Tsunamis in the Brain: Discovery and Potential Significance of Spreading Depolarizations in a Wide Range of Disorders

C.W. Shuttleworth

Distinguished Professor and Chair, Deparment of Neurosciences
University of New Mexico School of Medicine
Albuquerque, New Mexico, USA
bshuttleworth@salud.unm.edu

Abstract:

Spreading depolarizations (SDs) are massive waves of coordinated depolarization that propagate slowly (2-5mm/min) through brain tissue. A burst of activation occurs at the propagating wavefront and is followed by a longer-lasting period of neuronal silencing, leading to "cortical spreading depression". While SD has been studied in animal models for many decades, until quite recently SD has generally been considered irrelevant for human brain pathophysiology. Unlike high frequency neuronal events such as seizures, the slow, sustained mass depolarizations of SDs are almost invisible to conventional clinical brain recording methods such as electroencephalography (EEG). However, work in the last 15-20 years with DC recordings from electrode strips placed on the brain surface has revealed that SDs clearly occur in a human brain and are very likely central to secondary brain injury in stroke and traumatic brain injury (TBI). This discovery opens up exciting new opportunities for treatment of these challenging disorders and clinical trials targeting SDs have recently begun. SD is now beginning to be reported in other conditions where recording electrodes have been placed during brain surgery and, more broadly, it is anticipated that SD involvement could be discovered in other neurologic and psychiatric disorders where transient loss of cortical function occurs. A major opportunity for the field is to develop effective non-invasive recording methods to probe SD involvement in patients who have not had brain surgery, and thus greatly expand the search for these events.

The first part of the talk will introduce the discovery and basic mechanisms of SD. This will provide the basis for understanding the progress in recording SD from brain injury patients and excitement about new clinical interventions that are based on this knowledge. The final part of the talk will describe emerging conditions where SDs are being considered, and what next steps in signal recording and processing will be required to continue this exploration into larger populations.

Biography:

Dr. Bill Shuttleworth is Chair of the Department of Neurosciences at the University of New Mexico School of Medicine. He is a neurophysiologist with a basic science laboratory studying SD in brain slices and mouse models. For the last 17 years he has also been working closely with a colleague from the Department of Neurosurgery (Dr. Andrew Carlson) to explore SD in clinical settings, and is a steering committee member of the international consortium (COSBID) that coordinates basic and clinical studies of SD. His current interests focus on understanding the balance between damaging and beneficial effects of SD, to support refinement of future clinical trials in neurologic and psychiatric disorders.