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A new hypothesis to cytotoxic brain tissue edema and its potential treatment in neurosurgery

Brain diseases such as traumatic brain injury often present with cytotoxic brain tissue edema as a secondary consequence to ischemia. The pathophysiological mechanisms are known to some extent but far from complete. Using an advanced computational simulation model the consequences of kinetic energy transfer following external dynamic impacts were analyzed including the intracranial pressure (ICP), strain level and their potential influences on the non-covalent and covalent bonds in folded protein structures. Based on clinical material the simulations showed that the transferred kinetic energy is mainly absorbed by the skin and three bone layers. Also, a substantial amount of kinetic energy reached the gray and white matter. Thus, the kinetic energy from a dynamic impact has the theoretical potential to interfere not only with non-covalent but also covalent bonds when high enough. The induced mechanical strain and pressure may further interfere with the protein structures as well as the energy rich bonds in nucleotide adenosine-triphosphates. This event causes attraction of increased water molecules into the unfolded protein structures and could to some extent explain the etiology to cytotoxic brain tissue edema. Based on the new knowledge it is realistic to suggest a change the neurosurgical treatment of today by using neuro-engineering simulations already before a neurosurgical procedure is taking place. Thus, the innovative hypothesis makes it possible to open up for new drug and infusion treatments aiming at reducing the severe consequences of cytotoxic brain tissue edema to further improve the prognosis following traumatic brain injury.

Biography

Hans Von Holst has completed his PhD 1985 and he became Associate Professor at Karolinska Institutet. He is a Senior Neurosurgeon at the Department of Neurosurgery, Karolinska where he was Chairman of the department and the division of neurological clinics between 1990 and 1996. In 1995 he became Professor in Neuro-engineering and the Director of the neuro-engineering division at KTH, Royal Institute of Technology. He has published over 140 papers and book chapters in the field of clinical neuroscience and neuro-engineering.

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