Using the eye to "see" diseases of the brain

The eye is often quoted as the window to the soul, but paediatric neurosurgeon, Dr Llewellyn Padayachy, believes it is also the window to the brain. Assessing pressure inside the brain is a vital part of diagnosing certain neurosurgical conditions including brain tumours, cranial deformities, traumatic brain injury and infection. Previously, diagnosis involved drilling a hole in the skull in order to measure this pressure. This invasive and expensive method however, comes with the risk of infection and bleeding.

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The eye with its natural connection to the brain delivers essential visual information but can also be used to extract information from the brain. “Once you understand the relationship between the eye and the brain, you can then find ways “see” what you want, Padayachy told Research Contracts and Innovation Department at the University of Cape Town's Café Scientifique evening.

While accurate data regarding the number of hydrocephalus cases on the African continent is sparse, conservative estimates put it at some 100,000 cases annually. In the US, it affects approximately one-million people in every stage of life, from infants to the elderly and is said to be as common as Down’s syndrome and more common than spina bifida or brain tumours.

“Sadly, it is also the most common indication for brain surgery in children. Over the past few decades, there have been limited significant advances in the treatment of hydrocephalus, hence it is imperative that these cases are detected early,” says Padayachy.

Ultrasound

A team from Norway and South Africa working on this development realised the potential of traditional static ultrasound assessment of the eye as a non-invasive method for detecting raised pressure in the brain, but also identified the shortcomings in its diagnostic accuracy. They knew that advancing the current static imaging method was going to be the magic bullet.

Their novel technique not only improves accuracy by analysing the dynamic properties of the back of the eye as a marker of pressure in the brain, but perhaps more importantly simplifies the acquisition process so it can be performed at a very basic healthcare level.

According to Padayachy, the eye is directly linked to the brain by the optic nerve which sits at the back of the eyeball. The optic nerve sheath is a balloon-shaped structure. As pressure in the brain builds up, fluid from the brain is forced along this sheath. It dilates this sheath in the same way that a balloon is inflated.

“We figured that if this sheath appeared stretched when we compared it to other clinical and imaging markers, then this information could be really useful.”