SHORT REPORT

The effect of COVID-19 on referral patterns for clinical electrophysiological testing

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Abstract

Purpose   To provide an overview of the effect that the COVID-19 pandemic has had on visual electrophysiology referral patterns and the subsequent effect this may have on patients.

Methods   All electrodiagnostic tests performed at Kensington Vision and Research Centre, Toronto Canada, in a 3-month period prior to the COVID-19 pandemic (1 September 2019 to 30 November 2019) were compared to a 3-month period after the start of the COVID-19 pandemic (1 September 2021 to 30 November 2021).

Results   A total of 502 patients had electrodiagnostic testing carried out in the designated time periods: 292 in the time period prior to the COVID-19 pandemic and 210 patients after. There was a significant change in the reason for referral in patients pre-COVID compared to post-COVID ($p = 0.004$). There was a 43% reduction in referrals for drug monitoring, 25% reduction for hereditary pathology and a 27% increase in acquired pathology after the start of the COVID-19 pandemic compared to before.

Conclusions   There was a substantial decrease in the total number of patients referred after the start of the COVID-19 pandemic compared to pre-COVID with inherited retinal pathology and drug monitoring patients being 2 populations most affected by the disruption to healthcare services.

Abbreviations
ERG   Electroretinogram
VE   Visual electrophysiology

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Introduction

Office-based visual electrophysiology (VE) is a practical, noninvasive test used in Ophthalmology to provide a range of electrodiagnostic tests to help guide clinicians in the diagnosis of ocular pathology and assess function of the visual pathway. VE offers objective and quantifiable data [1] and is particularly important in the diagnosis of inherited retinal conditions and in the detection and monitoring of drug toxicity (most commonly hydroxychloroquine) as well as other acquired retinal and optic nerve conditions.

COVID-19 pandemic lockdowns and restrictions have led to major disruptions in Ophthalmic care and a significant reduction in patient clinic attendances

and physician activity in the last 2 years [2]. Our work aims to provide an overview of the effect that the COVID-19 pandemic has had on clinicians practice and the referral pattern for clinical electrophysiological testing and the subsequent effect this may have on patients. We aim to do this by evaluating the patients who were referred to our electrodiagnostic unit. The unit is the only adult referral centre in the Greater Toronto area and typically provides testing to around 1000 patients each year.

Methods

A retrospective chart review, analysing electrodiagnostic tests performed at Kensington Vision and Research Centre, Toronto Canada was carried out. Clinical electronic medical records were accessed, and the following information identified: patient sex and date of birth, reason for referral, electrophysiological tests performed and result of the testing (normal or abnormal). Patients in a 3-month period prior to the COVID-19 pandemic (1 September 2019 to 30 November 2019) were compared with patients seen in a 3-month period after the start of the COVID-19 pandemic (1 September 2021 to 30 November 2021). During both periods there were no significant backlog of patients or delay in performing the requested electrophysiology tests.

All tests performed within the period of interest were identified by querying the test system database (Espion E3, Diagnosys Llc, Lowell, MA, USA). All electrophysiology testing was performed according to standards published by the International Society for Clinical Electrophysiology of Vision (ISCEV) [3, 4]. Patients referred for electrophysiological screening for hydroxychloroquine retinopathy usually only received multifocal ERG testing while all other referrals received multifocal and full-field ERG testing. Multifocal ERG testing was performed without dilation. All test results were assessed for abnormality by an experienced electrophysiologist (TW), response waveform amplitudes and peak times were compared to manufacturer supplied control reference thresholds. Patients referred for mfERG screening for possible HCQ retinopathy were assessed using ring average response thresholds and ring ratios. Ring ratios were assessed for abnormality by comparison with published thresholds [5, 6]. Patients with abnormal electrophysiology results were identified by retrospective chart review.

Student t-test was used to assess group differences in patient age, chi-squared test was used to assess the frequency of abnormal electrophysiology results. 2-way analysis of variance (ANOVA) with post-hoc Tukey honest significant difference was used to assess differences in referral reasons.

Ethical approval for this study was received from the Health Sciences Research Ethics Board of the University of Toronto (protocol # 42517).

Results

A total of 502 patients had electrodiagnostic testing carried out in the designated time periods and were included in the analysis. 292 patients were tested in the specified 3 month prior to the COVID-19 pandemic (1 September 2019 to 30 November 2019) and 210 patients in the 3-month period after the start of the COVID-19 pandemic (1 September 2021 to 30 November 2021). Table 1 gives an overview of patient demographics and the proportion of full-field electroretinogram (ERG) and multifocal ERG which were abnormal in these patients.

Table 1 Overview of patient demographics and percentage of those patients which had an abnormal full-field electroretinogram (ERG) and/or multifocal ERG

	Prior to COVID-19 pandemic 01/09/2019–30/11/2019	After start of COVID-19 pandemic 01/09/2021–30/11/2021	P-value
Number of patients tested	292	210	
Age (± SD)	55.75 (± 15.99)	53.24 (± 16.49)	0.088
Female	205 (70.2%)	152 (72.4%)	0.596
Full-field ERG abnormal	73/121 (60%)	74/120 (62%)	0.895
Multifocal ERG abnormal	124/292 (42%)	102/210 (49%)	0.175

The reason for referral by the clinician was noted from the requisition form and classified into either hereditary ocular pathology, drug monitoring or acquired. For hereditary ocular pathology the main indications for referral were rod-cone dystrophy (45%) and macular/cone-rod dystrophy (40%). For drug monitoring, the medication was hydroxychloroquine in 99% of patients. For acquired referrals, indications included inflammatory disorders (35%), non-hereditary retinal pathology such as vascular occlusions and CSR (33%) and visual or field loss or disturbance (32%). Figure 1 summarises the reason for referral in patients pre-COVID and post-COVID; the change in referral pattern being statistically significant ($p = 0.004$).

Discussion

Our study highlights the substantial decrease in the total number of patients seen after the start of the COVID-19 pandemic compared to pre-COVID. During the COVID-19 pandemic, healthcare systems prioritised more urgent treatments and virtual care became a key tool for physicians. There has been difficulty in measuring the impact that this has had on patients whose care has been delayed or condition never diagnosed and there has been concern that the pandemic has highlighted pre-existing health inequalities [7]. Our results show two populations of patients who have seen a change in the care they have received likely because of the pandemic. For those patients with or suspected to have a hereditary ocular disease this may mean they have had a missed or delayed diagnosis of their condition and for those patients who are on medications which can be toxic to the eye the reduced frequency of monitoring or no monitoring at all would be concerning for missed and delayed detection of ocular toxicity.

In contrast, the number of patients being referred for acquired retinal conditions has increased. A considerable proportion of this group is of more acute

Fig. 1 Reason for referral for visual electrophysiology obtained from clinician requisition form for patients pre-COVID (1 September to 30 November 2019) and post-COVID (1 September to 30 November 2021)
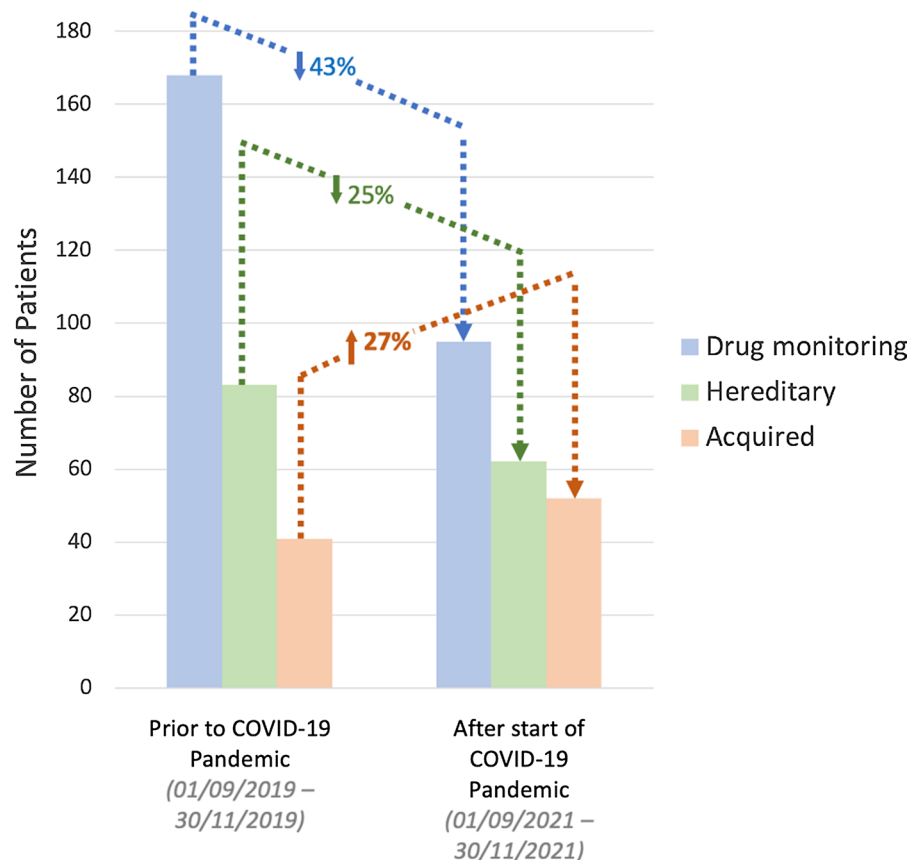
presentations of patients with visual loss which were more likely to have been prioritised during the pandemic. Care should be taken to make firm conclusions regarding this as the numbers of patients are smaller compared to the other 2 groups; however, within the acquired group there was a specific increase in the number of patients referred with visual symptoms, but no objective examination or investigation abnormality noted on the requisition form and with subsequently normal electrophysiology results (7 patients pre-COVID to 11 patients post-COVID). It is possible that this may represent an increase in functional or non-organic ocular disorders possibly as a consequence of mental health sequelae secondary to the pandemic.

The study has many strengths including the size of the two comparison groups. The two groups are also from a consistent population and were tested in the same unit by the same electrophysiologists. The time periods were chosen carefully in order to leave a clear 2 year separation between pre- and ongoing pandemic but were at the same time of year in order to account for any bias which may have occurred with seasonal variations in referral patterns.

Limitations of the study include the single centred nature of the study which limits the generalisability of the results nationally and internationally. And although the size of the two comparison groups were large the number of patients referred with less common indications were relatively small.

Our work highlights the substantial decrease in the total number of patients referred after the start of the COVID-19 pandemic compared to pre-COVID and identifies inherited retinal pathology and drug monitoring patients to be two populations most affected by the disruption to healthcare services. The work highlights to clinicians those patients at risk of vision loss due to missed or delayed diagnoses because of the pandemic.

Declarations

Conflict of interest   The authors have no conflict of interest.

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