lowering eye drops at baseline was 3.2 ± 0.9, and 1.0 ± 1.3 after 12 months of follow-up, that is an average reduction of more than 2 pressure-lowering eye drops after one year. Sixty-seven per cent of eyes did not need pressure-lowering eye drops one year after surgery. We did not find any statistically significant differences regarding IOP in eyes in which XEN stent implantation was combined with phacoemulsification, except after 1 month ($p < 0.01$), where IOP was higher in the combined group. The number of eyes included was too small to make any reliable conclusions regarding SLT, but there was a trend ($p = 0.05$) towards a difference in number of pressure-lowering eye drops after 12 months in favour of those who had not received SLT treatment.

Seventy per cent of all eyes did not require any postoperative surgical interventions. Needling (22%) and choroidal effusion (15%) were the most common postoperative surgical procedure and postoperative complication, respectively. Also, one very severe complication, necrotizing scleritis, was noted in this cohort, but after months of antibiotics, steroids and surgery, the eye was saved, and visual acuity and MD had not deteriorated.

Seven of our 27 patients had XEN implantation in both of their eyes. When including these eyes in the statistical analyses, the results were largely the same.

We therefore conclude that XEN stent implantation is an efficient method to lower IOP and reduce the need for pressure-lowering eye drops in patients with glaucoma for at least 12 months. Most complications in this retrospective study were minor; however, one severe complication was reported. Patients should be informed that reoperation or revision is not unusual. Major limitations to this study were the relatively low number of patients included and short follow-up time.

Acknowledgments

The authors wish to thank the Region of Southern Denmark.

Reference

Green W, Lind JT & Sheybani A (2018): Review of the Xen Gel Stent and InnFocus MicroShunt. Curr Opin Ophthalmol **29**: 162–170.

Received on October 23rd, 2020.
Accepted on October 25th, 2020.

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Age-related macular degeneration and mortality in SARS-CoV-2-infected patients

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doi: 10.1111/aos.14685

Editor,

Conditions associated with dysregulated complement were found to be risk factors for SARS-CoV-2-associated morbidity and mortality (Ramlall et al. 2020; Skendros et al. 2020; Lo et al. 2020). History of macular degeneration was an independent risk factor for morbidity and mortality in SARS-CoV-2-infected patients (Ramlall et al. 2020). This association was attributed to dysfunction in the complement system, which is known to account the risk for age-related macular degeneration (AMD), and which might also contribute in SARS-CoV-2-mediated disease (Toomey et al. 2018, Java et al. 2020). The hazard ratio (HR) of death associated with SARS-CoV-2 in patients with macular degeneration was 3.0 (95% CI: 2.0–4.6) in univariate analysis, and 1.5 (95% CI: 1.0–2.3) when age and sex-corrected (Ramlall et al. 2020).

It is true that several molecular pathways have been implicated in AMD and that the focus at current research is in modulating the complement cascade (Chakravarthy U & Peto, 2020). Importantly, it should be acknowledged the other obvious risk factors these patients have and the proposed vasculature–lung tissue interface pathophysiology in SARS-CoV-2 disease (Teuwen et al. 2020). In a previous study, we found a positive association between mortality and the number of anti-VEGF injections – a proxy for disease severity (Blasiak et al. 2019). Furthermore, we found a significantly elevated mortality ratio in wet AMD patients in comparison with controls (adjusted odds ratio [OR] = 4.18; 95% CI: 1.228–16.683) (Blasiak et al. 2019). We observed decreased serum levels of microRNAs (miRNAs): miR-34-5p, miR-126-3p, miR-145-5p and miR-205-5p in wet AMD patients when compared with controls. These miRNAs have been linked with oxidative stress, cytokine secretion during hypoxia, VEGF expression and extracellular matrix remodelling. Greater mortality in patients with macular degeneration was also reported by Hanhart et al.; during their follow-up (up to 73 months), 19.7% of individuals with wet macular degeneration treated with bevacizumab died compared with 12.1% in the control group (OR = 1.69; 95% CI: 1.54–1.84) (Hanhart et al. 2017). These results were seen prior to the current COVID-19 pandemic. Together, these show that patients with AMD, and especially with advanced disease, are at higher risk of mortality regardless of the cause.

The potential association between macular degeneration and the risk for morbidity and mortality in SARS-CoV-2-infected patients should not be, however, taken lightly. Patients with advanced disease commonly visit the hospital for repeated anti-VEGF injections, exposing them to contacts in proximity with health workers, and other patient populations. While other elderly patients practiced social distancing, especially from medical facilities, patients with wet AMD have no choice other than to frequent hospitals repeatedly. This is especially notable as a recent study has shown that SARS-CoV-2 may continue to circulate among human populations despite herd immunity due to natural infection or vaccination (To et al. 2020).

The emerging associations of SARS-CoV-2 morbidity and mortality with complement dysfunction are intriguing. They might be a basis for management decisions and possible treatment avenues. However, macular degeneration is a complex disease and should not be considered a straightforward marker of complement dysfunction, especially as patients with macular degeneration have other evident risk factors that can be attributed to increased susceptibility to this pandemic. Research into ways to modulate the complement cascade should nonetheless be encouraged, as this could hopefully be found to be beneficial to patients with macular degeneration, and perhaps eventually to patients infected with SARS-CoV-2 as well.

References

Blasiak J, Watala C, Tuuminen R et al. (2019): Expression of VEGFA-regulating miRNAs and mortality in wet AMD. J Cell Mol Med **23**: 8464–8471.

Chakravarthy U & Peto T (2020): Current perspective on age-related macular degeneration. JAMA **324**: 794–795.

Hanhart J, Comaneshter DS, Freier Dror Y & Vinker S (2017): Mortality in patients treated with intravitreal bevacizumab for age-related macular degeneration. BMC Ophthalmol **17**: 189.

Java A, Apicelli AJ, Liszewski MK et al. (2020): The complement system in COVID-19: friend and foe? JCI Insight **5**: e140711.

Lo MW, Kemper C & Woodruff TM (2020): COVID-19: complement, coagulation, and collateral damage. J Immunol **205**: 1488–95.

Ramlall V, Thangaraj PM, Meydan C et al. (2020): Immune complement and coagulation dysfunction in adverse outcomes of SARS-CoV-2 infection. Nat Med **26**: 1609–1615.

Skendros P, Mitsios A, Chrysanthopoulou A et al. (2020): Complement and tissue factor–enriched neutrophil extracellular traps are key drivers in COVID-19 immunothrombosis. J Clin Invest **130**(11): 6151–6157. Published online August 6, 2020. https://doi.org/10.1172/JCI141374.

Teuwen LA, Geldhof V, Pasut A & Carmeliet P (2020): COVID-19: the vasculature unleashed. Nat Rev Immunol **20**: 389–91.

To KK-W, Hung IF-N, Ip JD et al. (2020). COVID-19 re-infection by a phylogenetically distinct SARS-coronavirus-2 strain confirmed by whole genome sequencing. Clin Infect Dis [Epub ahead of print].

Toomey CB, Johnson LV & Bowes Rickman C (2018): Complement factor H in AMD: Bridging genetic associations and pathobiology. Prog Retin Eye Res **62**: 38–57.

Received on October 14th, 2020.
Accepted on October 25th, 2020.

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Fluorescence lifetimes increase over time in age-related macular degeneration

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doi: 10.1111/aos.14694

Editor,

Quantitative fundus autofluorescence FAF measurements revealed a decline of FAF intensity with age in AMD patients (Reiter et al. 2019). Fluorescence lifetime imaging ophthalmoscopy (FLIO) showed longer FAF lifetimes for AMD eyes than for age-matched controls (Dysli et al. 2017) and a annular lifetime pattern was described (Sauer et al. 2018). Here, we investigated changes of lifetimes in AMD during longitudinal follow-up of up to 75 months. Fifty-seven patients with initially early or moderate AMD were investigated with FLIO (Schweitzer et al. 2007) in a short-wavelength spectral channel (SSC: 500–560 nm) and in a long-wavelength channel (LSC: 560–720 nm). Patients were excluded when they developed cataracta proveta or underwent cataract extraction during follow-up. Finally, we report on 28 eyes of 26 patients (mean age at baseline: 72.0 ± 8.0 years) who had a first follow-up between 13 and 36 months (mean: 25.7 ± 6.2 months, 19 eyes) and/or a second one between 37 and 74 months (mean: 50.9 ± 6.4 months, 21 eyes, 13 eyes had both follow-ups). Seven eyes, which developed geographic atrophy (GA), were excluded from the follow-up, but their baseline values were compared to that of the 28 eyes without transition into GA. FAF lifetimes were calculated from the fluorescence decays per pixel by a three-exponential fit. As prolonged lifetimes were reported in an annular pattern (Sauer et al. 2018), we centred a standard ETDRS grid at the macula and averaged lifetimes over the inner and outer circle of the grid. Significance of lifetime differences was tested by Mann–Whitney *U*-test, changes over time by Wilcoxon test (SPSS 27.0, IBM, Armonk, NY, U.S.A.).

A general prolongation of lifetimes over the follow-up period was found. An example is given in Fig 1A–F. On average over all subjects, the lifetimes increased nonsignificantly in the first follow-up by 12.0 ± 42.6 ps (inner ETDRS ring, SSC), 8.6 ± 32.9 ps (outer ring, SSC), 7.2 ± 26.3 ps (inner ring, LSC), and 8.6 ± 22.9 ps (outer ring, LSC). For the second follow-up, the increases were significant: 15.8 ± 30.3 ps, ($p = 0.025$, inner ring, SSC), 12.2 ± 26.8 ps ($p = 0.05$, outer ring, SSC), 14.7 ± 19.7 ps ($p = 0.005$, inner ring, LSC), and 17.6 ± 19.0 ps ($p = 0.001$, outer ring, LSC). The lifetime increases per year were by the factor 1.36–2.26 (1. Follow-up) and 1.15 to 1.86 (2. Follow-up) higher than that reported for normal ageing (Sauer et al. 2020). The baseline lifetimes were higher for eyes which developed GA than for those which did not: 383 ± 91 ps versus 278 ± 63 ps (inner ring, SSC, $p = 0.006$), 356 ± 98 ps versus 273 ± 55 ps (outer ring, SSC, $p = 0.013$), 393 ± 36 ps versus 328 ± 27 ps (inner ring, LSC, $p = 0.001$), and 279 ± 43 ps versus 328 ± 42 ps (outer ring, LSC, $p = 0.017$). Figure 1G shows the lifetime change from baseline to the second follow-up per individual for the inner ring, LSC. Lifetime increase was