Nanotechnology drug delivery shows promise for treatment of pediatric cancer

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This month, *Molecular Pharmaceutics* reported promising findings from the Nemours Center for Childhood Cancer Research and the Materials Science and Engineering Department at the University of Delaware, about the potential for nanotechnology to deliver chemotherapeutic agents in a way that attacks cancer cells without harming healthy cells. To date, nanoparticle-based drug delivery approaches have been poorly developed for the treatment of childhood leukemia, which comprises 30% of childhood cancers. In the Nemours study, encapsulated dexamethasone ("dex") delivered to pre-clinical models with leukemia significantly improved quality of life and survival compared to the control receiving the unencapsulated drug.

Acute lymphoblastic leukemia (ALL) is the most common form of pediatric leukemia. Although 5-year survival rates for ALL approach 90% with available chemotherapy treatments, the deleterious side effects of the drugs, including secondary cancers and fertility, cognitive, hearing, and developmental problems, present a significant concern for survivors and their families. Dex is one of the most commonly used drugs to treat childhood leukemia and long-term systemic exposure to dex causes considerable side effects.

Studies conducted by the lead author A. K. Rajasekaran, PhD, and his team at Nemours in collaboration with Xinqiao Jia, PhD, and her team at the University of Delaware, used polymeric nanoparticles containing chemotherapeutic agents to ensure controlled delivery of drugs to cancer cells in preclinical models. "There are currently seven or eight drugs that

are used for chemotherapy to treat leukemia in children," said Dr. Rajasekaran. "They are all toxic and do their job by killing rapidly dividing cells." However, he explained, these drugs don't differentiate cancer cells from other, healthy cells. "The good news is that these drugs are 80-90% effective in curing leukemia. The bad news is that many chemotherapeutic treatments cause severe side effects, especially in children." He posits that it will take researchers hundreds of millions of dollars and many years to find better alternative drug treatments. In the interim, scientists like Dr. Rajasekaran and his colleagues are working on novel ways to deliver existing and affordable drugs to children. "Our polymer synthesis and particle engineering are guided by the clinical need for reducing the side effects of cancer drugs," Dr. Jia commented. Vinu Krishnan, the first author of the study and a chemical engineer and graduate student in Materials Science and Engineering, said, "I am very excited about the results and look forward to taking this to the next level and introducing this approach for the clinical treatment of childhood leukemia". Students in Dr. Jia's group contributing to this work also include Xian Xu and Xiaowei Yang.

To date, advances in nanotechnology have been primarily concentrated around adult cancers. Nanotechnology involves the use of encapsulated particles of drugs that go into the core of the cell. The nanoparticles stick only to the cancer cells and destroy them by delivering the drug precisely, without detecting or harming the normal cells. In preclinical models of leukemia, Dr. Rajasekaran and his team were able to improve survival and quality of life via nanotechnology. Encapsulating the drug uses one third of the typical dose, with good treatment results and no discernible side effects. In addition, the mice that received the drugs delivered via nanoparticles survived longer than those that received the drug administered in the traditional way.

Provided by Nemours