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Review Article

Tele Ophthalmology for Various Ocular Sub-specialities during Novel Coronavirus Disease 2019 Pandemic in Indian Scenario

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Abstract

Teleophthalmology is gaining importance in these days for providing quality eye care worldwide amidst novel coronavirus-19 pandemic when social distancing is one of the preventive measures. Among various sub specialities teleophthalmology can provide timely care by diagnosing and monitoring various ocular pathologies especially related to ocular surface. Glaucoma cases need in person consultation to make its diagnosis there after therapy can be monitored on teleophthalmology. Urgent or emergency conditions can be referred after having video consultation which can save time for the patient. Timely care or referral for retinopathy of prematurity, diabetic retinopathy, glaucoma and age-related macular degeneration, can be provided by teleophthalmology as these are sight threatening conditions. Despite having limitations, teleophthalmology is a new upcoming gamut available with ophthalmologists which can be exploited in this novel coronavirus-19 pandemic for best eye care towards the needy patients.

Keywords: *Novel Coronavirus-19; Teleophthalmology; Video Conferencing*

Abbreviations

CCT: Central Corneal Thickness; COVID-19: Novel Coronavirus-19; IOP: Intra Ocular Pressure; OCT: Optical Coherence Tomography; RMP: Registered Medical Practitioner

Introduction

In December 2019 a respiratory infection emerged in Wuhan, China named as novel coronavirus-19 (COVID-19) caused by severe acute respiratory syndrome corona virus 2 with flu like presentations as fever, cough, sore throat, dysnea and fatigue that quickly progress to pneumonia [1]. These symptoms aggravated to acute respiratory distress syndrome, in elderly population and in addition of comorbidities like diabetes, hypertension, cancer, asthma, cardiac diseases and immunocompromised population leading to septic shock, multiple organ failure and eventually mortality. The mode of spread of this disease is through splash of saliva droplets or nasal discharge from the nose during talks, coughs and sneezes of the infected person with close contact distance of 1.8 meters and even by touching the surfaces containing these virus laden droplets which survive for several days even after dissemination [2-4].

Due to its mode of spread the COVID -19 outbreak posed a great threat to global health and well- being drastically and World Health Organization declared it as Public Health Emergency of International Concern or Pandemic [5]. Looking at the scenario of this contagious and lethal disease, the Medical Council of India released its guidelines for telemedicine on 25th March 2020 in anticipation of its need amidst the lockdown imposed in the country [6].

Ocular manifestations of severely ill patients of COVID-19 occur in form conjunctival hyperemia, ocular irritation, foreign body sensation chemosis, epiphora and increased secretions [7]. The transmission of COVID-19 via ocular tissue is the major concern as its droplet spread may occur when viral particles in tears are drained through the nasolacrimal duct into the respiratory tract. Triaging has been adapted in various hospitals to avoid cross infection in all medical specialities including ophthalmology. As ophthalmologist has to examine the patient in very close vicinity so special precautions are required. Telemedicine carries so much scope in this speciality. The purpose of this review article is to highlight the role of virtual ophthalmology via telemedicine in various subspecialties of ophthalmology and management of various ocular disorders in current scenario.

Definition

Telemedicine is defined as delivery of health care services for valid information for diagnosis, treatment and prevention of disease or research purpose with the aim of advancing the health of individuals and communities by using the information and communication technologies." where distance is critical factor [6]. The final long awaited guidelines prepared by board of Governors with partnership of NITI Aayog are released recently to cope up with the medical services in COVID era. A Registered Medical Practitioner (RMP) who is registered in the State Medical Register or the Indian Medical Register under the IMC Act 1956, is entitled to practice telemedicine consultation to patients from any part of India but not outside India. The guidelines cover norms and standards for RMP to consult patients via telemedicine to enhance healthcare service and access to all. RMP has discretion to decide the mode of teleconsultation and independence has been given to the RMP to terminate the tele consultation if he or she is not satisfied with the various records provided to him and can err on diagnosis. It is the responsibility of RMP to think for best interest of the patient. Out of various disciplines of medicine, ophthalmology had been practicing tele consultation since long. The use of telemedicine in ophthalmology was first described in 1999 which emphasized practical aspects of setting up ophthalmic telemedicine centres [7]. Teleophthalmology is readily adaptable to a tele-health delivery system as most of the diagnostic instruments can be easily adapted to mount still and video cameras. Ophthalmologists make various diagnosis for a number of eye conditions on the basis of photographic images in their standard practice and even can treat and monitor patients on this basis. Due to this fact ophthalmologists have adapted and employed telemedicine for advanced eye care.

As ophthalmology is speciality with so many sub-specialities and in each of this the diagnostic gazettes are different. Proper triaging of patient is mandatory and depending upon the ailments under various sub-specialities, teleophthalmology can be effectively done (Figure 1).

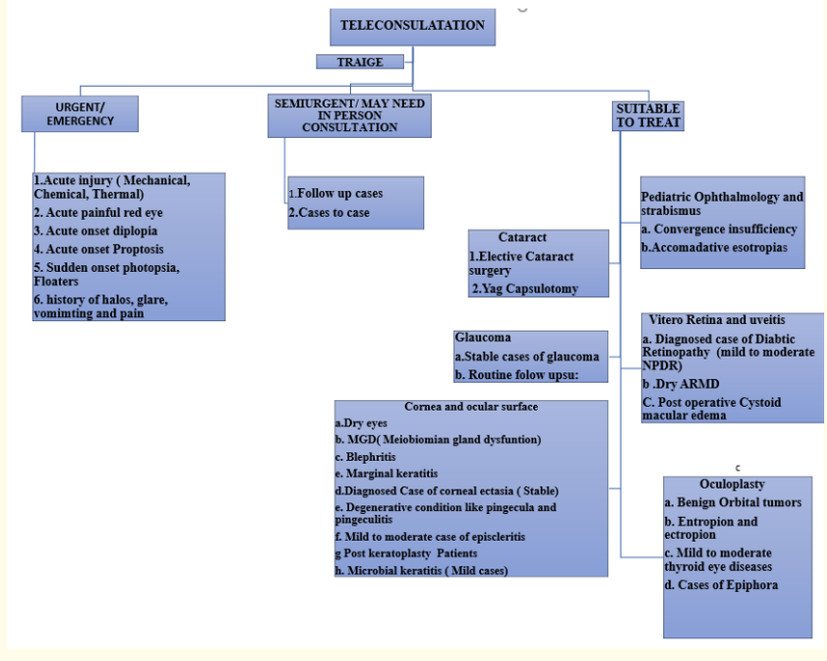

Figure 1: *Demonstrating triage of different clinical scenarios for teleconsultation.*

Glaucoma services

Glaucoma is the optic neuropathy associated with visual fields defect with or without raised intraocular pressure (IOP). It is also known as 'silent thief of sight' because most of its types typically are asymptomatic until it leads to severe visual loss. The basic factors which needs to be controlled and monitor in glaucoma is IOP. In teleophthalmology we can manage the patient in three ways of screening, intervening and monitoring. It is quite difficult to screen and monitor the disease of glaucoma on tele consultation. For both of these purpose of screening and monitoring the various parameters need to be assessed like IOP, central corneal thickness (CCT), anterior chamber depth and morphology, optic disc appearance, retinal nerve fibre layer (RNFL) thickness and current visual fields maps. Glaucoma management is mainly associated with IOP but on tele consultation the factors like diurnal variations of IOP and its spikes cannot be monitored. Teleophthalmology is applicable in follow up cases of already diagnosed glaucoma where we can change the topical medications if patient is developing some adverse effects like redness, watering etc which we can see on video conferencing or call. Compliance and effect of IOP lowering drugs cannot be ensured on this modality.

The patients can be taught digital tonometry which can be helpful for monitoring the IOP by patient itself. If patient is visiting the clinic then IOP measurement by Goldmann applanation tonometry carries the risk of infection and non-contact tonometry also leads to aerosol generation. Goldmann applanation tonometry can be done in emergency cases of primary or secondary acute angle closure glaucoma which can be otherwise sight threatening [8,9]. Phosphene tonometry is psychophysical test for selftonometry. Pressed with its probe against the upper lid with increasing pressure until visual phenomena are detected. Phosphene appears opposite to pressure applied. Portable IOP monitoring devices such as the Icare tonometer (Icare USA) offer at-home pressure readings that can be shared with a provider remotely. Smart contact lenses that can directly record IOP are also in development. Optic disc examination can be done by using mobile phones taking high-resolution fundus and optic nerve photographs using adapters such as the iExaminer (Welch Allyn), the iNview (Volk). Optical coherence tomography (OCT) is a non-invasive imaging modality used to assess optic nerve fibre layer damage. With OCT imaging, early structural glaucoma damage can be detected before perimetric defects are noted. Gonioscopy can be done only if urgent to make the diagnosis not to monitor at each visit and gonioscopes can be cleaned with soap and fresh running water and dried with wipes.

Visual field testing is very crucial element of glaucoma diagnosis. Static automated perimetry, as with the Humphrey Visual Field Analyzer (Carl Zeiss Meditec), is generally performed in an office setting, largely due to the high cost of the machines and the need for environmental control during testing which is difficult to be entertained on teleophthalmology. Due to complexity of the disease screening for glaucoma is relatively limited but periodic monitoring, timely referral, and compliance enhancement can be better done by teleophthalmology.

For remote areas the trained optometrist can do non-contact tonometry and optic disc photography on smart phones which can be monitored by ophthalmologist minimising the direct patient doctor encounter. To minimise interactions, these parameters were measured remotely, by trained technicians and sent to the treating physician, skipping patient-physician encounters.

Oculoplasty and ocular oncology

Ocular oncology is a branch that deals with tumours of the eye including eyelid, ocular surface, intraocular structures, and orbit are dealt in ocular oncology. It functions at multidisciplinary levels and life-saving is the main goal and vision salvage comes afterwards. Teleophthalmology aims at avoiding crowding so online appointments and registration can be done. Video calling can be done but the major limitation is for new cases which require detailed examination. The lesions confined to lids or conjunctiva can be evaluated to some extent on video calls [10]. Any lab reports, images and radiographs etc can be seen via WhatsApp or e mails so rough estimate of the pathology can be done beforehand and if any other new investigation is required to make the diagnosis can be advised to the patient as this reduces the visits of the patient to the hospital which is safe. Tele consultation holds good status for follow up cases if the pathology gets stable.

History taking should be concerned about the emergency symptoms like eye pain, vomiting, headache, sense of fullness, visual loss, and protrusion of the globe if any such symptoms exist then examination should be planned. If patients gets the diagnosis of the tumour the it has to be labelled as benign or malignant to manage such cases. After making the diagnosis, counseling of these patients can be done on video calling. For oculoplasty triaging as urgent or non-urgent cases can be done. In cases of eye lid abnormalities like ptosis, entropion and ectropion video calls can suffice to make diagnosis. If these abnormalities are not disabling vision and no irritation, corneal ulcers or conjunctival congestion seen then these cases can be conservatively managed. If some lesion of the lids are noticed on video consultation then rough diagnosis can be made. In cases of chalazion ask the patient for conservative management like hot fomentation. The cases of proptosis can be roughly evaluated on video calls depending upon the axial or non-axial proptosis. Movements of the globe can be checked to rule out neurological causes. In cases of proptosis two things to monitor are visual acuity and corneal exposure. If patient is complaining of diminution of vision or irritation in the eye or corneal discoloration then in person consultation is mandatory otherwise patient can loose vision due to optic nerve compression or pan-ophthalmitis. The cases of pan-ophthalmitis should be managed on urgent basis like evisceration can be done after putting personal protective kit after detailed examination and investigations like B-Scan. In cases of phthisis bulbi or anophthalmic socket no emergency is there for the elective surgical procedures like enucleation with implants. These procedures are considered as cosmetic one.

Neuro-ophthalmology

These cases can be interviewed in detail on tele consultation and role of telemedicine in this field has been established long back [11]. Proper detailed history and investigations if any can be evaluated on video or audio calls on smart phones. The ocular movements, strabismus or nystagmus can be assessed on video calls. Pupillary size can be evaluated on magnified and focus selfies to rule out anisocoria. If there is history of uniocular diplopia then neurological examination is not required. In cases where patient is showing symptoms like headache, vomiting, blurred vision or amoureux then patient can be referred to neurologist for further investigations. Visual fields, colour vision test, fundus photography can be done to rule out papilledema or disc edema [12]. Optical coherence tomography of the disc can be helpful for various optic disc abnormalities. Patient can show the reports of these tests on video calls or via e mail or wats app which help us to make diagnosis. If nothing falls into ophthalmology domain the neurologist opinion should be seeked. If on the basis of these investigations patient needs in person consultation by ophthalmologist then it can be advised.

Cataract

Cataract patients are more anxious in these days to find out whether they need surgery or not. The cases of cataract are not to be treated on urgent basis until and unless there is phacomorphic or phacolytic glaucoma or penetrating trauma induced cataract. In post-operative follow ups these patients can be monitored on video calls to rule out any untoward complications. If need arises like lid edema, redness, pain and diminution of vision then these patients can be called for in person consultation. On the other hand if the post-operative period is un remarkable then they can be called on video calls to grossly examine the eye and the topical drops can be tapered accordingly. Patient can grossly monitor his or her vision in the home only by looking at the wall clock, reading the calendar on the walls or subtitles on the television daily and by printed visual acuity charts available on internet in case of literate people. If gross vision defect, redness, lid oedema is noticed then patient can be called in person for examination.

Retinal diseases

Various retinal diseases like diabetic retinopathy, retinopathy of prematurity and age-related macular degeneration poses a significant risk for visual loss. All these retinal pathologies can be identified by their characteristics on retinal imaging. Tele ophthalmology has a great scope for early diagnosis and treatment of these conditions to prevent eventual blindness which poses a burden to the society. Acute retinal conditions like retinal detachments, vitreous hemorrhage, rhegmatogenous retinal detachment, and vascular occlusions etc. need

early diagnosis and treatment to prevent blindness [13]. Vasculitis retinal vein occlusion has been reported recently due to COVID-19 without any other co-morbidity [14]. Vasculitis has been reported in lung, liver, and kidney due to lung, liver, kidney and skin secondary to type-3 hypersensitivity wherein the deposition of immune-complexes leads to a pro-inflammatory stage and triggers a cytokine-storm [15]. In past telemedicine has been used with good success in retinal conditions like diabetic retinopathy and retinopathy of prematurity [16]. Posterior segment complications of anterior segment surgery can create a havoc which may need early referral for timely intervention. These complications are dropped nucleus, dislocated intraocular lens, endophthalmitis or globe Perforations with peribulbar anaesthesia etc. Anterior and posterior segment imaging helps in making the diagnosis via teleophthalmology before the referral of the patient so that the surgeon can plan the surgery accordingly in the given time. Various investigations can be done before referring the patient like Optical Coherence Tomography (OCT), Fundus Fluorescein Angiography, Ophthalmic Ultrasonography.

In this COVID era the need of the tele-consultation has been accelerated due to so many factors like restricted movements of the public, lockdowns and curfews. It has enabled the patients as well as health care workers protection by avoiding the exposure to the virus directly.

Telemedicine consultation can be in form of audio telephonic call or video call using smartphones and can be between patient and retinal physician or healthcare worker/ophthalmologist and vitreoretinal surgeon. Patient can be assessed on the basis of the history and symptoms with acute onset like metamorphopsia, floaters, vision loss or chronic cases who are in follow up with the surgeon but cannot visit hospital that frequently. If patient complains of sudden painless unilateral loss of vision then vascular occlusions should be kept in mind and should be tackled on emergency basis. If patient complains of dark halo in central vision with distorted images then diagnosis of serous retinopathy can be kept in mind. Curtain sign can be taken as emergency and theses patients need in person consultation for further interventions as these conditions can lead to irreversible visual loss. Video consultation can enable face to face conversation with the patient and monitor real time status in post-operative period. Patient's record of investigations like printed OCT and fundus fluorescein angiography reports in case of old follow up patients can be reviewed along with alleviating the anxiety of the patient on video conferencing. In remote set up fundus photos can help the ophthalmologist to make the diagnosis and timely interventions can be planned like intravitreal injections or surgical interventions.

Cornea and ocular surface

The slit-lamp evaluation has been the gold standard in the management of anterior segment diseases. However, the proximity of examiner and patient in slit lamp evaluation poses a significant threat for cross-infection. Although, the use of personal protection equipment kits and barrier shields can reduce the risk but cannot eliminate the risk of infection, especially in old, debilitated and immunocompromised patients. Therefore a critical assessment is required to weigh the risk-benefit ratio for the use of slit lamp in COVID era.

Tele-ophthalmology can be done through telephone or video calls. However, Video visits allow the physician to examine not only ocular adnexa and ocular surface but also the psychology of the patient.

In video visits, the patient is asked to be seated in well-lit area, preferably in sunlight and inquired about the deterioration of vision, redness, pain, photophobia and history of prior medications. This is followed by gross examination of eyelid and adnexa. Thereafter, the camera is focused on cornea and sclera to examine the ocular surface. It is advisable to take the help of a caregiver who may hold the device and can take the pictures. Ocular findings such as circum-ciliary congestion, corneal infiltrate, corneal foreign body and other significant findings should be documented. The photos can be used for documentation, review of the patient on follow up and monitoring the pathology.

In cases of red eye, the patient should be examined for corneal infiltrates, allergic conjunctivitis, acute conjunctivitis, conjunctival discharge and subconjunctival hemorrhage etc. However, diseases like corneal ulcers, corneal foreign body and corneal melt require utmost caution and need in person consultation.

In cases of corneal ulcers, live streaming and pictures can be used to assess the size and shape of ulcer, infiltrates and hypopyon. Empirical treatment could be started after ruling out fungal and viral aetiology based on clinical acumen. However, the involvement of limbus and sclera are the warning signs and the patient should be called or referred for urgent evaluation. The compliance of the patients for the medication can be checked and need for frequent instillation can be stressed upon. We can assure the patient's safety for instillation of the right drug by reviewing the old medical records. Patients with severe photophobia (corneal ulcers, impending corneal perforation) may not be able to open eyes on video calls so in person consultation should be suggested. In India, the most frequent indications of penetrating keratoplasty are infection [17]. In these days challenge is to manage large perforations, nonhealing corneal ulcers where PK is required on emergency basis but glycerine preserved corneas can be utilized for this purpose [18].

Patients with a chronic diseases like dry eyes, corneal dystrophies (epithelial and stromal) and ectatic disorders require counselling and the patient can be advised conservative management. In case of emergencies like ocular pain, recurrent corneal erosions and hydrops, the patient should be called in person for further management. Patients with pre-diagnosed stable ectatic disorders can be monitored. Post keratoplasty patients should adhere to the same medicines and should review the hospital in case of warning signs like redness, swelling, decrease in vision and loss of corneal clarity. Pterygium, pinguecula and climatic droplet keratopathy are common degenerations which are cause of concern to our patients due to inflammation, decrease in vision and cosmetic unacceptance. Symptomatic treatment is the mainstay of management however, the patient should be explained about the need for elective surgical procedure. The key to manage the anterior segment diseases is the successful implementation of forward triage. Conditions like a severe/large corneal ulcer, severe conjunctivitis and ocular trauma should not be undermined and patients should be called for an in-person consultation.

Pediatric ophthalmology

Refractive errors, amblyopia, strabismus are the most frequently encountered conditions by pediatric Ophthalmologist and it is a challenging task to assess these conditions either by phone or video visits. In COVID era, the basic examination can be done by parents at home under the guidance of treating ophthalmologist. Visual acuity could be assessed using either by web-based applications or using printed charts. Parents should be asked to share a small video of child examining the movements in different gazes. A well centered corneal reflex without the restriction of eye movements could be sufficient to monitor the patient till the full examination is carried out. Patients requiring surgery for strabismus should be counselled to abide by medical management for a time being.

The prime aim of teleconsultation is to avert the risk of developing amblyopia. Patient suggestive of refractive amblyopia and strabismic amblyopia should be called for an in-person examination. In cases of inaccessibility to an ophthalmologist, the optometrist should be consulted. Thereafter the amblyopia therapy could be initiated based on reports by the optometrist.

Limitations of the Study

Tele ophthalmology undoubtedly is proving as a boon in this era, but there are fair amount of chances to err on diagnosis. As red eye can be due to conjunctivitis, Iritis as well as corneal abrasion but Iritis can be missed without clinical examination. There can be medico-legal issues due to diagnostic errors. Still extensive research is required in this realm to evaluate patient's satisfaction, diagnostic errors and clinical outcomes.

Conclusion

Ophthalmologists should make use of telemedicine facilities for their patients wherever possible by using the facilities such as video-conferencing. Except emergency conditions the patients can be managed grossly and symptomatic on video consultation. Even referral of the patient can also be managed by teleconsultation without wasting patients crucial time for management in emergency scenario. The diseases of ocular surface and old or chronic cases of glaucoma can be easily tackled on this platform.

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