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Nanotechnology solutions for Alzheimer's disease: Advances in research tools, diagnostic methods and therapeutic agents (Review)

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Abstract
A century of research has passed since the discovery and definition of Alzheimer's disease (AD), the primary common dementing disorder worldwide. However, AD lacks definite diagnostic approaches and effective cure at the present. Moreover, the currently available diagnostic tools are not sufficient for an early screening of AD in order to start preventive approaches. Recently the emerging field of nanotechnology has promised new techniques to solve some of the AD challenges. Nanotechnology refers to the techniques of designing and manufacturing nanosize (١-١٠٠ nm) structures through controlled positional and/or self-assembly of atoms and molecules. In this report, we present the promises that nanotechnology brings in research on the AD diagnosis and therapy. They include its potential for the better understanding of the AD root cause molecular mechanisms, AD's early diagnoses, and effective treatment. The advances in AD research offered by the atomic force microscopy, single molecule fluorescence microscopy and NanoSIMS microscopy are examined here. In addition, the recently proposed applications of nanotechnology for the early diagnosis of AD including bio-barcode assay, localized surface plasmon resonance nanosensor, quantum dot and nanomechanical cantilever arrays are analyzed. Applications of nanotechnology in AD therapy including neuroprotections against oxidative stress and anti-amyloid therapeutics, neuroregeneration and drug delivery beyond the blood brain barrier (BBB) are discussed and analyzed. All of these applications could improve the treatment approach of AD and other neurodegenerative diseases. The complete cure of AD may become feasible by a combination of nanotechnology and some other novel approaches, like stem cell technology.

Author keywords
Alzheimer's disease; Amyloid; Atomic force microscopy; Nanodiagnostics; Nanotechnology; Targeted drug delivery; Tau protein

Indexed Keywords
EMTREE drug terms: ١،٢ dioleoyl snglycero ٣ phosphoethanolamine n [٤ (٤ maleimidophenyl)butyramide]; alpha tocopherol; amyloid; amyloid beta protein; carbon nanotube; carboxyfullerene; cyanoacrylate derivative; deferoxamine; dendrimer; donepezil; ethanolamine derivative; fullerene derivative; galantamine; gold; green fluorescent protein; hydroxyfullerene; macrogol; maleimide derivative; memantine; nanoparticle; penicillamine; poly (butyl ٢ cyanoacrylate); polystyrene; pullulan; pyridyldithiopropionylphosphoethanolamine; quantum dot; rivastigmine; tacrine; thioflavine; unindexed drug; tau protein

EMTREE medical terms: Alzheimer disease; atomic force microscopy; blood brain barrier; cell regeneration; degenerative disease; diagnostic procedure; drug delivery system; electron microscopy; fluorescence microscopy; fluorescence resonance energy transfer; human; mass spectrometry; nanotechnology; nerve cell; neuroprotection; nonhuman; nuclear magnetic resonance; oxidative stress; polymerase chain reaction; priority journal; review; surface plasmon resonance; transmission electron microscopy; hospitalization; instrumentation; metabolism; pathology; research; senile plaque; standard