Sunday October 6, 2019

Programme

08.00 Registration

08.15 An introduction to the Ocular Surface Workshop
- The Ocular Surface Unit
- Focus on meibomian glands and tear film lipid layer
- Principles of meibography and tear film interferometry

09.00 Non-Contact Infrared Meibography (NCIM) by OSA-Vet ocular surface analyser
- Technical specifications
- The instructors explain how to use the OSA-Vet for meibography
- Delegates examine each other with the assistance of Instructors
- Software processing of individual results under the Instructors’ guidance

10.30 Coffee break

11.00 Tear Film Interferometry, topography and NIBUT by OSA-Vet ocular surface analyser
- Technical specifications
- The instructors explain how to use the OSA-Vet for lipid layer/ocular surface evaluation
- Delegates examine each other with the assistance of Instructors
- Software processing of individual results under the Instructors’ guidance

12.30 Discussion

13.00 End of the workshop
MEIBOMIAN GLANDS

Meibomian glands (MGs) are large holocrine sebaceous glands located in the eyelids (~30-40 per eyelid). Unlike those of the skin they are not associated with hair follicles. They are considered modified hair follicles instead. However, hairs (distichiae) may develop from undifferentiated glandular tissue and in diseases such as chronic blepharitis. MGs ductal orifices open on the lid margin forming the so called “grey line”.

Meibography

Meibography is the only in vivo technique for visualizing the morphology of the MGs, including their ducts and acini. It may be performed using contact or non-contact techniques.

Contact meiboscopy is a transillumination technique where the eyelid is everted over a light source such as a Finoff transilluminator and MGs are observed from the conjunctival surface of the eyelid. Meibography is the photographic documentation of MGs under such illumination.

Non-contact infrared meibography was first described by Reiko Arita in 2008 to show the effects of aging in a normal human population. At the 2011 ACVO meeting, Masanori Endo presented a poster on “Non-contact infrared meibography in dogs and cats” in which he described results obtained with a portable probe. In 2014, Yasunary Kitamura, Akihiko Saito, and Maehara Seiya described morphological changes in canine MGs by comparing results of meibography and histopathology.

ICP-OSA-VET® - HAND HELD MEIBOGRAPH FOR VETERINARY USE
AVAILABLE AT THE ESVO WORKSHOP

The ICP-OSA-VET® Ocular Surface Analyser (SBM Sistemi, Torino, Italy), cable-connected to a computer.

The light source is an infrared LED, and the images are recorded by a infrared-sensitive camera. The system works through a web-connected platform, the Integrated Clinical Platform (ICP) software to record and elaborate images and videos; this is continuously improved to match the users’ needs.

Brightness and contrast of images can be adjusted to allow an easy examination.

The best images are selected to evaluate MGs number, morphology, arrangement within the eyelid and the ductal openings at the lid margin.
In case of meibomian gland dysfunction (MGD) openings occlusion and ductal dilatation with whitish material inside, gland atrophy and endstage dropout are visible.

By marking the lid area to be examined, the software allows to define the percentage of tissue lacking MGs due to glandular shortening and drop-out, and to grade the results so as to create a meibography score ("meibo-score").

For the ICP software the morphologic changes are classified in 4 degrees with a coloured scale:
- Loss between 0 and 25% (green)
- Loss between 25 and 50% (yellow)
- Loss between 50 and 75% (orange)
- Loss between 75 and 100% (red)
TEAR FILM EXAMINATION

TEARSCOPE AVAILABLE AT THE ESVO WORKSHOP

Technical specifications

The OSA-VET (Ocular Surface Analyser) system is the same used for meibography, and is cable-connected to a computer.

As for meibography, both systems work through a web-connected platform, and the software is continuously improved to match the users’ needs.

Brightness and contrast of images can be adjusted to allow the best evaluation.

A Placido disc can be inserted in the cone of the OSA-Vet to perform OS topography

OSA-VET®

A grid with circles and lines can be inserted in the cone of the OSA-Vet to evaluate the non-invasive break-up time

TEAR FILM

The Tear Film (TF) is a hydrated mucin gel whose mucin concentration decreases with distance from the epithelial surface. It interacts with corneal and conjunctival epithelium via the membrane-spanning mucins. Mucins secreted by conjunctival apocrine goblet cells play a key role in maintaining TF stability. A superficial lipid layer (LL), composed of polar and non-polar lipids produced by the MGs, limits evaporation of the aqueous phase of the TF, and is also believed to stabilize the TF by lowering surface tension. Hence, meibomian lipids are essential for the maintenance of ocular surface health and integrity.

The TF LL can be visually examined by observing interference patterns generated by light reflected from the front surface (i.e., the air-lipid boundary) and the lower surface (i.e., the lipid-aqueous boundary) of the LL.
The LL thickness determines the phase difference between the two reflected light paths. Light of a particular wavelength is cancelled out because of this difference in phase, only the remaining wavelengths are seen.

A thin film has a thickness (t) smaller than a few times the wavelength of light (\( \lambda \)). Since colour is associated indirectly with \( \lambda \) and because all interference depends in some way on the ratio of \( \lambda \) to the size of the object involved, we should expect to see different colours for different film thicknesses.

Light reflected from the top and bottom surfaces of a film can interfere with one another. Incident light is only partially reflected from the top surface of the film (Ray 1). The remainder enters the film and is itself partially reflected from its bottom surface. Part of the light reflected from the bottom surface can emerge from the top of the film (Ray 2) and interfere with light reflected from the top (Ray 1). The ray that enters the film travels a greater distance, so it may be in or out of phase with the ray reflected from the top. As a consequence a more or less uniform and coloured film pattern is observed.

Features of the TF LL patterns provide information used to evaluate LL thickness and fluidity. For humans several interference patterns have been described, based on colour and texture. Thick LLs show clear patterns, meshworks with waves, and interference fringes while thinner layers are more homogeneous. The data set available in the human literature may serve as a reference for animals.

One of the most accurate descriptions takes into consideration five main grades of LL interference patterns. In the veterinary field, Carrington examined the precorneal TF using polarized light biomicroscopy. Assessments of the range of thickness of the TF LL were made from photographs using the colour and order
of the Newtonian interference fringes observed. Carrington listed 16 different interference colours and 3 principal variants of surface lipid morphology seen in dogs (“wave”, “islet”, and “granitiform”).

Interferometry is now an established technique for clinical examination that allows visualization of the kinetics of the TF LL. Although LL interferometry grading is subject to personal interpretation, its reliability is conditioned by individual experience and accuracy in performing the examination. Minimal lid margin compression or forced blinking may squeeze meibum from MGs, increase LL thickness, and alter interferometry patterns. Moreover, it must be considered that LL thickness is not necessarily proportional to aqueous layer thickness. In a study using a five-grade scale of increasing thickness to assess TF LL by interferometry, the authors reported that “… in the more severe dry eye, there is a thicker lipid layer. This unexpected result in dry eye is explained as follows: the reduced aqueous tear volume in aqueous deficient dry eye (ADDE) consequently reduces the forward displacement of lid oil as the TF is compressed during blinking, leaving a greater amount of oil on the lid margin for it to be redistributed to the precorneal TF…”.

In veterinary ophthalmology LL interferometry is a useful exam in the diagnosis of ocular surface disease. In our studies interferometric patterns were evaluated to define the LL thickness (LLT) according to frame-grading scales and video-grading scales to consider also TF dynamics. We have been using a three, five and eight-grade frame-grading scale to set LLT in the dog. We have also been using a four-grade video-grading scale to evaluate interferometric pattern dynamics, which are highly influenced by polar/non-polar lipids balance in the LL and TF mucin gel composition. These parameters, more than thickness, play an important role to control TF evaporation and stability.

Eight-grade frame grading scale.
Grade 0 refers to the presence of hydrophobic plaques of lipid contaminated mucus.
Grades 1 to 7 are examples of interference patterns from 15 to >100 nm.

The three-grade frame-scale allows an easy, quick evaluation during clinical work.

1. ≈ 15-30 nm
2. ≈ 30-60 nm
3. ≈60-150 nm

The five-grade frame-scale is more accurate and used in clinical research.
After a short period of training to examine and grade frames, the video grading-scale should be used whenever possible to consider TF dynamics.
**OCULAR SURFACE TOPOGRAPHY**

By placing a plastic Placido disc within the OSA-Vet cone or by using a specific Placido cone it's possible to view the image of Placido rings projected on the cornea. It provides important information when assessing the quality of the tear film or the presence and causes of local OS irregularities.

**NON-INVASIVE BREAK UP TIME (NIBUT)**

In OS examination non-invasive methods should be always preferred. NIBUT is evaluated by examining circles and lines of a dedicated NIBUT grid or a Placido disc projected over interferometric patterns. Time from blinking and initial grid distortion is not influenced by administration of a fluorescein drop like for BUT and is exclusively a variable of TF composition and OS wettability.

In most cases, in animals, continuous eye and third eyelid movements prevent NIBUT evaluation although palpebral fissure is held wide open.

**MENISCOMETRY**

Tear Meniscus Height (TMH) may be evaluated on selected interferometric images and software processing to make interesting deductions about the relationship between tear volume and stability. Meniscometry should be evaluated 3-4 seconds after blinking.
References

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