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*Clinical Paper*

# Surgical planning during a pandemic: Identifying patients at high risk of severe disease or death due to COVID-19 in a cohort of patients on a cataract surgery waiting list.

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## ABSTRACT

### Background

The delivery of cataract surgery during the COVID-19 pandemic is challenging because of the risk of nosocomial SARS-CoV-2 infection when patients attend hospital for elective care. In order to ascertain the risk to patients awaiting cataract surgery, this study aimed to identify the presence of systemic comorbidities that are associated with a high risk of severe disease or death due to COVID-19.

### Methods

A prospective study of 315 patients (630 eyes) was conducted from 3rd June to 31st July 2020. An electronic health record was used to identify any systemic comorbidities that would render a patient 'clinically extremely vulnerable' to COVID-19, as outlined by the Department of Health for Northern Ireland. Patient demographics, best-corrected visual acuity (VA) and risk of postoperative anisometropia were also recorded.

### Results

The median age of patients awaiting cataract surgery was 76 years (range 22-97). Of the 315 patients, 72% were aged over 70 and 16% were aged over 85. A systemic comorbidity that would confer high risk status was identified in 21% of patients. This high risk status was attributable to severe respiratory disease, cancer, and immunosuppression therapies in the majority of cases. The high risk group were younger than those deemed non-high risk, but there were no significant differences with respect to gender, anticipated degree of surgical difficulty, VA, or whether the patient was undergoing first or second eye surgery. Of those patients awaiting first eye cataract surgery, the mean VA in the listed eye was 0.84 logMAR and 39% (70/179) had a VA <0.3 logMAR (6/12 Snellen acuity) in their fellow eye. 57% of patients were awaiting first eye surgery, and 32% of those patients would be at risk of symptomatic anisometropia postoperatively.

### Conclusion

One-fifth of patients awaiting cataract surgery were found to be at high risk of severe disease or death from COVID-19 and these patients may experience delays in their surgical care. Additional planning is required in order to minimise the morbidity associated with delayed cataract surgery.

### Keywords

Cataract, COVID-19

## INTRODUCTION

The COVID-19 pandemic has presented a significant challenge to the delivery of surgical care globally, as elective operations and outpatient appointments have been postponed, and resources reallocated to manage the burden of disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection.[1] As these disrupted services resume, additional precautions are required to avoid hospital-acquired infection, particularly in patients who are vulnerable to worse outcomes and a higher mortality rate if they develop COVID-19. The Royal College of Ophthalmologists (RCOphth) issued guidance on resuming cataract surgery, with recommendations to prioritise care based on clinical need and balancing this against the risk of developing COVID-19.[2]

Cataract is the second most common cause of reversible visual impairment worldwide.[3] Cataract surgery is the most frequently performed elective operation in the United Kingdom and is a cost-effective intervention that improves quality of life significantly.[4,5] The demand on cataract surgery services in the UK is expected to increase by 50% between 2015 and 2035.[6] This increase in demand is related to a greater prevalence of cataract in an ageing population, but can also be attributed to a lower threshold for surgical

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intervention as the safety and visual outcomes of modern phacoemulsification surgery have improved.[6] The disruption of cataract services during the COVID-19 pandemic means that, in addition to the background increase in demand, there will be a significant backlog of patients requiring surgery.[7]

Patients undergoing cataract surgery are often elderly and have systemic comorbidities.[8] COVID-19 has a significantly higher mortality rate in older patients and those with certain comorbidities.[9] The Department of Health for Northern Ireland outlined specific diseases that would pose a greater risk of severe illness from COVID-19 (Table 1).[10] Patients meeting any of these criteria were described as 'clinically extremely vulnerable' to COVID-19.[10] This is distinguished from those who are 'clinically vulnerable' on the basis of age or other lower risk comorbidities.

**Table 1:** Conditions considered to make a patient clinically extremely vulnerable to a severe COVID-19 infection[10]

- Solid organ transplant recipients.
- People with specific cancers:
  - people with cancer who are undergoing active chemotherapy
  - people with lung cancer who are undergoing radical radiotherapy
  - people with cancers of the blood or bone marrow such as leukaemia, lymphoma or myeloma who are at any stage of treatment
  - people having immunotherapy or other continuing antibody treatments for cancer
  - people having other targeted cancer treatments which can affect the immune system, such as protein kinase inhibitors or PARP inhibitors
  - people who have had bone marrow or stem cell transplants in the last 6 months, or who are still taking immunosuppression drugs
- People with severe respiratory conditions including all cystic fibrosis, severe asthma and severe chronic obstructive pulmonary (COPD).
- People with Motor Neurone Disease
- People with rare diseases and inborn errors of metabolism that significantly increase the risk of infections (such as Severe combined immunodeficiency (SCID), homozygous sickle cell).
- People on immunosuppression therapies sufficient to significantly increase risk of infection.
- Women who are pregnant with significant heart disease, congenital or acquired.
- People who have had a splenectomy
- Those undergoing renal dialysis

In order to ascertain the risk to patients awaiting cataract surgery, we sought to investigate which of these patients would be considered to be 'clinically extremely vulnerable', or at high risk of severe illness or death due to COVID-19. Surgery was typically deferred for these high risk patients until transmission rates of COVID-19 had fallen, in order to mitigate the risk of infection.

## METHODS

A prospective study was conducted between 3rd June and 31st July 2020 with the aim of identifying patients on the waiting list for cataract surgery in the Belfast Health and Social Care Trust who were deemed to be at high risk of severe illness or death from COVID-19. A standardised pro forma was used when reviewing the patients' clinical information via the Northern Ireland Electronic Care Record (NIECR). The following information was recorded: patient demographics (age, gender, laterality of listed eye); best-corrected visual acuity; whether the listed eye was the first or second eye to undergo cataract surgery; risk of anisometropia; comorbidities that would make a patient extremely vulnerable to severe disease or death from COVID-19.

If any of the conditions listed in Table 1 were present, a patient was graded as high risk. In the absence of these

**Table 2:** Description of Degree of Surgical Difficulty (DSD) Grading[14]

| DSD Grade | Description |
|---|---|
| 1 | A very straightforward case, suitable for a novice cataract surgeon |
| 2 | A straightforward case which should cause an experienced surgeon no difficulties. May have one or two factors that increase surgical complexity e.g. sub-optimal dilation, difficulty lying flat, dense or mature cataract, high myopia or hypermetropia, age >85 |
| 3 | A more challenging case for an experienced surgeon, likely to carry a higher risk of complication. Will have three or more factors that increase surgical complexity e.g. pseudoexfoliation syndrome, poor dilation requiring pupil expansion device, severe positional issues, shallow anterior chamber, any of those factors listed for Grade 2 |
| 4 | A very challenging case with a very high risk of major complication. High risk factors include phacodonesis/ iridodonesis, previous significant blunt trauma, nanophthalmos |

**Table 3:** Demographics and ocular characteristics of study population

| Parameter | Results (n = 630) |
|---|---|
| Median age (Range) | 76 years (22-97) |
| Male (%) | 47 |
| Right (%) | 53 |
| 1st eye (%) | 57 |
| Mean VA in listed eye ± SD (Range) | 0.84 logMAR + 0.87 (0.00 – PL) |
| Mean VA in fellow eye ± SD (Range) | 0.45 logMAR ± 0.69 (-0.10 – NPL) |
| DSD grading of listed eye (%) | |
| DSD1 | 36 |
| DSD2 | 48 |
| DSD3 | 15 |
| DSD4 | 1 |

DSD, Degree of Surgical Difficulty; PL, Perception of Light; NPL, No Perception of Light.

conditions, a patient was considered non-high risk. Patients who were non-high risk may still be considered 'clinically vulnerable' to COVID-19 because of their age or other systemic comorbidities but did not meet the specific criteria outlined for the 'clinically extremely vulnerable' group.[10]

The preoperative visual acuity was recorded using Snellen notation as the best-corrected distance visual acuity using the patient's habitual spectacle prescription at the time of listing for surgery. If visual acuity was documented following first eye cataract surgery but before patients had updated their spectacle prescription, best-corrected distance visual acuity was recorded with pinhole. Snellen visual acuity was converted to logMAR values prior to analysis.[11] Patients were defined as being sight impaired (SI) if binocular best-corrected visual acuity (BCVA) was between 3/60 and 6/60, and severely sight impaired (SSI) if binocular BCVA was less than 3/60.

Anisometropia exists when an individual's two eyes have different refractive powers. For patients with preoperative refraction data available, they were deemed to be at risk of significant anisometropia if an aimed postoperative emmetropic spherical equivalent in the first eye would leave ≥3 dioptres of residual myopia or hyperopia in the fellow eye. An interocular difference of 3 dioptres was considered to pose a significant risk of causing impaired postoperative binocular visual function, such as reduced stereopsis or diplopia.[12,13]

Additionally, all cases were graded according to the anticipated degree of surgical difficulty (DSD).[14] This preoperative grading is undertaken routinely at the time of listing in order to risk-stratify for intraoperative complications and plan operating lists appropriately. In cases where the DSD grade was not specified by the listing surgeon, the clinical notes were reviewed and a DSD grade assigned accordingly. A summary of the DSD grading system used is outlined in Table 2.

Patients were excluded from the final analysis if the pro forma was incomplete. Statistical analysis was conducted using Microsoft Office Excel (Microsoft, USA). In order to compare characteristics of the high risk and non-high risk groups, Chi-square and two-tail t-tests were used, with significance set at 0.05.

## RESULTS

### Demographics

The clinical information pro formas of 315 patients (630 eyes) were analysed. The median age was 76 (range 22-97) years (Table 3). The majority (72%) of patients were aged over 70, and 16% were aged over 85. Of those eyes included in the study, 57% were listed as the first eye to undergo cataract surgery in a bilaterally phakic patient. Eight incomplete pro formas were excluded from the analysis.

### Risk factors for severe disease or death due to COVID-19

21% (66/315) of patients met the criteria as being at high risk of severe illness or death due to COVID-19 (Table 4). The majority of these patients had severe respiratory conditions (37/66), cancer (15/66) or were on immunosuppression therapies (9/66). Severe COPD accounted for the majority of patients (32/37) identified as having a severe respiratory condition.

The mean age of the high risk patients was significantly less than that of the non-high risk patients (Table 5). There were no statistically significant differences between the high risk group and non-high risk groups with regards to gender, first or second eye status, proportion that were DSD grade 3 or 4, or mean VA.

**Table 4:** Clinical reasons for being at high risk of severe disease or death due to COVID-19

| Reason | % (n = 66) | Underlying diagnosis | (n) |
|---|---|---|---|
| Solid organ transplant recipients | 5 (3) | Organ not specified | 3 |
| Specific cancers | 23 (15) | Undergoing chemotherapy | 7 |
| | | Undergoing immunotherapy | 1 |
| | | Haematological malignancy | 3 |
| | | Lung cancer | 4 |
| Severe respiratory conditions | 56 (37) | Severe COPD | 32 |
| | | Severe asthma | 1 |
| | | OSA on CPAP | 2 |
| | | Severe bronchiectasis | 1 |
| | | Pneumonia requiring hospitalisation | 1 |
| Motor Neurone Disease | 0 (0) | - | |
| Rare disease and inborn errors of metabolism | 0 (0) | - | |
| Immunosuppression therapies | 14 (9) | Systemic immunosuppression for autoimmune disease | 9 |
| Pregnant with significant heart disease | 0 (0) | - | |
| Splenectomy | 2 (1) | Previous splenectomy | 1 |
| Undergoing renal dialysis | 2 (1) | Renal dialysis for end-stage renal failure | 1 |

COPD, Chronic Obstructive Pulmonary Disease; OSA, Obstructive Sleep Apnoea; CPAP, Continuous Positive Airway Pressure.

## Visual acuity

The mean visual acuity in all eyes listed for surgery was 0.81 logMAR (6/38 Snellen acuity) and 0.45 logMAR (6/18 Snellen acuity) in the fellow eye (Table 3). Of those undergoing first eye cataract surgery, the mean VA in the listed eye was 0.84 logMAR and 39% (70/179) had a VA less than 0.3 logMAR (6/12 Snellen acuity) in the fellow eye. For bilaterally phakic patients, 3% (5/179) had a binocular visual acuity that would be registrable as Sight Impaired and 1% (2/179) would be registrable as Severely Sight Impaired.

## Risk of anisometropia

Of those patients undergoing first eye surgery with preoperative refraction data recorded, 32% (37/115) would be expected to have ≥ dioptres of anisometropia if emmetropia was the aimed refractive outcome in the first eye. Of those awaiting second eye surgery, 35% (41/118) had ≥ dioptres of anisometropia.

**Table 5:** Comparison of high risk and non-high risk patients

| Variable | High risk group (n=66) | Non-high risk group (n = 249) | p value** |
|---|---|---|---|
| Age (years)* | 71.7 ± 8.9 | 75.6 ± 11.3 | 0.003 |
| Male (%) | 45 | 48 | 0.55 |
| 1st eye (%) | 52 | 58 | 0.22 |
| DSD: Grade 3 or 4 (%) | 14 | 16 | 0.59 |
| VA in listed eye* | 0.83 logMAR ± 0.90 | 0.81 logMAR ± 0.83 | 0.83 |

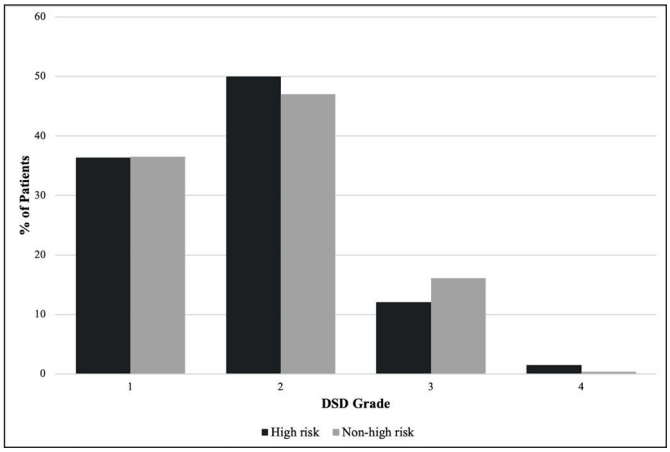
*Mean ± standard deviation **Chi-square test for frequency values and *t*-test for mean values

### Degree of surgical difficulty

The majority of patients (48%, 150/315) were listed as DSD grade 2 (Table 3). There were no statistically significant differences in the proportion of patients in each DSD grade between high risk and non-high risk patients (Figure 1).

## DISCUSSION

**Figure 1:** Proportion of high risk and non-high risk patients assigned DSD Grades 1-4




This study found that 21% of patients awaiting cataract surgery were deemed clinically extremely vulnerable to severe disease or death due to COVID-19. The coexistence of cataract and these high risk comorbidities poses the challenge of delivering cataract surgery safely to this vulnerable group of patients.

This cohort of patients had a mean age of 74.8 years and this is similar to the mean age of 76.0 years for the RCOphth National Ophthalmology Database Audit, which analysed a UK-wide population of patients undergoing cataract surgery.[15] The high risk group had a lower mean age than the non-high risk group. This may be related to the increased mortality rate associated with the conditions present in the high risk group. It is important to note that 72% of the patients in this study were aged over 70 and would therefore be considered 'clinically vulnerable' to COVID-19 even in the absence of high risk features.

A proportion of these patients would be expected to have senile cataract, but high risk comorbidities may increase the likelihood of developing visually-significant cataract. Severe COPD was the most common comorbidity that conferred high risk status. Smoking, the primary cause of COPD, and the use of inhaled steroid in its treatment both increase the likelihood of cataract formation.[16,17] 23% of patients deemed high risk had one of the specific cancers listed by the Department of Health for Northern Ireland. Several chemotherapy agents can cause cataract, and systemic corticosteroid may also be used during cancer therapy.[18] Patients who are systemically immunosuppressed to treat autoimmune disease or for solid organ transplant are typically maintained on steroid-sparing agents, but may receive short courses of corticosteroid and this would increase the likelihood of posterior subcapsular cataract formation.

This study highlights that a significant proportion of patients awaiting cataract surgery are at risk of delays in their care because of their systemic risk profile. For patients identified as being at high risk of severe illness or death due to COVID-19, surgery was typically deferred until after 31st July 2020, when the incidence of COVID-19 had decreased and public health guidance was adjusted accordingly.[19] This was done with the aim of mitigating the risk of developing COVID-19. However, delays in cataract surgery are also associated with significant morbidity. Visually significant cataract is associated with depression, impaired cognitive function, reduced quality of life, limitation of physical activity and impaired driving ability.[20-23] In addition to the negative impact on overall health and social wellbeing, there are ocular sequelae of delayed cataract extraction such as phacomorphic and phacolytic glaucoma.[24,25] Dense cataract can also mask retinal disease that cannot be visualised through the opacified lens.[26]

Visual acuity in the listed eye was similar in the high risk and non-high risk groups. The mean preoperative VA of 0.81 logMAR (6/38 Snellen acuity) for all eyes listed for surgery in this study was worse than the mean preoperative VA of 0.63 logMAR (6/24 Snellen equivalent) reported by the RCOphth's National Ophthalmology Database audit, which includes data from multiple health trusts across the UK.[27] There were seven patients in total who would be eligible for registration as being Sight Impaired or Severely Sight Impaired; three in the high risk group and four in the non-high risk group. This study did not record ocular comorbidities, but these patients had been listed for surgery because of vision loss secondary to cataract and so would be expected to have an improvement in vision post-operatively.

Approximately half of the patients included in the study were awaiting first eye cataract surgery. Of those, 32% were at risk of anisometropia following first eye cataract surgery. While the relationship between anisometropia and symptoms of reduced binocular visual function is complex, 40% of both hyperopes and myopes will have reduced stereopsis when anisometropia is ≥3 dioptres.[12] As such, 3 dioptres of anisometropia is generally considered to be clinically relevant, with an increased risk of headaches, aesthenopia, double vision and photophobia.[13] One study demonstrated an increased rate of falls requiring hospitalisation between first- and second-eye surgery, attributing this to surgically-induced anisometropia and loss of stereopsis.[22] Second-eye surgery presents an opportunity to correct anisometropia and improve stereopsis, stereoacuity, VA, contrast sensitivity and self-reported visual functioning.[28,29] It also offers a significant gain in quality of life.[30] It should be delivered in a timely fashion to avoid a possible increase in falls risk due to refractive imbalance between first- and second-eye surgeries.

Patients with more severe vision loss due to cataract may need to be prioritised if surgical capacity is reduced during the COVID-19 pandemic. While second-eye surgery is important, the greatest improvement in visual function is gained from first eye surgery and so prioritising those awaiting first eye surgery may be a reasonable approach during a period of limited capacity.[31] For patients with visually-significant cataract in both eyes, immediately sequential bilateral cataract surgery (ISBCS) has been suggested as an alternative method of delivering cataract surgery to vulnerable patients during the COVID-19 pandemic.[7,32] ISBCS involves operating on both eyes during a single visit to the operating theatre, therefore reducing the probability of nosocomial infection while addressing binocular visual function.

The increased use of telemedicine for tasks such as explaining the diagnosis and surgery, discussing aimed refractive outcomes and gaining consent, can be used to reduce the amount of time patients need to spend in clinical settings for face-to-face encounters.[7] The introduction of mandatory reverse transcriptase-polymerase chain reaction (RT-PCR) testing for SARS-CoV-2 in patients attending hospital for cataract surgery has reduced the likelihood of individuals with COVID-19 transmitting this to other patients and staff in hospital. Ensuring social distancing and reducing time spent in hospital, by streamlining patient flow through the day case surgical unit, have further mitigated this risk.

This study demonstrates the utility of an electronic health record in efficiently screening patients for risk factors associated with worse outcomes from COVID-19. It was not practical to access the paper-based case notes for this number of patients in a short period of time, but the relevant medical information was readily accessible through NIECR which allowed rapid screening of a large patient cohort. Some patients deemed to be 'clinically extremely vulnerable' chose to attend for cataract surgery during the period of this study. However, this decision was taken after a detailed discussion regarding the additional risks of SARS-CoV-2 infection and what steps were being taken to limit potential exposure. As such, individual patients could make an informed decision regarding the timing of their cataract surgery.

## CONCLUSION

This is the first study to quantify the proportion of patients undergoing cataract surgery who are at high risk of severe disease or death from COVID-19. This high risk is attributable to severe respiratory disease, cancer and immunosuppression therapy in the majority of these vulnerable patients. This study also highlights the challenge of delivering cataract surgery safely to a high risk population with sight loss secondary to cataract. Screening for significant comorbidities can be performed efficiently using an electronic health record. Patients with severe vision loss can also be identified in this way. It is therefore important that relevant clinical information is recorded accurately on the electronic health record at the time of listing for surgery. Changes to how surgical care is delivered may also help to reduce visual morbidity and minimise the risk of nosocomial SARS-CoV-2 infection during the pandemic.

This study has not previously been submitted for publication or presentation.

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