Singapore nanotechnology combats fatal brain infections

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Doctors may get a new arsenal for meningitis treatment and the war on drug-resistant bacteria and fungal infections with novel peptide nanoparticles developed by scientists at the Institute of Bioengineering and Nanotechnology (IBN) of Singapore and reported in *Nature Nanotechnology*.

The stable bioengineered nanoparticles devised at IBN effectively seek out and destroy bacteria and fungal cells that could cause fatal infections and are highly therapeutic.

Major brain infections such as meningitis and encephalitis are a leading cause of death, hearing loss, learning disability and brain damage in patients.

IBN's peptide nanoparticles, on the other hand, contain a membrane-penetrating component that enables them to pass through the blood brain barrier to the infected areas of the brain that require treatment. The ability of IBN's peptide nanoparticles to traverse the blood brain barrier offers a superior alternative to existing treatments for brain infections. The brain membrane is impenetrable to most conventional antibiotics because the molecular structure of most drugs is too big to enter the membrane.

"Our treatment damages the structure of the pathogen and literally breaks it apart," said Yiyan Yang, Ph.D., group leader at IBN, one of the research institutes sponsored by Singapore's A*STAR (Agency for

Science, Technology and Research).

"Our oligopeptide has a unique chemical structure that forms nanoparticles with membranepenetrating components on their surface," Dr. Yang added. "These nanoparticles can easily enter bacteria, yeast or fungal cells and destabilize them to cause cell death. For example, the nanoparticles cause damage to bacteria cell walls and prevent further bacterial growth."

The IBN research team has demonstrated that these engineered peptide nanoparticles have high antimicrobial activity and are highly effective in killing microbes.

Additionally, the peptide nanoparticles are more powerful in inhibiting the growth of fungal infections than conventionally available anti-fungal drugs such as fluconazole and amphotericin B.

"We are able to kill bacteria better than conventional antibiotics. By attacking the cellular structure of the microbes, our nanoparticles can be used to successfully combat persistant bacterial infections," added IBN scientist Lihong Liu, Ph.D.

Pre-clinical tests have shown that IBN's peptide nanoparticles are biocompatible and cause no damage to the liver or kidneys at tested doses. Highly anti-infective, the therapeutic doses of the peptide nanoparticles are expected to be safe for use because they also do not damage red blood cells.

IBN Executive Director Jackie Y. Ying, Ph.D., said, "Our interdisciplinary research groups have made tremendous progress in finding novel drug and gene delivery avenues for medical treatments. With this peptide nanoparticle, we have found a way through the blood brain barrier and produced a treatment for previously challenging

diseases."

Source: Agency for Science, Technology and Research (A*STAR), Singapore