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The Nano-complex: Revolutionizing Cancer Radiotherapy for Enhanced Tumor Elimination and Long-term Immune Surveillance

This invention is an innovative breakthrough in cancer radiotherapy, offering a cutting-edge solution to address the challenges of radio-resistant and immunosuppressive tumors. This technology involves a gold cluster-based nanocomplex serving as both the radiosensitizer and a gene vector carrying siRNA, specifically targeting the tumor marker protein Galectin-1.

Cancer treatments often face the daunting obstacle of radio-resistance and immunosuppression, hindering the effectiveness of conventional therapies. Additionally, distant metastasis remains a critical concern, impacting long-term patient survival rates. This technology is designed to autonomously accumulate within tumor and metastatic niches, delivering its siRNA payload to knock down the radio-resistant Galectin-1 protein. Simultaneously, the gold atoms within the nano-complex generate cell-killing reactive oxygen species upon radiation treatment, promoting efficient tumor elimination. To further boost the systemic immune response, the gold nano-complex facilitates enhanced stereotactic body radiotherapy, leading to increased immunogenic cell death. Additionally, the clearance of immunosuppressive Galectin-1 supports long-term immune surveillance, preventing distant metastasis and improving overall survival rates. In tumor mouse models, the gold nano-complex showcased superior outcomes compared to radiation therapy alone or in combination with antibodies or inhibitors against Galectin-1, or cisplatin. Its multifaceted effects lead to prolonged survival rates and efficient prevention of metastasis, promising a new era in cancer treatment.

In addition to Galectin-1, the siRNA cargo could be switched to downregulate various tumor-supportive protein targets.

Benefiting from the specific chemical design, the nanocomplex could be gradually cleared out from living bodies through urine and feces, thus circumventing the chronic toxicity problem confronted by plasmonic gold nanoparticles which are not possible for in vivo excretion.

This nanocomplex has a portion of free amine groups on the surface, providing conjugation sites for further on-demand modifications.

Stage of Development
Research - *In vivo*

Applications

- Commercial radiosensitizers
- Gene therapy drugs
- Clinical radiotherapy
- Cancer treatment

Advantages

- **Better bioavailability** in primary and distant tumors
- **Excellent pharmacokinetics** elicits long blood circulation time
- **Superior efficacy** against head and neck cancer compared to cisplatin
- **Better *in vivo* clearance** than plasmonic gold nanoparticles
- **Good gene delivery vector** for delivery of siRNA and in vivo gene knockdown

Patents

- Published Application: WO2026085291

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