, and then converted to logMAR visual acuity for data analysis. Patients also completed the visual function and quality of life questionnaires.

The visual function and quality of life questionnaires used in this study are those designed for developing countries by the World Health Organization and National Eye Institute, USA (NEI-VFQ)[3-4]. Visual function questionnaire consists of 13 questions to assess the following 4 aspects: limitation in daily activity (questions 2-5), peripheral vision (question 6), adaptation (questions 7a, 7b, 8a, 9a, 11a and 11b), and stereo vision (question 10). Quality of life questionnaire was used to measure the overall quality of life, consisting of 11 questions that covered 4 aspects: self-care (bathing, eating, and dressing), general daily activity (walking to the neighbor, shopping, and housework), social activity (attending party and meeting people), and psychologic stress (self-contempt, emotion, and self-confidence).

Participating researchers had rigorous training. To ensure the data reliably and comparably, one examiner filled out and completed the questionnaires in all subjects.

Data Analysis Patients were divided into subgroups according to age (≤49 y, 50-59y, 60-69y, and ≥70y), gender, duration of poor vision preoperatively (<1y, 1-3y, 4-6y, 7-10y, and >10y), other diseases (diabetes, hypertension, diabetes and hypertension, and other), cataract classification (senile, traumatic, secondary caused by other eye conditions, and metabolic), and other ocular diseases (corneal diseases, glaucoma, high myopia, uveitis, ocular trauma, and fundus lesions).

A subset of eyes (83 eyes) was randomly selected for visual function and quality of life analyses. A simple scoring method was used for the visual function and quality of life questionnaire results with ranges from 1 to 4. A score of 1 represents extreme difficulty and 4 as no difficulty at all. In order to make the starting point of each index score and maximum score in the same level, all scores were transformed into a score between 0 and 100, with 0 indicating the maximum degree of difficulty, and 100 representing no difficulty at all. This means the higher a score, the better subjective visual function and quality of life are.

The cost/effectiveness analysis is a form of analysis that compares the relative costs and outcomes (effects) of two or more courses of action. It is expressed in terms of a ratio where the denominator is a gain in health from a measure and the numerator is the total cost associated with the health gain. In this study, uncorrected visual acuity (UCVA) of 20/40 or better following cataract surgery was defined as successful, and the success rate for cataract surgery was calculated as the ratio of number of eyes with UCVA of 20/40 or better to total number of eyes. Then, the success rate for cataract surgery and the total cost of hospitalization were used in the cost/effectiveness analysis.

Statistical Analysis The SPSS version 22.0 (IBM American, USA) was used in this study. The Student's-t test, Chi-square test, multiple linear regression, and logistic regression model were performed for statistical analysis. A $P<0.05$ was considered as statistically significant.

RESULTS

Totally 334 eyes of 334 patients were included; 117 patients (35%) were male and 217 patients were female. Of these patients, 12 patients aged ≤49y, 54 patients aged 50-59y, 102 patients aged 60-69y, and 166 patients aged ≥70y.

Visual Acuity The mean UCVA values were 1.48±0.58 (LogMAR, mean ± standard deviation) preoperatively and

Table 1 Uncorrected visual acuity before and 1wk after the surgery (n=334)

Time	<20/400	20/400-20/70	20/70-20/40	≥20/40
Before surgery	183(55%)	138 (41%)	9 (3%)	4 (1%)
1wk after surgery	16 (4.8 %)	45 (13.5%)	38 (11.4%)	235 (70.4%)

Table 2 Factors associated with postoperative visual acuity

Categories	n	Postoperative visual acuity (Mean ± SD)
Gender		
M	117	0.32±0.38
F	217	0.38±0.43
Age[a]		
≤49a	12	0.59±0.69
50-59a	54	0.32±0.38
60-69a	102	0.27±0.30
≥70a	166	0.42±0.44
Duration of poor vision		
<1a	56	0.38±0.40
1-3a	182	0.33±0.39
4-6a	68	0.38±0.43
7-10a	15	0.29±0.45
>10a	13	0.67±0.57
Associated diseases		
None	263	0.34±0.40
Diabetes	20	0.35±0.41
Hypertension	43	0.48±0.48
Others (heart disease)	3	0.44±0.18
Diabetes and hypertension	5	0.53±0.06
Cataract classification[a]		
Senile	263	0.37±0.23
Traumatic	2	0.75±0.21
Secondary	49	0.66±0.49
Metabolic	20	0.29±0.37
Other ocular diseases[a]		
Corneal disease	4	0.50±0.29
Glaucoma	2	1.30±0.71
High myopia	29	0.55±0.37
Uveitis	7	0.69±0.62
Trauma[b]	1	0.40
Retinal disease	3	0.50±0.57
None	288	0.32±0.39

[a]P<0.05; [b]There is only one eye with trauma, so we cannot calculate the SD value.

0.36±0.41 at 1wk postoperatively; there was significant improvement (t=34.139, P<0.01). The percentages of eyes with UCVA of <20/400, 20/400-20/70, 20/70-20/40, and ≥20/40 before and 1wk after the surgery are listed in Table 1, and postoperative UCVA was significantly better than that preoperatively (χ^2=428.50, P<0.01).

Factors Associated with Postoperative Visual Acuity Table 2 shows that age was a significant factor that contributed to postoperative visual acuity; patients with ages between 60-69y had better UCVA than patients with ages of ≤49y and of ≥70y (both P<0.01). Cataract classification was also a significant factor contributing to postoperative visual acuity; patients with senile cataract and metabolic cataract had better postoperative visual acuity, compared to patients with secondary cataracts and traumatic cataracts (both P<0.01). Other ocular diseases was a significant factor as well; patients with no other ocular diseases had better postoperative visual acuity, compared to patients with glaucoma, high myopia, and uveitis (all P<0.01). Postoperative visual acuity was not associated with gender, duration of poor vision preoperatively, or associated diseases (all P>0.05).

Table 3 Multiple regression analysis investigating factors associated with postoperative visual acuity

Variable	Regression coefficients		Standardized regression coefficients
	B	S. E	
Constant	0.580	0.144	-
Ocular diseases (X1)	-0.045	0.019	-0.15
Cataract classification (X2)	0.041	0.019	0.134

F=10.933, P<0.001.

Multiple regression analysis, adjusting for potentially confounding variables that have been included in the model, revealed that other ocular disease and cataract classification were significant factors for postoperative visual acuity (Table 3). The regression equation was follows:

Y=0.580-0.045X1+0.041 X2

Postoperative Low Vision Postoperative low vision (UCVA <20/70) occurred in 18.2% of eyes (61/334). The duration of poor vision preoperatively, associated disease, cataract classification, other ocular diseases, and preoperative visual acuity were significant factors for postoperative low vision (all P<0.05) (Table 4).

Postoperative Low Vision Logistic Regression Analysis Logistic regression analysis showed that preoperative low vision and associated other ocular diseases were risk factors for postoperative low vision. The odds ratio (OR) and 95% confidence interval were 6.5 (2.8-14.8) and 1.3 (1.0-1.6), respectively.

Visual Function and Quality of Life Following the cataract surgery, patients' visual function and quality of life were significantly improved, compared to those before the surgery (all P<0.05) (Table 5).

Intraoperative and Postoperative Complications Table 6 shows the intraoperative and postoperative complications. Intraoperatively, 22 eyes (6.6%) had posterior capsular tear, 5 eyes (1.5%) had lens nucleus in the vitreous cavity, and 17 eyes (5.1%) had anterior vitrectomy.

Cataract Surgery Cost/effectiveness Analysis The cost/effectiveness of cataract surgery was 2 708 CNY in patients with LSES, and 8 663 CNY in standard cataract patients. Using the low cost/effectiveness in patients with LSES as

Table 4 Factors associated with postoperative low vision (uncorrected visual acuity <20/70)

Categories	Low vision	
	Yes(%)	No(%)
Gender		
M	20(32.8%)	97(35.5%)
F	41(67.2%)	176(64.5%)
Age		
<49a	4(6.6%)	8(2.9%)
50-59a	12(19.7%)	42(15.4%)
60-69a	11(18.0%)	91(33.3%)
≥70a	34(55.7%)	132(48.4%)
Duration of poor vision[a]		
<1a	12(19.7%)	44(16.1%)
1-3a	25(41%)	157(57.5%)
4-6a	16(26.2%)	52(19.0%)
7-10a	2(3.3%)	13(4.8%)
>10a	6(9.8%)	7(2.6%)
Associated diseases[a]		
None	39(63.9%)	224(82.1%)
Diabetes	5(8.2%)	15(5.5%)
Hypertension	14(23.0%)	29(10.6%)
Others (heart disease)	1(1.6%)	2(0.7%)
Diabetes and hypertension	2(3.3%)	3(1.1%)
Cataract classification[a]		
Senile	34(55.7%)	229(83.9%)
Traumatic	2(3.3%)	0(0%)
Secondary	23(37.7%)	26(9.5%)
Metabolic	2(3.3%)	18(6.6%)
Other ocular diseases[a]		
Corneal disease	1(1.6%)	3(1.1%)
Glaucoma	2(3.3%)	0(0%)
High myopia	12(19.7%)	17(6.2%)
Uveitis	4(6.6%)	3(1.1%)
Trauma	1(1.6%)	0(0%)
Retinal disease	1(1.6%)	2(0.7%)
None	40(65.6%)	248(90.8%)
Preoperative UCVA[a]		
<20/400	54(88.5%)	129(47.3%)
20/400-20/70	7(11.5%)	128(46.9%)[b]
20/70-20/40	0(0%)	9(3.3%)
≥20/40	0(0%)	4(1.5%)

[a]$P<0.05$; [b]There is data loss of 3 preoperative UCVA.

standard, the incremental cost/effectiveness in standard cataract patients was 45 798.2 (Table 7).

DISCUSSION

Cataract remains the leading cause of blindness worldwide. It reduces visual function and affects patient's daily life, study, and work. Global blindness among cataract will increase by 50% till 2020[5]. By contrast, China is still a developing country, the incidence of cataract is high, the coverage rate is uneven[6-7] and cataract surgery for prevention of blindness is more important. Especially with the increase of population in our country and the arrival of an aging society, the incidence of senile cataract blindness dramatically increases. Therefore it is important to prevent blindness in the elderly[8].

Table 5 Visual function and quality of life before and after surgery ($n=83$) (Mean±SD)

Categories	Before surgery	After surgery
Visual Function[a]	21.98±19.56	65.26±14.01
Daily activity[a]	19.65±18.16	63.78±14.76
Peripheral vision[a]	23.19±21.66	66.26±14.31
Adaptation[a]	20.71±18.28	64.76±14.06
Stereo vision[a]	24.39±23.74	66.26±14.31
Quality of Life[a]	57.30±19.67	72.12±7.67
Self-care[a]	60.97±21.19	72.63±8.25
Daily activity[a]	57.83±21.39	73.19±6.89
Social activity[a]	61.87±19.21	73.79±6.65
Psychologic stress[a]	49.19±25.98	68.97±13.85

[a]$P<0.05$.

Surgery was the most effective treatment of cataract. Many studies showed that surgery significantly improved the visual quality and quality of life in patients with cataract. In this study, we evaluated the visual acuity, visual function, quality of life, and cost/effectiveness of the cataract surgery in patients with LSES who received government subsidies for free cataract surgery. Our results showed that visual acuity was significantly improved after the surgery, 70.4% of patients had UCVA of 20/40 or better 1wk after the surgery, and visual function and quality of life were significantly better postoperative, consistent with results from other studies[9-12]. In this study, we found that other ocular diseases and cataract classification were factors contributing to postoperative visual acuity. Preoperative poor vision and other ocular diseases were risk factors for postoperative low vision. Due to limited funding, cataract patients with LSES received standard spherical intraocular lenses, and some patients had residual myopia and astigmatism. Some of these patients with postoperative low vision may have improved vision with glasses. Unfortunately, refraction was not performed at 1wk postoperatively. Further study is desirable in this regard. A few patients had uveitis and iris synechiae postoperatively, and 7.5% of patients had posterior capsule opacification. Some of these patients had poor compliance with medication postoperatively and did not see a doctor on time, which may be the cause of low vision and poor quality of life. A better system for postoperative follow-up and patient education is desirable to reduce postoperative complications[13-14].

Studies showed that different surgical procedures and surgeries at different hospitals had different costs[15-16]. With lower surgical cost, higher percentage of patients may undergo the cataract surgery[17]. Our survey results demonstrated that the cost/effectiveness of cataract surgery in patients with LSES was lower than that in standard cataract patients. The surgical cost in patients with LSES was lower, the effectivenss was better, and postoperative visual acuity and quality of life were significantly improved.

Table 6 Intraoperative and postoperative complications ($n=334$)

Complications	Intraoperative				Postoperative			
	Posterior capsular tear/ zonular dehiscence	Vitreous loss/ anterior vitrectomy	Lens nucleus in vitreous cavity	Other	Posterior capsule opacification	Iritis	IOL decentration	Others
Number of cases	22	17	5	4	25	6	4	4
Percentage (%)	6.6	5.1	1.5	1.2	7.5	1.8	1.2	1.2

Table 7 Cataract surgery cost/effectiveness analysis

Subgroups	Success rate	Total cost (CNY)	Cost/effectiveness (CNY)	Incremental cost/effectiveness
Cataract surgery in poor patients	71.1% (160/225)	1926.0	2708	-
Cataract surgery in standard patients	82.5% (99/120)	7147.0	8663	45798.2

This study had certain limitations. We did not include a control group, and could not compare results, such as visual outcomes and improvements in quality of life, in patients with LSES and patients with standard cataract surgery. Our results were consistent with results from other studies[9-12]. The follow-up of 1wk was short, and manifest refraction and best-corrected visual acuity were not obtained at 1wk postoperatively. Some of the patients with postoperative low vision may have improved vision with glasses. Further studies with longer follow-up are warranted.

In summary, we have made good progress in the prevention of blindness. There are still some problems that need to be solved, such as the slow increase of cataract surgery procedures[18]. This study provides a helpful guide to blindness prevention. The Millions of Poor Cataract Patients' Extraction Project provides affordable blindness prevention and treatment services for cataract patients[19-21], especially cataract patients with LSES, and explores the suitable, effective, convenient, sustainable, and low cost cataract health service system.

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