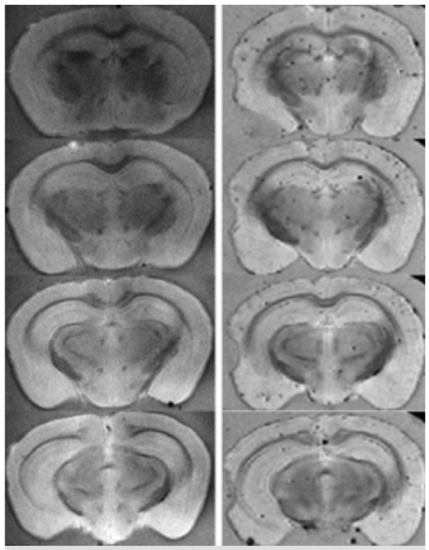
Nanoparticles spice up Alzheimer's diagnosis

19 March 2015 | Cordelia Sealy

Dementia has a devastating effect on the 40 million sufferers worldwide and costs billions in healthcare. Alzheimer's disease makes up 60-80% of cases and, with no known cure or prevention, early diagnosis could be vital for new treatments seeking to halt or slow the disease before irrevocable brain damage occurs.

Magnetic nanoparticles combined with a derivative of the spice turmeric could help make earlier diagnoses of Alzheimer's easier, according to researchers at the Chinese University of Hong Kong [Cheng et al., Biomaterials 44 (2015) 155,



MRI and histochemical staining of mice brains showing Cur-MNP labeled plaques (right) but not in the control group (left).

http://dx.doi.org/10.1016/j.biomaterials.2014.12.005].

Diagnosis relies on the detection of amyloid β (Aβ) plaques – build-ups of Aβ proteins secreted from brain cells, which are normally cleared from the brain but in the disease aggregate into deposits. Aβ aggregates may contribute to neuronal damage and the debilitating symptoms of Alzheimer's. Early on in the disease, plaques may be present long before the patient experiences symptoms. Current detection techniques rely on positron emission tomography (PET), which is expensive and exposes patients to radiation.

Alternatively, magnetic resonance imaging (MRI) is cheaper, widely available in hospitals, and does not involve radiation exposure. As MRI also offers better spatial resolution, it is more suitable for early intervention or mass screening. But the technique cannot detect plaques directly; a contrast agent is needed to bind onto amyloid plaques to make them visible in MRI. Magnetic nanoparticles are a common contrast agent, but Kwok Kin Cheng, Albert Chow, and Larry Baum have designed clever super-paramagnetic iron oxide (SPIO) nanoparticles treated with curcumin – derived from turmeric – that bind

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onto amyloid plaques. Not only does curcumin bind naturally to both SPIO and amyloid plaques without the need for additional chemical linkers, it appears to have no toxic side effects.

To help the curcumin magnetic nanoparticles (Cur-MNPs) sneak into the brain without detection by the immune system, Baum's team coated the particles with the polymers polyethylene glycol-polylactic acid (PEG-PLA) and polyvinylpyrrolidone (PVP). The polymer coating prevents the nanoparticles from aggregating, prolongs the time they can circulate in the blood, and appears to facilitate crossing of the blood-brain barrier (BBB).

The researchers tested their novel Cur-MNPs in mice, demonstrating that the particles bind to plaques in the brain, which appear as dark spots in MRI.

"We showed that the particles can distinguish transgenic mice with amyloid plaques from control mice without plaques, suggesting that the particles would be able to detect plaques in humans," Baum told Materials Today.

He would now like to see the Cur-MNPs tested in humans to confirm their safety and compare their ability to detect amyloid plaques with PET imaging agents.

"Our approach opens up new ground for research and applications," he says.

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