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EPIDEMIOLOGICAL PROFILE AND VISUAL OUTCOMES OF CATARACT SURGERY IN A RURAL MEDICAL COLLEGE SETTING

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ABSTRACT

Background

Cataract is the leading cause of preventable blindness globally, with age-related cataracts being the most common. Cataract surgery is a critical intervention for restoring vision, particularly in rural areas where access to healthcare services may be limited. This study aimed to assess the epidemiological profile and visual acuity improvement following cataract surgery in a rural medical college setting.

Methods

A hospital-based, prospective, observational study was conducted over 12 months. A total of 1624 patients with senile cataract, attending screening camps and advised to undergo surgery were included. demographic information, systemic risk factors, Preoperative visual acuity, type of cataract, intraocular lens (IOL) placement, and post operative visual acuity were recorded. The study included follow-up assessments at 1st week, 4th week, and 6th week post-surgery.

Results

The study showed a higher prevalence of cataracts in the 50-59 age group (48.6%), with a mean age of 60 ± 8 years. The majority of patients (60.5%) had bilateral cataracts, and 54.8% were male. Nuclear cataracts (52.7%) were the most common type. Small Incision Cataract Surgery (SICS) was performed in 94% of cases. Postoperative visual acuity improved significantly, with 89.03% of patients achieving vision better than 6/18. Systemic risk factors such as hypertension (16.5%) and diabetes (22.9%) were prevalent.

Conclusion

Cataract surgery in a rural setting demonstrated a high success rate in improving visual acuity, with 89.03% of patients achieving functional vision post-surgery. Expanding cataract surgical services in rural areas is essential in reducing preventable blindness.

Keywords: Cataract surgery, visual acuity, small incision cataract surgery (SICS), phacoemulsification.

INTRODUCTION

Cataract, a condition characterized by the clouding of the eye's natural lens, are the leading cause of blindness worldwide. According to the World Health Organization (WHO), cataract is responsible for approximately 51% of the global blindness burden, affecting millions of individuals, particularly in low- and middle-income countries [(1)]. Cataract formation typically occurs as a part of the natural aging process, although it can also result from trauma, systemic diseases like diabetes, and environmental factors such as prolonged ultraviolet radiation exposure. In India, cataract is the most prevalent cause of preventable blindness, contributing to approximately 66.2% of all blindness cases [(2)]. With the increasing aging population and the growing prevalence of risk factors such as diabetes, glaucoma and other risk factors, cataract-induced blindness poses a significant public health challenge in both urban and rural India [(3)].

India, with its vast population, represents a significant portion of the global burden of cataract-related blindness. As one of the largest developing countries, India has a substantial number of blind individuals who require sight-restoring cataract surgery. Cataract surgery is therefore, among the most commonly performed and essential procedure in the country. According to the National Blindness and Visual Impairment Survey conducted by the Government of India, cataract account for nearly 80% of all visual impairment cases in India, of which a significant proportion remains untreated due to factors such as socioeconomic constraints, inadequate healthcare infrastructure, and limited access to specialized surgical services, particularly in rural areas [(4)].

A cataract can significantly impair vision and quality of life, as it can affect an individual's ability to perform daily tasks like reading, driving, and even basic mobility. Left untreated, cataracts can lead to total blindness, severely affecting an individual's independence and increasing their vulnerability to other health-related complications. Cataract surgery is the most effective treatment for this condition, and its primary objective is to restore vision by removing the opaque lens and replacing it with an artificial intraocular lens (IOL). The success of cataract surgery is often measured in terms of visual acuity improvement, with good outcomes being defined as achieving a postoperative visual acuity of 6/18 or better, which is considered the minimum threshold for functional vision [(5)].

The purpose of cataract surgery is to restore the transparency of the lens and to correct the visual impairment that the cataract causes. While the surgery itself is considered safe and effective, the success of the procedure can be influenced by several factors, including the type of cataract, the surgical technique used, the presence of comorbidities, and the surgical environment [(6)]. The type of cataract is critical, as it can affect the complexity of the surgery and the risk of intraoperative and postoperative complications. For instance, patients with nuclear sclerosis and mature cataracts may experience a more complicated surgery due to the hardness of the lens, while those with posterior subcapsular cataracts may present with visual difficulties earlier in life, even when the cataract is less mature [(7)].

A variety of surgical techniques are used to perform cataract surgery. The most commonly used methods include Small Incision Cataract Surgery (SICS), Phacoemulsification (PHACO). SICS and PHACO are the preferred techniques in most of the developing world due to their effectiveness, quicker recovery times, and lower complication rates compared to traditional methods. SICS is the most widely used technique in rural India, particularly in outreach camps, due to its relatively low cost compared to phacoemulsification and due to the simplicity of the procedure, which makes it suitable for settings with limited access to advanced technology [(8)]. Phacoemulsification, on the other hand, is a more advanced technique that uses ultrasonic waves to break up the cataract.

The visual outcomes of cataract surgery depend not only on the surgical technique and expertise of the ophthalmologist but also on various preoperative and postoperative factors. Preoperative conditions such as the type of cataract, the age of the patient, and the presence of systemic diseases like diabetes, hypertension, or glaucoma can affect the prognosis of the surgery [(9)]. For example, patients with diabetes may have a higher risk of developing postoperative complications such as posterior capsule opacification (PCO), a condition that leads to clouding of the lens capsule and decreased visual acuity. Other factors such as the presence of other ocular conditions like age-related

macular degeneration (ARMD), pseudoexfoliation syndrome, or glaucoma can also influence the outcomes of the surgery [10].

Postoperative complications can further complicate the recovery process. The most common postoperative complication is PCO, which occurs in approximately 20-30% of patients within a few months to years after cataract surgery. However, PCO is treatable with laser surgery (YAG laser capsulotomy) [11]. Other potential complications include intraocular pressure (IOP) changes, infection, inflammation (uveitis), and retinal detachment. Effective management of these complications is essential to ensuring the best visual outcomes and minimizing long-term disability.

In rural India, cataract surgery is often performed in eye camps or at small hospitals with limited resources. These camps are usually set up by government health agencies, non-governmental organizations (NGOs), or charitable institutions to provide free or low-cost surgeries to underserved populations. However, the lack of trained medical personnel, adequate infrastructure, and follow-up care can lead to suboptimal outcomes in some cases. Moreover, patients who undergo cataract surgery in such settings may not have access to appropriate postoperative care, including refractive correction and glasses, which can further impact the success of the surgery [12]. Therefore, ensuring that patients receive proper follow-up care, including refractive correction and postoperative glasses, is crucial for improving long-term visual outcomes [13].

Given the high prevalence of cataracts and the increasing number of cataract surgeries being performed in rural India, it is essential to evaluate the epidemiological factors, surgical techniques, and visual outcomes associated with these surgeries. This study aims to examine the clinical and demographic profiles of patients undergoing cataract surgery in a rural medical college setup, analyse the visual outcomes after surgery, and identify the factors influencing the success of the procedure. The study also seeks to highlight the importance of adequate follow-up care and the provision of glasses to improve the long-term success of cataract surgeries, particularly in underserved rural areas. Furthermore, it underscores the need for greater access to specialized eye care services, especially for the growing elderly population, to reduce the burden of cataract-induced blindness in India.

MATERIALSS & METHODS

Study Design

The study was designed as a hospital-based, prospective, observational research. This design allowed for the collection of real-time data from patients undergoing cataract surgery, which facilitated the monitoring of visual outcomes following the procedure. By using a prospective approach, the study was able to capture the natural progression of patient outcomes, from preoperative conditions to postoperative follow-ups. The observational nature of the study enabled a comprehensive analysis of variables without manipulating any conditions or treatments. This approach was particularly appropriate as it reflected real-world settings in a rural medical college and hospital, where various factors such as patient comorbidities, type of cataract, and surgical techniques might affect outcomes.

Study Setting

The study was conducted in a rural medical college hospital in India. The medical college is situated in a rural area with a large catchment population. This setting was ideal for the study as it allowed for a diverse sample population that mirrors the demographic and health challenges faced in rural India. The hospital provided cataract screening camps, which were instrumental in identifying potential candidates for cataract surgery. The ophthalmology department at the hospital had the necessary infrastructure, including operating theatres, to perform the surgeries and also post-surgical facilities. The study took place within this facility, where patients received all the necessary care from preoperative to postoperative stages.

Study Duration

The study was conducted over a period of 12 months. During this time, a systematic recruitment process was employed to identify eligible participants. The patients were followed up at regular intervals post-surgery, including 1st week, 4th week, and 6th week, to assess visual acuity and monitor

for any complications. This duration was considered sufficient to evaluate both the immediate and short-term postoperative outcomes of cataract surgery. Follow-up visits allowed the research team to capture data on the visual improvement or deterioration over time, assess the surgical success, and identify any postoperative complications such as posterior capsule opacification or raised intraocular pressure.

Participants - Inclusion and Exclusion Criteria

The inclusion and exclusion criteria were strictly defined to ensure that the study focused on patients who were most likely to benefit from cataract surgery and to control for confounding variables.

Inclusion Criteria

Patients diagnosed with visually significant senile cataracts requiring surgery.

- Age ≥ 50 years.
- Patients who attended cataract screening camps and were advised to undergo surgery.
- Patients willing to provide informed consent.

Exclusion Criteria

- Patients with congenital or developmental, traumatic, complicated cataracts.
- Patients with advanced glaucoma, retinal disorders, corneal opacity and any other ocular pathology influencing on visual outcome other than cataract and cataract surgery.

Study Sampling

The sampling method used for this study was convenience sampling. This approach was chosen because the study relied on patients attending the cataract screening camps who were subsequently advised to undergo surgery. As this study took place within a single medical college setting, convenience sampling provided an efficient way to include patients who were already under the care of the institution. Although this method may introduce some bias, it was deemed appropriate for the study's scope, as it allowed the research team to gather a sizable sample within a reasonable timeframe.

Study Sample Size

The study sample size consisted of 1624 patients who met the inclusion criteria and were willing to participate in the study. The sample size was determined based on the expected number of cataract surgeries performed at the medical college over the study period and the inclusion and exclusion criteria set forth. A power analysis was conducted prior to data collection to ensure that the sample size was sufficient to detect clinically meaningful differences in visual outcomes post-surgery. The large sample size also ensured the generalizability of the results to the broader population of patients undergoing cataract surgery in similar rural settings.

Study Parameters

Several key parameters were assessed during the study to evaluate the success of cataract surgery and the factors influencing the visual outcomes. These included:

- **Demographic Information**: Age, gender, occupation and address of patients.
- **Ophthalmic Examination**: Preoperative visual acuity, type of cataract (nuclear, cortical, posterior subcapsular, etc.), and presence of any ocular comorbidities (e.g., glaucoma, diabetic retinopathy).
- **Systemic Risk Factors**: Pre-existing conditions such as hypertension, diabetes, and hypothyroidism etc.
- **Surgical Parameters**: Type of surgery (SICS or PHACO), intraocular lens (IOL) type and placement.
- **Visual Acuity**: Measurement of preoperative and postoperative visual acuity using Snellen's chart.
- **Complications**: Recording of any intraoperative or postoperative complications, including posterior capsule rupture, aphakia, or posterior capsule opacification.

Study Procedure

The procedure for conducting the study began with the screening of potential patients attending cataract screening camps. Those who met the inclusion criteria were informed about the study, and written informed consent was obtained. A detailed preoperative assessment was conducted, including a thorough ocular examination, demographic data collection, and an evaluation of systemic conditions that could affect surgery outcomes. Patients were then scheduled for cataract surgery, either SICS or PHACO, depending on the surgeon's assessment. The patients were monitored closely for complications in intraoperative and Postoperative period and follow-up visits were scheduled at 1st week, 4th week, and 6th week to assess visual acuity and other outcomes.

Study Data Collection

Data collection was carried out at multiple stages during the study. Preoperative data, including demographic details, systemic risk factors, and preoperative visual acuity, were collected before surgery. During surgery, the type of cataract, surgical procedure, intraoperative events and IOL placement were documented. Postoperative data were gathered during follow-up visits at 1st week, 4th week, and 6th week. During these visits, visual acuity was measured, and any complications, such as posterior capsule opacification or infection, were recorded. Data were also collected regarding the necessity for corrective glasses post-surgery. A structured format was used to record all relevant clinical and demographic information.

Data Analysis

Data analysis was conducted using statistical software. Descriptive statistics were used to summarize the demographic characteristics of the study population, including age, gender, and systemic comorbidities. The primary outcome measure, postoperative visual acuity, was analysed to assess the success of the surgery. The visual outcomes were compared between different age groups, genders, and cataract types. Chi-square tests were employed to assess the association between categorical variables, such as gender and type of cataract, and visual outcomes. The presence of preoperative risk factors and their relationship with postoperative complications was also analysed using logistic regression.

Ethical Considerations

The study adhered to ethical guidelines set forth by the institutional review board and the Declaration of Helsinki. Prior to participation, all patients were provided with detailed information about the study's objectives, procedures, and potential risks. Written informed consent was obtained from all participants, ensuring that they voluntarily agreed to participate in the study. Confidentiality of patient information was maintained at all stages of the study. The study was approved by the Ethics Committee (IEC194), and it ensured that patient safety and well-being were prioritized throughout the research process. Any adverse events were reported and managed promptly, following ethical protocols for research studies.

RESULT AND ANALYSIS

Gender	Number of Patients	Percentage
Female	734	45.2%
Male	890	54.8%
Total	1624	100%

Table 1: Gender distribution

Interpretation: The study showed a higher prevalence of male patients (54.8%) undergoing cataract surgery compared to females (45.2%). In terms of cataract laterality, the majority of patients had bilateral cataracts (60.5%), followed by those with left eye cataracts (21.65%) and right eye cataracts

(17.85%). This distribution indicates that bilateral cataracts are common among patients, which is typical for age-related cataract development.

Laterality	Number of Patients	Percentage
Bilateral	983	60.5%
Right Eye	290	17.85%
Left Eye	351	21.65%
Total	1624	100%
Table 2: Laterality		

Interpretation: The majority of patients undergoing cataract surgery were in the age group of 50-59 years (48.6%), with the mean age being 60 ± 8 years. A significant number of patients (42.3%) were between 60 and 69 years of age, while fewer patients were in the 70-79 years (7.6%) and above 80 years (1.3%) categories. This age distribution reflects the higher prevalence of age-related cataracts among individuals in their 50s and 60s, which is consistent with the natural aging process that leads to cataract formation.

Age Distribution	Number of Patients	Percentage
50-59	790	48.6%
60-69	687	42.3%
70-79	125	7.6%
>80	22	1.3%
Total	1624	100%
Mean Age	60 ± 8 years	
Table 3: Age Distribution		

Occupation and Address

majority of them were farmers(84%) in occupation. The study population belonged to the rural background

Type of Cataract	Number of Patients	Percentage
Nuclear	856	52.7%
Cortical	1256	77.33%
SIMC	275	16.19%
SMC	121	7.4%
SHMC	346	21.3%
Table 4: Type of Cataract		

Interpretation: The majority of patients had senile immature cataracts (77.3%), with nuclear cataracts being the most common type (52.7%). Other types included cortical cataracts (16.19%), posterior subcapsular cataracts (21.3%) and some had senile mature cataracts (SMC), and senile hypermature cataracts (SHMC). This pattern of cataract types is consistent with the aging population, where nuclear cataracts are often seen in older individuals, while senile immature cataracts reflect the early stages of cataract development.

Visual Acuity	Before Surgery	Percentage
>6/18	8	0.6%
6/18 to 6/60	721	44.39%
<6/60	895	55.11%
Total	1624	
Table 5: Pre OP Visual Acuity		

Interpretation: Presenting visual acuity in 55.11% of patients was <6/60, 6/18 to 6/60 in 44.39%, and few had >6/18. This indicates majority of subjects had moderate to poor vision before surgery affecting their quality of life.

The most common systemic risk factors observed were hypertension (16.5%) and diabetes (22.9%). A significant portion of patients (18.65%) had both hypertension and diabetes. Other less common conditions included hypothyroidism (0.85%) and asthma (1.2%). About 39.7% of patients had no systemic illnesses. The high prevalence of diabetes is consistent with their known associations with cataract development and their influence on visual outcome highlighting the importance of managing these conditions to improve surgical outcomes.

Preoperative risk factors, such as pseudoexfoliation (36.14%), age-related macular degeneration (ARMD, 5.29%), glaucoma (5.24%), and diabetic retinopathy (2.33%), were prevalent in the study population. These factors are known to increase the complexity of cataract surgery and may influence postoperative outcomes. Addressing these risk factors preoperatively can help in planning appropriate surgical techniques and postoperative care to optimize visual results.

The majority of patients (94%) underwent Small Incision Cataract Surgery (SICS), which is a cost-effective and widely practiced technique in rural India. The remaining 6% of patients underwent Phacoemulsification (PHACO), a more advanced surgical technique. This distribution reflects the surgical preferences in rural settings where SICS is commonly used due to its lower cost and fewer equipment requirements.

Intraocular lens (IOL) placement was predominantly posterior chamber IOL (PCIOL) in 90.5% of cases. A smaller proportion of patients received anterior chamber IOL (ACIOL) or IOL placed in the sulcus (2%) due to specific conditions like weak posterior capsules, bag dialysis, or posterior capsule rupture. Less than 1% of patients had aphakia, indicating the careful approach in IOL implantation to avoid this outcome.

11.76% 0f patients had intraoperative complications. Most common complication was zonular dehiscence (8.43%) posterior capsular rupture (0.59%). Zonular dehiscence was common in mature and hyper mature cataract. Other complications were less prevalent and includes lens subluxation (0.15%), iridodialysis (0.09%) Descemet membrane detachment (0.06%).

Visual Acuity	After Surgery (BCVA)	Percentage Change
>6/18	1446	89.03%
6/18 to 6/60	162	9.97%
<6/60	16	0.9%
Total	1624	100%
Table 6: Post OP Visual Acuity		

Interpretation: The visual outcomes of cataract surgery were highly favourable, with 89.03% of patients achieving visual acuity greater than 6/18 post-surgery. Prior to surgery, 55.11% of patients had poor vision (<6/60). Postoperative results indicated a significant improvement, with only 9.97% of patients having a postoperative visual acuity between 6/18 and 6/60. The results underscore the effectiveness of cataract surgery in restoring vision and improving the quality of life for patients.

DISCUSSION

The findings of this study provide valuable insights into the epidemiological profile, surgical trends, and visual outcomes of cataract surgery in a rural medical college setting. The results align with previous studies, reinforcing the high prevalence of cataracts in older adults and the effectiveness of Small Incision Cataract Surgery (SICS) in resource-limited settings.

The study enrolled total of 1624 subjects. In this study it is observed that the majority of patients undergoing cataract surgery were in the age group of 50-59 years (48.6%), with a mean age of 60 ± 8 years. In terms of cataract laterality, the majority of patients had bilateral cataracts (60.5%), followed by those with left eye cataracts (21.65%) and right eye cataracts (17.85%). This is comparable to the findings of shrehtha et al. (2022), who reported nearly half (50.7%) were male while the other half were female (49.3%) with the mean age of 69.4±9.7 years. Similarly, about half (48.6%) of the surgeries were performed on the right eye while the other half (51.4%) were performed on the left eye. [14]

Additionally, the higher prevalence of nuclear cataracts (52.7%) aligns with Singh S et al. (2019), In the monotype group, nuclear cataracts were the most common type of cataract (10.88%) in the rural group and nuclear cataract with the presence of Cortical cataract was the most common type of cataract in the urban group (7.3%).[15]

Gender distribution showed a higher number of males (54.8%) undergoing surgery compared to females (45.2%). [16]

Diabetes (22.9%) and hypertension (16.5%) were the most prevalent systemic risk factors in this study. In a study by sarkar et al, Diabetes mellitus was one of the important risk factors for the development of cataracts where 25.1% of cataract patients had diabetes. [2] In a study by Mehta R et al. (2016) have found that prevalence of cataract is significantly higher in hypertensive patients (87.83%) as compared to non-hypertensive patients (70.8%) [17] similarly in the study by Jemeberie HA, et al. (2023), among the participants, 21 (5.1%) had a known history of hypertension, and 12 (2.9%) had a known history of diabetes mellitus. [18]

The predominant surgical technique used was SICS (94%), while phacoemulsification was performed in only 6% of cases. According to Jaggernath1 j et al. (2013), both Phaco and SICS are safe and effective techniques to rehabilitate cataract patients, but Phaco is costlier, with its instrumentation, and intraocular lens (IOLs), and had a steeper learning curve. Small-incision cataract surgery, in comparison, has been shown to be faster and more cost-effective. It is useful in intumescent white, black, brown, and lens-induced glaucoma cataracts and could incorporate recent trends like topical and sub-Tenon anesthesia and temporal incisions. Both give equal best-corrected visual acuity but unaided vision has been shown to be slightly better in Phaco due to lesser astigmatism. [19], BCVA in both phaco and SICS groups is comparable at the end of 6-8 weeks.

According to study by Singh SK et al. (2010), there was no difference between the groups in terms of gender, age and pre-operative visual acuity (p = 0.09). In phacoemulsification group (n=93) more than two thirds and in SICS group (n=89) more than three quarters of the patients had good visual outcome (6/6-6/18) on first postoperative day (p=0.065). Poor outcome (<6/60) was recorded in 6% (phacoemulsification group) and 1% (small incision cataract surgery group). Mean visual acuity was 0.43 ± 0.27 in phacoemulsification group and 0.47 ± 0.24 in SICS group. Mean surgery time was significantly shorter in SICS group (p=0.0003). [15]

In our study IOL placement was predominantly posterior chamber IOL (PCIOL) in 90.5% of cases. A smaller proportion of patients received anterior chamber IOL (ACIOL) or IOL placed in the sulcus (2%) due to specific conditions like weak posterior capsules, bag dialysis, or posterior capsule rupture. Similar to the study by Dvivedi A et al. (2024), posterior chamber IOL (PCIOL) was the commonest

secondary IOL in 21 (35%) eyes, scleral fixated in 20 (31.6%), anterior chamber IOL (ACIOL) in 13 (21.6%), iris fixated IOL in three (5%) and three eyes (5%) were left aphakic. [20]

In our study most patients (58.8%) had an intraocular pressure (IOP) in the range of 10-15 mmHg, which is considered a normal IOP range post-surgery. In a study by Mukhtar SA et al. (2014), Mean IOP was found to be 15.368 ± 3.37 mm Hg giving a range of 5 to 25 mm Hg. It also revealed that IOP in both eyes of the same individual was almost the same. [21]

Pseudoexfoliation (36.14%) was the most common preoperative risk factor in this study. Jemeberie HA, et al. (2023), Out of the 408 individuals who participated in this study, the most frequently observed preexisting ocular comorbidities were central corneal opacity (7.6%), glaucoma (6.4%), and pseudoexfoliation (5.1%).[18] in a study by sandeep et al, 6% (n = 19) had operative 216 complications, which included striate keratopathy (n = 13) and others (n = 6) (capsule rupture 217 without vitreous loss, capsule rupture with vitreous loss, and wound leak).

The postoperative visual acuity results in this study were highly favorable, with 89.03% of patients achieving visual acuity >6/18. This is consistent with of shrehtha et al. (2022), who reported that the visual acuity of the majority of the patients was improved during 12 weeks of follow-up period, i.e., 98.4% of the participants had normal/near normal visual acuity after best correction while they came for follow-up 12 weeks after surgery. [14]

Furthermore, the proportion of patients with residual poor vision post-surgery (0.9%) was low, indicating good surgical outcomes. Similar findings were reported by Tamang et al. (2024), 285 (91.94%) of the cataract-operated eyes had best-corrected vision greater than 6/60, while 25 (8.06%) of the eyes had vision less than 6/60. [22]

CONCLUSION

In conclusion, the findings of this study demonstrate that cataract surgery in a rural medical college setting is highly effective in improving visual acuity and restoring quality of life for patients, with 89.03% of patients achieving functional vision after surgery. The study also highlights the importance of addressing systemic risk factors, such as diabetes, in cataract patients to optimize surgical outcomes. The widespread use of SICS, along with proper IOL implantation, contributed to the success of the procedure. Postoperative complications, though present, were manageable, and the overall success rate of the surgery was consistent with findings from other studies conducted in similar settings. Given the increasing burden of cataract-related blindness in India, this study emphasizes the need for expanding cataract surgical services in rural areas to improve access to care and reduce the prevalence of preventable blindness.

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