EuCornea Medal Lecture probes neural basis of ocular sensations

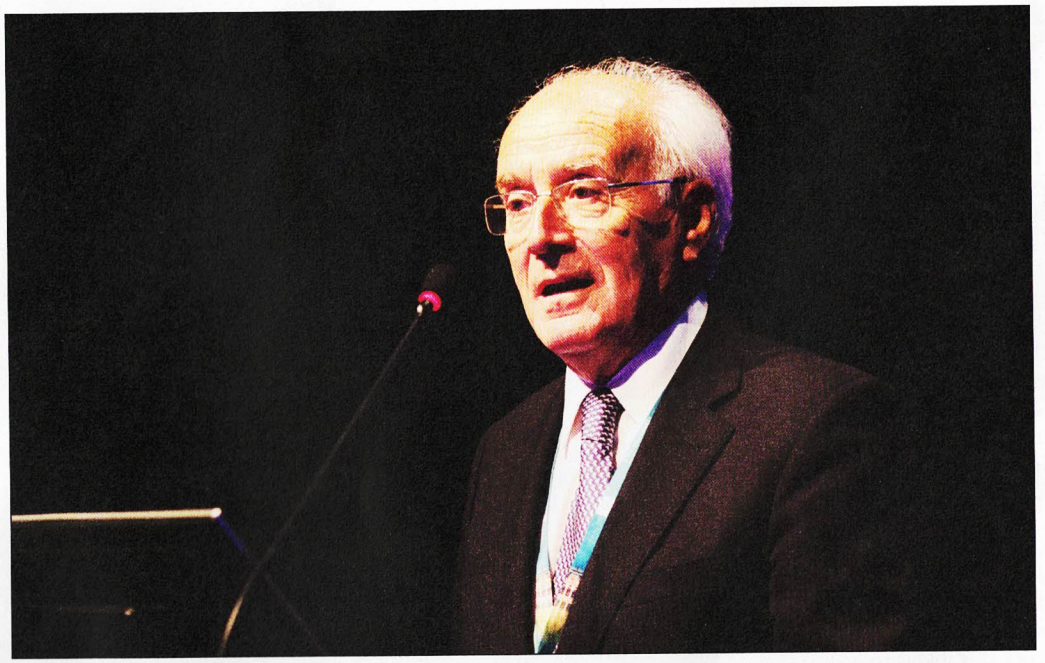
MAJOR advances have been made in recent years into understanding the characteristics and neural basis of corneal and conjunctival sensations such as dryness, discomfort and pain, Carlos Belmonte said in the keynote EuCornea Medal Lecture at the Opening Ceremony of the 9th EuCornea Congress.

"Ophthalmologists have traditionally dedicated very limited attention to the study of the non-visual sensory capacities of the eye. Pain, the most relevant symptom of disease in most medical specialties, rarely accompanies the main ocular pathologies such as cataract, retinal degeneration, refractive defects and glaucoma, thus explaining the scarce preoccupation of clinicians for a detailed knowledge of the somatosensory physiology of the eye innervation," said Dr Belmonte, Emeritus Professor of human physiology at the Medical School, University Miguel Hernandez in Alicante, Spain.

This initial lack of interest has reversed rapidly in recent years with the development of invasive, sophisticated surgical procedures to treat patients suffering ocular pathologies, the increasing use of contact lenses and the growing incidence of dry eye among the growing population of elderly people, noted Dr Belmonte.

Injury to ocular surface tissue is consubstantial to any surgical intervention on the eye and occurs in a number of contact lens users and in elderly and dry eye patients, causing variable levels of nerve damage. Local inflammation of the eye surface tissues is the most relevant sign in allergic, immune and infectious eye diseases.

"Inflammation and nerve injury have important short- and long-term consequences on the architecture, molecular organisation and excitability of sensory neurons. Their magnitude differs according to the original pathology and may produce immediate, acute pain sensations and delayed, chronic dysesthesias such as burning, stinging or pricking, persisting unpleasant sensations, and overt neuropathic pain and neurotrophic disturbances of the cornea," he said.



Carlos Belmonte delivering the EuCornea Medal Lecture

The cornea has a far higher concentration of nerve endings than anywhere else in the human body, explained Dr Belmonte, with recent research estimating the density of pain receptors in the cornea as 300-600 times greater than skin and 20-40 times greater than dental pulp, making any injury to the structure excruciatingly painful.

Using cellular, electrophysiological and behavioural techniques, Dr Belmonte's research has shown how corneal nerves are responsible for sensations of touch, pain and temperature and also play an important role in the blink reflex, wound healing and tear production and secretion.

Corneal nerves are functionally heterogeneous, noted Dr Belmonte: about 20 per cent respond exclusively to noxious mechanical forces (mechano-nociceptors); 70 per cent are additionally excited by extreme temperatures, exogenous irritant chemicals and endogenous inflammatory mediators (polymodal nociceptors); the remaining 10 per cent are cold-sensitive and increase their discharge with moderate cooling of the cornea (cold receptors). Each of these types of sensory fibres contribute distinctly to corneal sensations, he said.

> *Ophthalmologists have traditionally dedicated very limited attention to the study of the non-visual sensory capacities of the eye*

Mechano- and polymodal nociceptor neurons evoke qualitatively unpleasant sensations of irritation, itch and pain, while cold thermoreceptors evoke cooling and unpleasant dryness sensations and also regulate unconscious basal tearing and blinking rates. Mechano- and polymodal nociceptors have also been shown to evoke irritative tearing and lid closure, he added.

Under pathological conditions such as inflammation, surgical injury and dryness of the ocular surface, the activity of ocular sensory nerve fibre changes markedly as the result of short-term changes in ion channel expression secondary to local release of inflammatory agents and growth factors, and of long-lasting modifications in gene expression, explained Dr Belmonte. This leads to the development of spontaneous activity and of abnormal responsiveness to natural stimuli.