

Update in Neurosurgery – Nanotechnology in Neurosurgery

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Nanotechnology define the science and engineering providing entirely new tools and capabilities, concerned with the design, synthesis, characterization and application of materials and devices that have a functional organization in at least 1 dimension on the nanometer (one billionth of a meter) capable to interact with cells and tissues at a molecular - sub cellular level with a high degree of functional specificity, involving innumerable aspects of technology, including neurosurgery, too (1).

The advances in neurosurgery in the near future should be based on (2):

- nano-manipulation – techniques to perform “surgery” on the nervous system at the level of the neuron, neuronal processes, intracellular,
- approaches for the functional regeneration and neuroprotection of the central nervous system after traumatic or degenerative insults,
- nano-imaging - refers to capabilities to view the nervous system at the cellular or sub cellular level,
- non-surgical nano-repair should consider

techniques and substances able to promote axonal regeneration, to stop hemorrhage, but also to give a solution for neurodegenerative diseases and consequences of neurologic deficits after trauma, stroke or brain tumor treatment,

- nano-neuromodulation: to control pain, realizing “biologic pumps”, used both in neuropathic and chronic pains in cancer patients, to release catecholamine and opioid peptides to block NMDA receptors or local sensorial circuits (3).

Nanotechnology offer a highly interdisciplinary area of research in conjunction with basic and clinical neuroscience advances: molecular biology, neurophysiology, neuropathology of the nervous system; but also chemistry and materials science to define and integration of specific nano-applications to the nervous system (1). Neurosurgeons of the present and future must take an active function in shaping the plan and research of nanotechnologies to ensure maximal clinical relevance and patient benefit, to provide or administer the nano-engineered substrate (materials, devices, or drugs) to the site where it is needed in the CNS itself to the patient.

REFERENCES

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