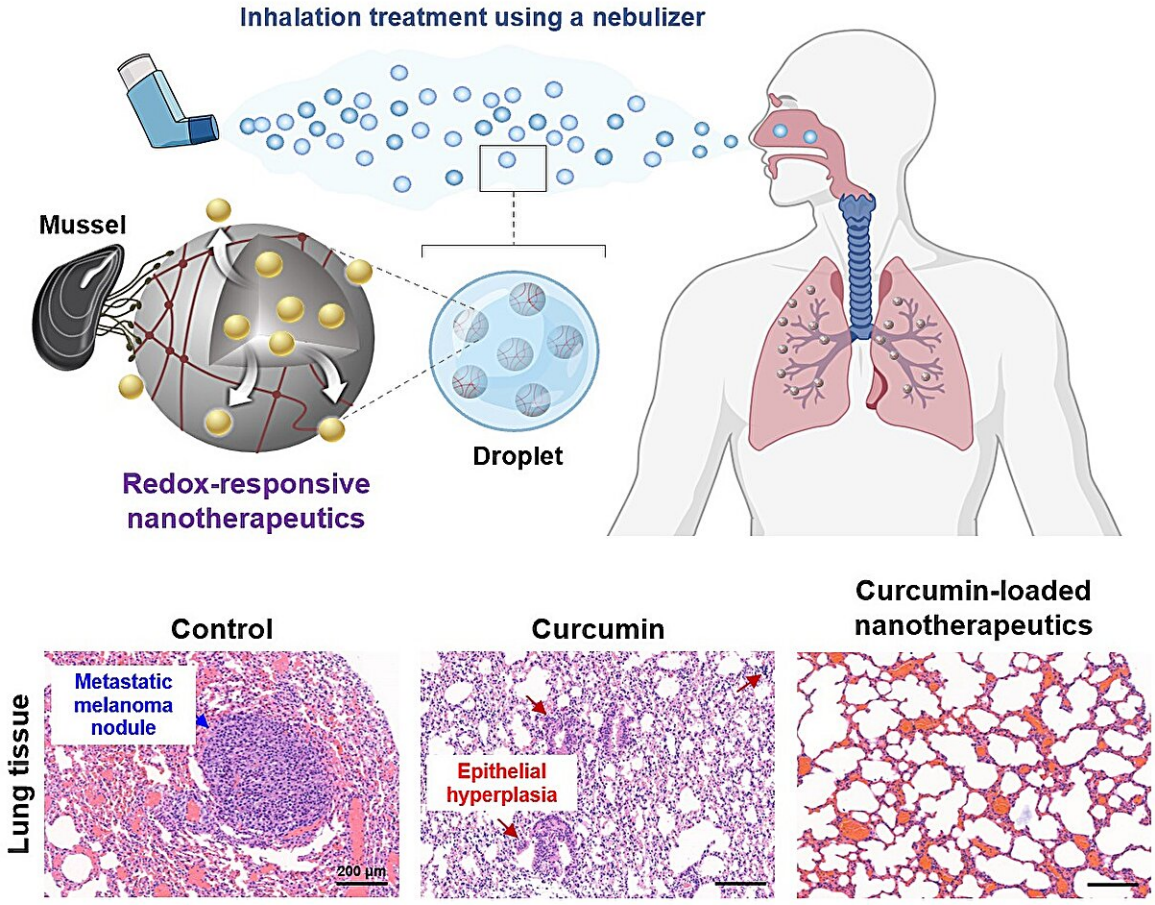
Inhalable therapy uses mussel-inspired nanoparticles to target lung cancer cells

January 9 2025



Schematic Diagram of Inhalable Mucoadhesive Nano-anticancer Drug Based on Mussel Adhesive Proteins (Top) and Treatment Results in Lung Cancer Animal Model (Bottom). Credit: POSTECH

Researchers from POSTECH and Kyungpook National University have developed a novel inhalable therapeutic delivery system for lung cancer, leveraging mucoadhesive protein nanoparticles inspired by the adhesive properties of marine mussels.

Lung cancer remains one of the deadliest cancers globally. Non-small cell lung cancer (NSCLC), which accounts for 85% of all lung cancer cases, is particularly challenging to treat due to difficulties in early detection. Current anticancer treatments are predominantly administered intravenously, impacting both malignant and healthy tissues, often leading to severe adverse effects.

As a result, inhalable therapeutics have emerged as a promising alternative, enabling localized drug delivery directly to the lungs. However, the efficacy of this approach has been significantly hindered by the lung's mucosal barriers and immune cells. Building on this context, collaborative research has culminated in the development of a mucoadhesive protein nanoparticle designed for lung cancer treatment.

The study is published in the journal *Biomaterials*.

The approach leverages the remarkable adhesive properties of marine mussel proteins, renowned for their underwater adhesion. Drawing inspiration from the oxidation-reduction mechanisms of foot protein type 6 (fp-6), the researchers engineered foot protein type 1 (fp-1) by integrating cysteine, creating a biomaterial with enhanced adhesive strength and precise drug delivery capabilities within the lung cancer microenvironment.

These nanoparticles exhibit exceptional therapeutic efficacy by enabling selective payload release while effectively inhibiting release in healthy tissues to minimize adverse effects.

Moreover, the intrinsic biocompatibility, biodegradability, and immunocompatibility of marine mussel proteins ensure superior biological safety and substantially prolong the retention of anticancer drugs, thereby amplifying their therapeutic impact.

In animal models of lung cancer, the nanoparticles developed by the research team and contained anti-cancer drugs showed effectiveness in inhibiting cancer cell metastasis and invasion after being delivered to the lungs through a nebulizer and adhering to the mucosa for extended periods.

This advancement holds the potential to enhance patient access to lung cancer treatment, as the simplified inhalation-based drug administration could be self-managed at home. Furthermore, this approach may significantly improve patients' quality of life by reducing the need for hospital visits.

Professor Hyung Joon Cha stated, "The findings from our study have the potential to substantially enhance both the precision and efficacy of lung cancer treatments, while significantly improving patients' quality of life."

This effort was spearheaded by Professor Cha (Department of Chemical Engineering and Graduate School of Convergence Science and Technology with a specialization in Medical Science) and Dr. Yeonsu Jeong (Department of Chemical Engineering) at POSTECH, in collaboration with Professor Yun Kee Jo (Department of Biomedical Convergence Science and Technology, Advanced Institute of Science and Technology) at Kyungpook National University.

More information: Yeonsu Jeong et al, Redox-activatable inhalable mucoadhesive proteinic nanotherapeutics for targeted treatment of lung cancer, *Biomaterials* (2024). DOI: 10.1016/j.biomaterials.2024.123004

Provided by Pohang University of Science and Technology