Cancer therapy breakthrough: X-rays expose and exterminate brain tumor cells with precision

A revolutionary **study** from **Nanyang Technological University in Singapore** (NTU Singapore) developed a novel way to selectively target and destroy **brain tumor** cells using extremely low-dose X-rays. Radiodynamic therapy, a novel treatment, stopped tumor development and doubled survival time in animal studies without damaging healthy cells.

Combining therapies to improve results

Traditional radiation and photodynamic treatment both have substantial limitations. Radiotherapy can destroy healthy cells near the tumor, resulting in nausea and hair loss. In contrast, photodynamic treatment struggles to penetrate deep-seated cancers. To address these issues, the new strategy combines the qualities of both medicines.

Radiodynamic therapy employs a unique substance known as a "molecular radio afterglow dynamic probe" (MRAP). Unlike typical heavy metal-containing substances, MRAPs are composed of biochemicals and iodine, reducing the possibility of cell harm. These probes are inserted directly into the tumor and activated by low-

dose X-rays, which are substantially less intense than those used in traditional radiotherapy.

Targeting tumor cells specifically

The activation mechanism is the key to the effectiveness of MRAPs. They are only activated in the presence of the cathepsin B (CatB) enzyme, which is overexpressed in **cancer cells**. When activated, MRAPs produce brilliant, near-infrared afterglow and cancer-destroying free radicals, leaving healthy cells unharmed.

"We used very low dosages of X-rays and cancer-killing MRAPs," said Professor Pu Kanyi of NTU Singapore's School of Chemistry, Chemical Engineering, and Biotechnology. "The anti-cancer compounds were active only in the brain tumor and not in healthy cells. So, we expect our treatment method to be safer and have fewer side effects than existing ones."

Positive results from preclinical trials

The medication was tried on mice models of glioblastoma, a rapidly developing brain tumor with dismal survival rates in humans. The findings were promising: tumors injected with MRAPs and exposed to low-dose X-rays stopped growing, and treated mice lived twice as long as untreated mice. Importantly, there were no adverse effects or tissue damage, and the MRAPs were naturally eliminated.

Future directions

The success of MRAPs in preclinical trials sets the door for future study. The team intends to continue testing the safety and efficacy of MRAPs in bigger preclinical models before moving on to human trials. Furthermore, they intend to improve the MRAPs' targeting capabilities and integrate immune-boosting characteristics to prevent **cancer recurrence**.

This groundbreaking research represents a huge advancement in cancer treatment, promising more effective and less hazardous medicines.

Source study: *Nature Materials*—**Molecular radio afterglow probes for cancer radio dynamic theranostics**