Original Article

Impact of comprehensive eye examination in identifying the ocular co-morbidities in patients screened for cataract surgery through the out-reach activities

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Purpose: To evaluate the impact of comprehensive eye examination in identifying the ocular co-morbidities in patients presenting for cataract surgery through the community screening program. **Methods:** This was a hospital-based retrospective cross-sectional descriptive study in a tertiary eye care institute. Comprehensive eye examination was performed for all patients screened for cataract surgery through the out-reach activities. Patients suspected to have any ocular co-morbidity were revaluated by sub-specialty trained ophthalmologists, and further management was planned. The demographic details of patients, sub-specialty consultation, final diagnosis, and type of the treatment received by these patients were recorded. **Results:** During the study period, 4022 patients were referred to the base hospital for cataract surgery, of whom 922 (22.9%) needed a specialist opinion. Glaucoma (238) and retinal disorders (232) constituted half (51%) of these referrals. There were 313 (33.9%) patients having co-morbidities because of corneal, oculoplastic, and neuro-ophthalmic conditions. After specialist review, 397 (43.1%) patients underwent only cataract surgery, 55 patients (5.9%) underwent combined surgeries, and 168 (18.2%) patients underwent other procedures. Cataract surgery was not performed in 470 (50.9%) patients, of which 302 were prescribed glasses or managed medically. **Conclusion:** All patients screened for cataract surgery through out-reach programs require a comprehensive eye examination to identify ocular diseases other than cataract. Provisions must be made for providing alternative or additional treatment in those with various ocular co-morbidities.

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Cataract and refractive error remain the most common causes of visual impairment and blindness in India and worldwide. In a limited resource setting such as India, organization of mass screening and surgery camps for cataract has been a common practice. With an aim to prevent intra-ocular infection, cataract surgeries are now being conducted at the base hospitals. However, the screening camps in out-reach are still conducted to reach the under-served population.

The most recent National Survey on Blindness and Visual Impairment suggests that in patients who have undergone cataract surgery, over 94% had the intra-ocular lens (IOL) implanted.[1] Of these patients, at least about 7% patients with IOL implantation had poor visual outcome (a best corrected visual acuity less than 6/60). Notably, the ocular co-morbidities (41.4%) remained the most significant cause for this poor visual outcome despite a successful IOL surgery.[1]

In a setting of mass screening camps in out-reach activities outside the base hospital, the ocular examination is largely performed by the primary eye care workers using Snellen visual acuity charts and torch light examination. A comprehensive eye examination in the screening camp is likely to dilute the main aim of the activity, which is identification of persons with moderate to severe visual impairment in large numbers and in short time. A comprehensive ocular examination can become a cumbersome resource-intensive process under resource-limited conditions. However, at the base hospital, all such patients identified as "cataract" need to undergo a comprehensive eye examination including slit-lamp evaluation, intra-ocular pressure (IOP) measurement, dilated lens and fundus examination, and systemic examination and routine blood investigations to rule out hypertension, diabetes, and other common diseases. Therefore, this examination provides a window of opportunity to detect ocular co-morbidities that may directly or indirectly cause poor visual outcome after IOL surgery and systemic diseases that may put the patient at risk for surgery. The ocular examination is performed by a general ophthalmologist or specially trained residents to

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screen patients for cataract surgery, but co-morbidities such as glaucoma and vitreo-retinal diseases may require specialist intervention. Such an exercise shall enable patients with ocular co-morbidities to receive an appropriate treatment and better surgical outcome rather than a blanket cataract surgery with the possibility of a poor visual outcome. With this intention, we planned this study to evaluate the impact of comprehensive eye examination in identifying the non-cataract causes of visual impairment and ocular co-morbidities in patients referred for cataract surgery through the community out-reach screening program.

Methods

Study design

This was a hospital-based retrospective cross-sectional study conducted in a tertiary eye care institute in central India from May 2021 to April 2022. The study was approved by the Institute Ethics Committee and adhered to the tenets of the Declaration of Helsinki. The study included all patients screened through the community out-reach program and referred to the base hospital for cataract surgery. During the screening, coronavirus disease (COVID) appropriate protocols were followed by the screening personnel as well as the patients. With an aim to compare the results with the recent National Program for Control of Blindness rapid assessment of avoidable blindness (NPCB-RAAB) survey report,[1] patients aged less than 50 years of age were excluded from analysis.

Examination of patients

The screening in the community out-reach program was performed by the trained vision technicians and field coordinators, which included assessment of presenting visual acuity and torch light examination of the anterior segment. Visual acuity (VA) was measured with a Snellen tumbling E chart using optotype size 18 on one side and size 60 on the other side at a 6 meter distance. Those with visual impairment (VI) (unable to read optotype size 18) were referred to the base hospital. At the base hospital, the patients underwent a comprehensive eye examination. The examination included history taking, measurement of uncorrected and pinhole-corrected visual acuity, refraction where indicated, external ocular examination, Goldmann applanation tonometry, and gonioscopy where indicated. Post-dilated evaluation included grading of cataract according the Lens Opacity Classification System III and fundus examination by +90 D slit-lamp bio-microscopy or indirect ophthalmoscopy with a +20D lens. Patients with total cataract and corneal scar precluding the evaluation of posterior segments underwent B-scan ultrasound, and their management was decided based on the ultra-sonography findings. In patients with a normal scan, routine cataract surgery was performed, and dilated fundus examination was performed after the surgery. If any posterior segment disease was noted in these patients or in patients where the initial ultra-sonography was suggestive of posterior segment pathology, the opinion of vitreo-retina specialists was taken. Nasolacrimal duct patency was assessed by pressure on the lacrimal sac region (ROPLAS test) or syringing. Patients found to be suffering from cataract, without other associated pathological eye findings, were posted for cataract surgery on next day. These patients underwent a general and systemic physical examination, pulse and blood pressure measurement, examination of random blood sugar, and serology for HIV I and II, with Australia antigen and Hepatitis C antigens and an electro-cardiogram for those aged >60 years. Those detected with ocular co-morbidities with or without cataract were examined the next day by a sub-specialty trained ophthalmologist designated as a specialist ophthalmologist for this study. Subsequent management for such patients was based on the advice of the specialty ophthalmologist.

The medical records of all the patients registered through the community out-reach program for the study period were retrieved from the electronic medical records. Data related to demographic characteristics, clinical diagnosis, and treatment were entered in an Excel spread sheet.

Statistical analysis

All quantitative data are described as mean and standard deviation, and qualitative data are described with frequency and proportions. To test the significance association between qualitative variables, we used Chi-square test, whereas continuous variables were analyzed by analysis of variance (ANOVA). We excluded patients with refractive error from analysis to minimize the skewing data while analyzing effects of age on probability of requiring a specialist opinion. Statistical analysis was computed using the statistical software Statistical Package for Social Sciences ver. 23.0 (IBM, Chicago, IL). A two-tailed *P* value less than 0.05 was considered statistically significant.

Results

Patient population

During the study period, 4022 patients were referred to the base hospital through the out-reach program. It included 2124 (52.8%) males and 1898 (47.2%) females. The mean age of the patients screened was 62.9 + 8.8 years (range 50–97). After comprehensive eye examination, 922 (22.9%) patients were found to have one or more ocular co-morbidities and were advised for a specialist ophthalmologist's opinion, whereas the rest of the patients underwent cataract surgery. Of the 922 patients, a single specialist's opinion was sought for 883 (95.8%) patients, whereas 39 (4.2%) patients required multiple specialists' opinion. Patients requiring a specialist opinion were older (64.3 + 8.8 years) than others (62.6 + 8.6 years) ($P < 0.01$). The mean age of patients with refractive errors was the lowest (60.6 + 6.6 years), whereas patients requiring an oculoplasty opinion were the oldest (66.1 + 8.2 years). Male patients required more sub-specialty opinion (511, 55.4%) than females (411, 44.6%) ($P = 0.04$).

Patients undergoing evaluation by a specialist ophthalmologist

Diseases related to glaucoma (238) and vitreo-retina (232) constituted nearly half of the patients requiring a specialist opinion (50.9%). There were 313 (33.9%) patients who had diseases of cornea, ocular surfaces or lacrimal systems, lids, or neurological issues which were responsible for ocular morbidity with or without visual impairment. A significant proportion of patients (131, 14.2%) had visual impairment because of refractive errors or early cataract which was corrected by spectacles [Table 1]. There were 14 patients who had significant

systemic co-morbidities such as uncontrolled diabetes mellitus or open wound which precluded the eye surgery. The detailed distribution of specialty-wise diagnosis of the patients seen with the specialist ophthalmologist is given in Appendix.

After initial comprehensive examination and a specialist opinion (when indicated), 3538 patients were advised for either only cataract surgery (3483, 98.4%) or a combined surgery (55, 1.6%). Small-incision cataract surgery (3176, 89.8%) was the most common type of cataract surgery performed, followed by phaco-emulsification (358, 10.1%), intra-capsular cataract extraction (3), and extra-capsular cataract extraction (1). IOL was placed in 3518 (99.4%) patients, whereas 20 (0.6%) patients were left aphakic during the primary cataract surgery.

Treatment received by the patients (n = 922) after a specialist opinion

After being seen by the specialist ophthalmologist, 452 (49%) patients underwent cataract surgery, whereas 470 (50.9%) patients did not undergo cataract surgery [Fig. 1]. Along with cataract surgery, 55 (6%) patients needed other surgical intervention. Cataract surgery with trabeculectomy was the most commonly performed combined surgery (37, 67.3%). Among the 470 patients who did not undergo cataract surgery, about two-third were either managed medically or prescribed glasses (302, 64.3%), whereas the reminder (168, 35.7%) required different surgeries or procedures such as lacrimal sac surgeries, neodymium yttrium aluminum garnet peripheral iridotomy (YAG PI), and so on. The most commonly performed surgeries other than cataract were lacrimal sac surgeries (65/223, 29.1%), followed by trabeculectomy (39/223, 17.5%), pterygium excision with conjunctival autograft (29/223, 13%), vitreo-retinal surgery (19/223, 8.5%), and intra-vitreal anti vascular endothelial growth factor (VEFG) injection (17/223, 7.6%) [Fig. 1].

Thus, comprehensive eye examination was useful in identifying 470 (50.9%) patients who did not require cataract surgery as the primary intervention. Moreover, we also identified 55 patients who required additional surgical intervention along with cataract surgery.

Discussion

The study highlights the relevance of comprehensive eye examination of all patients undergoing cataract surgery through the mass screening programs. In the current study, comprehensive eye examination helped in identifying a significant proportion of patients (13%) in whom performing only cataract surgery would have been an inappropriate intervention, leading to poor post-operative visual outcome. Moreover, comprehensive eye examination also helped in delivering appropriate treatment to these patients at a tertiary eye care level. In the absence of such an algorithm, we can assume that these patients would have undergone cataract surgery albeit with poor visual outcome (because of associated glaucoma, retinal disorders) or with an enhanced risk of intra-operative complications (early cataract, pseudo-exfoliation) or post-operative complications (e.g., prolonged post-operative inflammation from undetected uveitis or risk of intra-ocular infection because of associated chronic dacryocystitis). To the best of our knowledge, this is the first study highlighting the significance of comprehensive eye examination in a systematic manner in patients undergoing cataract surgery through mass screening activities.

Non-cataract causes of visual impairment and comparison with NPCB-RAAB

In the current study, we observed posterior segment pathologies (6.1%), glaucoma (3.6%), and refractive error (3.3%) to be the most significant non-cataract causes of visual impairment. However, the NPCB-RAAB survey reported refractive error (13.4%), cataract surgery complications (5.9%), and corneal opacity (2%) as the most common non-cataract causes of visual impairment [Table 2]. This variation is likely to be because of a fundamental difference in the method of sampling between two reports. Both the current study and NPCB-RAAB survey had evaluated people >50 years of age; however, the current study is expected to have selection bias because of organization of camp or door to door survey activities directed at identification of individuals with moderate to severe vision loss, whereas NPCB-RAAB survey employed a population-based systematic method of random selection, independent of visual symptoms. People with vision loss,

Table 1: Pattern of distribution of ocular co-morbidities in different ophthalmic sub-specialties (*n*=922)

	Number of patients (%)
Specialty/Disease condition	
Glaucoma	238 (25.8)
Vitreo-retina and uvea	232 (25.2)
Cornea and ocular surface	143 (15.5)
Oculoplasty	128 (13.9)
Squint and Neuro-ophthalmology	39 (4.2)
Other conditions not requiring cataract surgery	
Refractive errors	131 (14.2)
Posterior capsule opacification	11 (1.2)

Table 2: Comparison of NPCB-RAAB (2015-2019) and current study for causes of visual impairment in individuals over 50 years of age[1]

Causes of VI in age >50 years (Other than cataract)	NPCB-RAAB (%)	Current study percentage (number)
Refractive error	13.4	3.3 (131)
Cataract surgery complications	5.9	0.32 (PCO-11, PBK-2)
Corneal opacity (Trachomatous and Non-trachomatous)	2	0.6 (24)
Glaucoma	1.4	3.6 (151)*
Age-related macular degeneration + Diabetic retinopathy + Other posterior segment diseases	4.4	6.1 (244)†

* Only proven cases of glaucoma are included, whereas others such as disc suspects, primary angle closure, and primary angle closure suspect are excluded. †225 patients with retinal disorders, 11 patients with optic atrophy, 4 patients with amblyopia, 2 patients with non-arteritic ischemic optic neuropathy, 1 patient with disc edema, and 1 patient with toxic optic neuropathy. NPCB-RAAB: National Program for Control of Blindness Rapid Assessment of Avoidable Blindness; PCO: Posterior capsular opacification; PBK: Pseudophakicbullus keratopathy

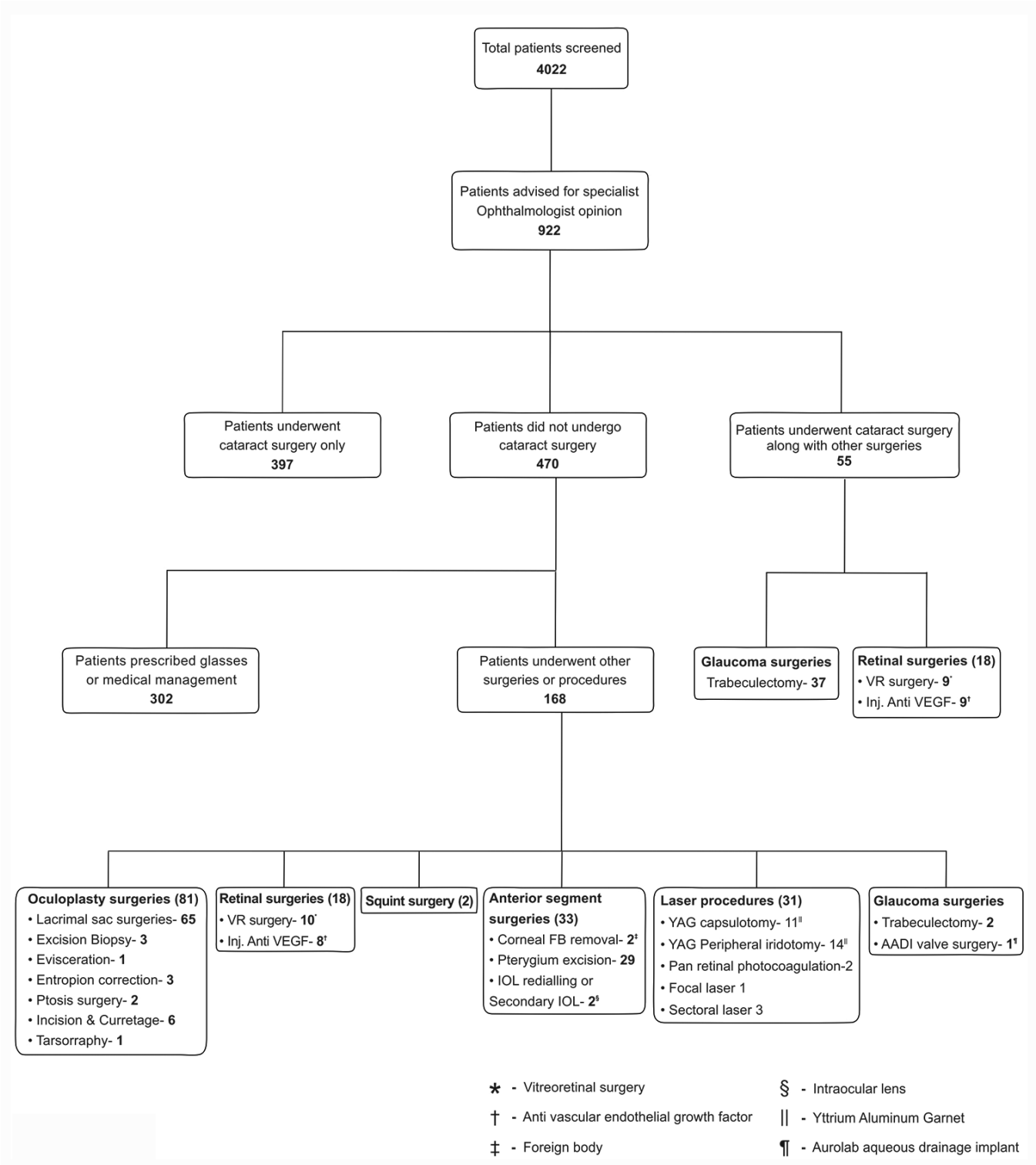

Figure 1: Details of treatment received by the patients after the specialist opinion

irrespective of its cause, are more likely to report to a cataract screening camp, assuming it to be because of cataract, the most common cause for vision loss in people over 50 years of age. However, people having refractive error or those who already underwent cataract surgery in both eyes, irrespective of its outcome, are unlikely to report in a cataract screening event. This possibly increased the probability of identifying more patients with vision loss because of glaucoma and retinal pathologies and fewer patients with refractive error and cataract surgery complications in current study.

Opportunistic screening for glaucoma

Besides refractive error and cataract, glaucoma remains the most important cause of avoidable blindness in people more

than 50 years of age. However, identification of glaucoma needs more comprehensive evaluation (intra-ocular pressure measurement, gonioscopy, optic disc examination, and visual field testing) compared to cataract.[2] This makes screening for glaucoma more difficult in a mass screening setting. However, comprehensive pre-operative examination of the target group (>50 years) screened for cataract provided us with an opportunity to screen for glaucoma. In the current study, 238 patients were re-examined by the glaucoma specialist for clinical findings suggestive of glaucoma. After specialist opinion, 54 (22.7%) of these patients underwent procedures for management of glaucoma, which would have been missed in the absence of a comprehensive eye examination. Even for others, a glaucoma specialist opinion provided the opportunity to start medical therapy or counsel them about the need for regular follow-up.[3] The current study identified 80 patients who were diagnosed as disc suspects. In the absence of other ocular pathologies, these patients are expected to have good post-operative visual acuity after cataract surgery and very unlikely to undergo posterior segment examination. Thus, fundus evaluation as a part of comprehensive examination proved useful in identification and counseling of such patients.

Identification and counseling of patients with expected poor visual outcome

As per the NPCB-RAAB report, most important causes for post-operative poor visual outcome (<6/60) are associated ocular co-morbidities and operative complications. Poor visual outcomes after surgery and fear of surgery-related complications are important deterrents to seek treatment for cataract surgery.[1] Again, a comprehensive examination can be helpful in identifying potential patients with conditions which could result in post-operative poor visual outcomes (glaucoma, retinal pathologies, optic atrophy, and amblyopia) like in our study. Identification or even treatment of such conditions does not necessarily ensure a good visual outcome; however, counseling such patients shall be helpful in priming them about the expected outcome, alleviating their fear. A poor visual outcome after such counseling is less likely to have a negative influence on seeking treatment for cataract at the social level. Fear was identified as one of the important barriers to cataract surgery in the NPCB-RAAB report.[1]

Ocular morbidities and systemic co-morbidities

The All India Ophthalmic Society task force on endophthalmitis recommends thorough pre-operative evaluation of adnexa to identify risk factors for endophthalmitis.[4] We identified 98 patients with oculoplasty diseases such as nasolacrimal duct obstruction (NLDO), stye, chalazion, and etropion, which needed surgical correction (73 patients) or medical management prior to considering them for cataract surgery. We identified 54 patients with pterygium and operated 29 of them (those with astigmatism >2 D) before cataract surgery. These ocular conditions are potential risk factors in post-operative complication (endophthalmitis because of NLDO) and poor or borderline visual outcome after cataract surgery (high astigmatism because of pterygium) and can be easily screened by pre-operative evaluation. The current study noted 10 patients with an open and infected wound over exposed body parts and another 13 patients with uncontrolled systemic conditions such as diabetes mellitus and hypertension. They did not undergo cataract surgery but were referred to the physician or surgeon for the management of systemic states. Although not a part of comprehensive eye examination, such scrutiny at the time of examination will prove useful in preventing intra-operative and post-operative complications.

Limitation and strengths

There are certain limitations in this study. The current study has a selection bias because of inclusion of the patients from targeted cataract screening events. The proportion of patients having ocular co-morbidities in current study is likely to be a good representation for this cohort of individuals; however, it cannot be generalized to the population over 50 years of age. Second, even after comprehensive pre-operative examination, it is still possible that some posterior segment pathologies masked by dense or mature cataract might have been missed in the initial examination and are not represented in these data. Despite these limitations, there are several strengths and learning points from this study. Foremost, the success of current study in identifying as well as treating the non-cataract causes of visual impairment and ocular morbidities can largely be attributed to three crucial factors/resources:

1. Availability of general ophthalmologists and trainees/fellows for initial comprehensive eye examination (trained human resource);
2. Availability of specialist ophthalmologists for diagnosis and management of specific ocular pathologies (highly trained human resource and tertiary eye care infrastructure); and
3. The institute's policy to provide free surgical treatment to all patients referred to the base hospital by community screening, irrespective of the final diagnosis (financial support to the economically weaker section).

An effective replication of our module or algorithm by other institutes or hospitals will be dependent on availability of the resources and applicability of the policy. However, most of the tertiary eye care hospitals, performing high-volume cataract surgeries, are expected to have ophthalmology trainees and specialist ophthalmologists. For the financial aspect, NPCB or other non-governmental agencies working in the eye care sector can consider laying down a policy about financial aid to the eye care organizations for surgically managing such non-cataract diseases. Second, in regions with high burden of cataract blindness, identification and treatment of other causes of visual impairment and ocular morbidities may sound very optimistic and rational but may not be very realistic or reasonable in the absence of the above facilities.

Recommendations

Based on the findings of this study and our experience, the following recommentations can be made.

1. We recommend that as a part of the national program, we should be gearing up for better identification and management of non-cataract causes of visual impairment and ocular morbidities.
2. Eye care systems primarily engaged in high-volume free cataract surgery should incorporate pre-operative comprehensive eye examination. They can scale up their services to deliver a specialist treatment for patients with non-cataract co-morbidities. In the absence of specialists, they need to develop a referral system for appropriate management of these patients.

3. Establishing a policy about pre-operative comprehensive examination of patients referred from the mass screening activities can be a first and decisive step toward achieving the above goals. This comprehensive examination shall at least include pinhole-corrected visual acuity, IOP measurement by available methods, undilated anterior chamber examination, and dilated posterior segment examination.

Conclusion

All patients screened for cataract surgery through out-reach programs require a comprehensive eye examination to identify ocular diseases other than cataract. Provisions must be made for providing alternative or additional treatment in those with various ocular co-morbidities.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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Appendix: Detailed description of specialty wise diagnosis of patient seen by specialist ophthalmologist

Specialty	Diagnosis	Number of pts.	Total
Glaucoma	Disc suspect	80 (33.6%)	238
	Primary open angle glaucoma	48 (20.1%)	
	Normal tension glaucoma	39 (16.3%)	
	Primary angle closure glaucoma	23 (9.7%)	
	Pseudoexfoliation glaucoma	18 (7.6)	
	Lens induced glaucoma	9 (3.8%)	
	Glaucomatous optic atrophy	7 (2.9%)	
	Primary angle closure suspect	5 (2.1%)	
	Absolute eye	4 (1.7%)	
	Primary angle closure	2	
	Angle Recession	1	
	Ocular hypertension	1	
	Steroid responder	1	
Vitreo- retina and Uvea	Foveal atrophy, Dry AMD, Macular scar, PFT, CSCR, CME, PED	41 (17.7%)	232
	BRVO, CRVO, HRVO	40 (17.2%)	
	ERM, MH, VMTS, Optic disc Maculopathy	28 (12.1%)	
	Uveitis, scleritis, choroiditis, retinal vasculitis	18 (7.8%)	
	Pathological myopia	17 (7.3%)	
	NPDR	17 (7.3%)	
	nAMD, Myopic CNVM, IPCV	16 (6.9%)	
	VH	16 (6.9%)	
	RD	15 (6.5%)	
	RP, Stargardt disease, Macular dystrophy	10 (4.3%)	
	PDR	5 (2.1%)	
	Hypertensive retinopathy	5 (2.1%)	
	CRAO	2	
	Lattice degeneration	2	
	Posterior dislocation of lens	2	
	Retinoschisis	1	
Cornea and ocular surface	Pterygium	58 (40.6%)	143
	Corneal scar/opacity	24 (16.8%)	
	Fuchs endothelial dystrophy, PBK	21 (14.7%)	
	Corneal Foreign body	11 (7.7%)	
	Corneal ulcer	9 (6.3%)	
	Corneal degeneration	7 (4.9%)	
	Conjunctivitis	5 (3.5%)	
	Conjunctival xerosis, Dry eye disease	3 (2.1%)	
	HSV keratitis, PED	4 (2.8%)	
	Failed graft	1	
Oculoplasty	NLDO, Chronic dacryocystitis	71 (55.5%)	128
	Chalazion, stye, sebaceous cyst, hematic cyst	16 (12.5%)	
	Canalicular obstruction, Punctal stenosis	12 (9.4%)	
	Entropion, Trichiasis	9 (7%)	
	Lagophthalmos, Hemifacial spasm, Blepharospasm	6 (4.7%)	
	Ptosis	4 (3.1%)	
	Lid mass, compound nevus	3	
	Acquired dacryocystitis, lacrimal fistula	2	
	Hydrocystoma	2	
	Blepharitis, Meibomitis	2	
	Rhinosporidiosis	1	

Contd...

Appendix: Contd...

Specialty	Diagnosis	Number of pts.	Total
Squint and Neuro-ophthalmology	Optic atrophy	11 (28.2%)	39
	Alternate exotropia	6 (15.4%)	
	Esotropia	5 (12.8%)	
	Exotropia	5 (12.8%)	
	Amblyopia	4 (10.3%)	
	NAION	2 (5.1%)	
	Sixth Nerve palsy	2 (5.1%)	
	Third nerve palsy	1	
	Homonymous hemianopia	1	
	Disc edema	1	
	Toxic Optic neuropathy	1	

Abbreviations

- AMD: Age related macular degeneration
- BRVO: Branch retinal vein occlusion
- CME: Cystoid macular edema
- CNVM: Choroidal neovascular membrane
- CRAO: Central retinal artery occlusion
- CRVO: Central retinal vein occlusion
- CSCR: Central serous chorioretinopathy
- ERM: Epiretinal membrane
- HRVO: Hemi retinal vein occlusion
- HSV: Herpes simplex virus
- IPCV: Idiopathic polypoidal choroidal vasculopathy
- MH: Macular hole
- NAION: Nonarteritic ischemic optic neuropath
- nAMD: Neovascular age related macular degeneration
- NLDO: Nasolacrimal duct obstruction
- NPDR: Non proliferative diabetic retinopathy
- PBK: Pseudophakic bullus keratopathy
- PDR: Proliferative diabetic retinopathy
- PED: Pigment epithelium detachment
- Persistent epithelial defect
- PFT: Parafavoeal telengectasia
- RD: Retinal detachment
- RP: Retinitis pigmentosa
- VH: Vitreous hemorrhage
- VMTS: Vitreomacular traction syndrome