Age-Related Macular Degeneration

On November 13, the 63rd Fielmann Academy Colloquium took place—a traditional event that experienced a premiere this year. For the first time, the colloquium was organized in cooperation with the European Academy of Optometry and Optics (EAOO). Both organizations share the common goal of advancing the development of optometry, creating platforms for lifelong learning in optical and optometric sciences, and networking professionals across Europe who are involved in eye health. At the centre of the international conference was one of the most urgent issues in eye health: age-related macular degeneration. The event was opened by Prof. Dr. med. Dipl.-Ing. (FH) Hans-Jürgen Grein, Head of Science at the Fielmann Academy Schloss Plön; Prof. Dr. Daniela Nosch, M.Sc. clin. Optom, from the Institute of Optometry at the University of Applied Sciences Northwestern Switzerland and a member of the EAOO Educational Committee; and Rupal Lovell-Patel, BSc (Hons), Academic Lead for Vision Sciences at the University of Central Lancashire and President of the EAOO. Together, they welcomed over 200 participants from numerous countries.

Introduction to Age-Related Macular Degeneration

Prof. Dr. Marcel N. Menke, Chief Scientific Advisor at Ocumeda AG in Riedt near Erlen, Switzerland, and Head Physician and Clinic Director of the Eye Clinic at Kantonsspital Aarau, presented the fundamentals of the pathophysiology of age-related macular degeneration (AMD). The macula, he explained, is a five-millimetre-wide area of the central retina and the most functionally important for vision. A loss of central vision entails a loss of quality of life, as it limits abilities such as reading and facial recognition.

Age-Related Macular Degeneration

Age-related macular degeneration is a degenerative disease of the central retina, affecting about 25% of Europeans over the age of 60, with 2.4% suffering from an advanced form. Ageing processes lead to a progressive functional impairment of the retinal pigment epithelium (RPE). Over the course of the disease, the RPE deteriorates, creating gaps in Bruch's membrane. The onset of the disease is known as drusen maculopathy. Drusen contain metabolic by-products that accumulate beneath the RPE and can no longer be broken down. In particular, these deposits can impair the retina's supply of nutrients in the area of the fovea centralis. Additionally, lipofuscin, a cytotoxic by-product of photoreceptor metabolism, accumulates in the RPE cells. Another ageing process affects Bruch's membrane. While it facilitates the exchange of substances between the choroid and retina in young individuals, its permeability for oxygen and nutrients decreases over time. This is particularly problematic for the avascular fovea, which relies entirely on nourishment from the choroid.

Dry and Wet AMD

Two forms of AMD can develop from the initial drusen maculopathy: dry and wet AMD. Whether dry or wet AMD develops depends on individual risk factors. Dry AMD, accounting for 88–90% of cases, is the more common form and is characterized by a slower progression of the disease. In the early stages, patients often notice increasing blurriness, especially in low-light conditions. Wet AMD, on the other hand, represents only 10–15% of cases but is responsible for more severe visual impairments. This form of AMD progresses significantly faster. Within a few weeks, patients may experience a loss of visual acuity, central visual field defects, or distorted vision. Risk factors for AMD include age, genetic predisposition, smoking, intensive sun exposure, and ethnicity. Additionally, cardiovascular diseases and a high body mass index appear to play a significant role in the development of the disease.

Diagnostic Methods

A wide range of state-of-the-art diagnostic techniques is available for the detection of AMD. Ophthalmoscopic evaluation of the fundus provides a good overview and is a simple method for early detection of the disease. Fundus photography is particularly suitable for monitoring drusen progression.

Based on the findings of funduscopic evaluation, the ophthalmologist can decide which additional examinations are useful and necessary. Optical coherence tomography (OCT) allows detailed imaging of individual retinal layers. It visualizes drusen and fluid accumulations in the macula and is the most important tool for disease monitoring. To analyse OCT images comprehensively, extensive knowledge of the histological structure of the retina is required.

Fluorescein angiography remains a well-established standard procedure in AMD diagnostics. This invasive method involves injecting a dye into the veins and observing its distribution in the eye's blood vessels. This technique can identify abnormal and leaky vessels.

Fluorescein angiography is distinct from the relatively new OCT angiography, which is based on data from optical coherence tomography. OCT angiography enables detailed imaging of vascular structures, such as macular neovascularisations. However, it cannot provide information about vessel permeability. As a non-invasive procedure, OCT angiography has the advantage of causing no side effects. However, its imaging is susceptible to artifacts, complicating the interpretation of results.

Another imaging method is fundus autofluorescence, which focuses on the distribution of lipofuscin in the retina. The characteristic patterns of lipofuscin accumulation allow conclusions to be drawn about the progression speed of the dry form of AMD. Additionally, this technology enables precise quantification of atrophic areas.

AI-Assisted AMD Diagnosis

"Collecting and analysing image data requires significant medical resources. Could part of the diagnostics, particularly data analysis, be replaced by the use of artificial intelligence?" With this central question, Grein handed the microphone to Prof. Dr. Ursula Schmidt-Erfurth, Head of the Department of Ophthalmology and Optometry at the Medical University of Vienna. She responded with a decisive "Yes," appearing for a brief moment to suggest the question had already been definitively answered. However, she immediately continued: Age-related macular degeneration is the leading cause of permanent visual impairment. The disease is often diagnosed late. Given the demographic trends in Germany, this problem is expected to grow significantly in the coming years. In her opinion, this could be prevented if diagnostics were made more accessible to at-risk groups. She sees great potential here in interdisciplinary collaboration between different professional groups in the field of eye health, complemented by the targeted use of artificial intelligence.

"The question is not whether artificial intelligence can support diagnostics—it must do so." Especially in ophthalmology, which already relies on modern, high-resolution imaging such as optical coherence tomography, this is crucial. Manual evaluation of these image data by ophthalmologists not only takes a lot of time but is also prone to errors. The CATT study showed that even experienced ophthalmologists agree on diagnoses in only about 72% of cases. Artificial intelligence, on the other hand, can perform this task faster and with greater reliability within seconds.

Fluid Monitor

A validated and successfully used AI-supported software is the so-called Fluid Monitor. This tool analyses OCT images precisely on a pixel basis and identifies fluid accumulations in the retina. The

software distinguishes between intraretinal, subretinal, and sub-RPE fluid, which is visualized with colour coding. This differentiated representation significantly influences therapy decisions for wet AMD. Intraretinal fluid is a clear indicator for an intravitreal injection, whereas subretinal fluid should not be treated as long as it remains stable. Scientific studies even suggest that subretinal fluid in AMD patients may have a protective effect on photoreceptor function. Precise detection and localization of these fluids are therefore crucial, as they play a significant role in photoreceptor functionality.

AMD Therapy

Currently, wet AMD can only be treated symptomatically. Medications used are injected directly into the vitreous cavity of the eye. Their effect is based on inhibiting the body's own messenger substance VEGF. The procedure for intravitreal injection requires sterile conditions, representing a considerable organizational and time commitment for both clinics and surgical centres. For patients, this treatment also involves significant effort, as it is a lifelong, regularly repeated therapy.

"Whatever you do, the fluid always comes back," summarized Schmidt-Erfurth regarding the sobering results of the VIBES study. Additionally, many patients are undertreated, exacerbating the problem further. Here, the use of artificial intelligence combined with easier access to AI-supported diagnostics, for example, through opticians and optometrists, could provide valuable support. For dry AMD, however, there is currently no approved therapy in Europe.

Low Vision Care

Low vision care plays a central role in AMD therapy and complements medical treatment. The goal of low vision rehabilitation is to make the best use of the remaining vision. Various aids are available for this purpose. However, not every aid is equally suitable for every patient, explained Frank Wersich, master optician and optometrist (HWK) and managing director of Schrodin & Wersich Optik GmbH in Baden-Baden.

Patients come from diverse life situations: Some are retired, while others are still actively working. For Wersich, low vision is much more than merely fitting aids. He sees himself as a consultant, listener, motivator, and encourager.

The Perfect Aid

For successful low vision rehabilitation, the right timing is crucial. After receiving the diagnosis of a life-changing disease, patients go through various emotional stages—from shock to depression, acceptance, adaptation, reorganization, and ultimately a new self-perception and personal growth. Rehabilitation only makes sense once the patient has started to accept their condition.

The selection of available aids is extensive, ranging from optimized lighting to reading glasses, magnifiers, filter lenses, large-print materials, electronic visual aids, and tactile tools. The principle is: the simplest aid is usually the best. Additionally, existing resources should not be overlooked. Many older people already own a smartphone, which provides access to helpful apps. Practical tips like these foster a trusting relationship between the advisor and the patient, positively influencing collaboration.

Equally important as the choice of aid is training in its use. Only a correctly applied aid can achieve its full benefit. It is also crucial that patients and their relatives understand both the possibilities and limitations of these aids. Many conditions that lead patients to low vision care are progressive.

Regular check-ups are therefore recommended to detect deterioration early and adjust the aid accordingly. A central concern should be that patients leave the practice knowing that their care options are not yet exhausted. This not only instills hope but also lays the foundation for long-term care.