Nanoparticles can aid in stroke therapy

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Tiny selenium particles could have a therapeutic effect on ischemic brain strokes by promoting the recovery of brain damage. Pharmacologists, including Alireza Mashaghi from the Leiden Academic Centre for Drug Research discovered that selenium nanoparticles inhibit molecular mechanisms that are responsible for the loss of brain cells after a stroke. The results were published in *Nature Scientific Reports* in April.

Nanoparticles against strokes

An ischemic stroke happens when a supplying blood vessel to the brain is narrowed or obstructed. As a result, the brain gets too little blood. "This lack of blood can lead to brain tissue damage due to cellular toxicity, inflammation and cell death," Mashaghi explains. "This will, in turn, lead to brain dysfunction and neurological complaints such as numbness, vision problems, dizziness and severed headache." Ischemic stroke accounts for 87% of all strokes and is a significant cause of death. "So far, no neuroprotective agents have been shown to produce any measurable improvement in health in cerebral stroke cases. Our results now demonstrated that selenium nanoparticles inhibit molecular mechanisms that are responsible for the loss of brain cells after a stroke."

Ischemia

Ischemia is a restriction in blood supply to tissues, causing a shortage of oxygen that is needed for cellular metabolism. Ischemia is generally

caused by problems with blood vessels, with resultant damage to or dysfunction of tissue. It is often caused by closure of the vessels due to vasoconstriction, thrombosis or embolism. Ischemia comprises not only insufficiency of oxygen, but also reduced availability of nutrients and inadequate removal of metabolic wastes (the latter leading to cellular toxicity).

Surpressing inflammation

According to Mashaghi, the new approach not only helps healing of brain damage caused by a stroke, but also limits the extent of injuries by protecting brain cells during the event of a stroke itself. "During and after a stroke, the limited blood supply to the brain induces oxidative tissue damage to the affected brain regions," he explains. "Selenium particles reduce this oxidative stress and the related cell death." This happens because the nanoparticles affect the metabolism of nerve cells and suppress inflammation, a major culprit of the harmful effects. "This stroke-induced brain inflammation can cause excessive accumulation of fluid, which results in elevation of intracranial pressure (pressure inside the skull) and the clinical symptoms of a stroke."

Smart particles

Mashaghi is enthusiastic about the discovery: "The designed nanoparticles are unique because of the neuroprotective effect and their safety. They are smart and can sense and target ischemic brain regions." It is critical not to affect the healthy regions of the brain or other organs in order to reduce the side effects. "These nanoparticles are therefore advantageous over conventional drugs. They can be "programmed" to specifically target the affected brain areas, while regular drugs often get distributed all over the body and contaminate all organs," Mashaghi says. For now, the therapeutic nanoparticles are still at an experimental stage.

"However," Mashaghi says, 'in the future, we will assess the effectiveness of this novel drug in patients."

More information: Hamed Amani et al. Selenium nanoparticles for targeted stroke therapy through modulation of inflammatory and metabolic signaling, *Scientific Reports* (2019). DOI: 10.1038/s41598-019-42633-9

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