TECNOLOGIA SETUBAL

ESCOLA SUPERIOR POLITÉCNICO SETÚBAL

Nanotechnologies for the Prevention of Brain Cancer

CRISPR Technique

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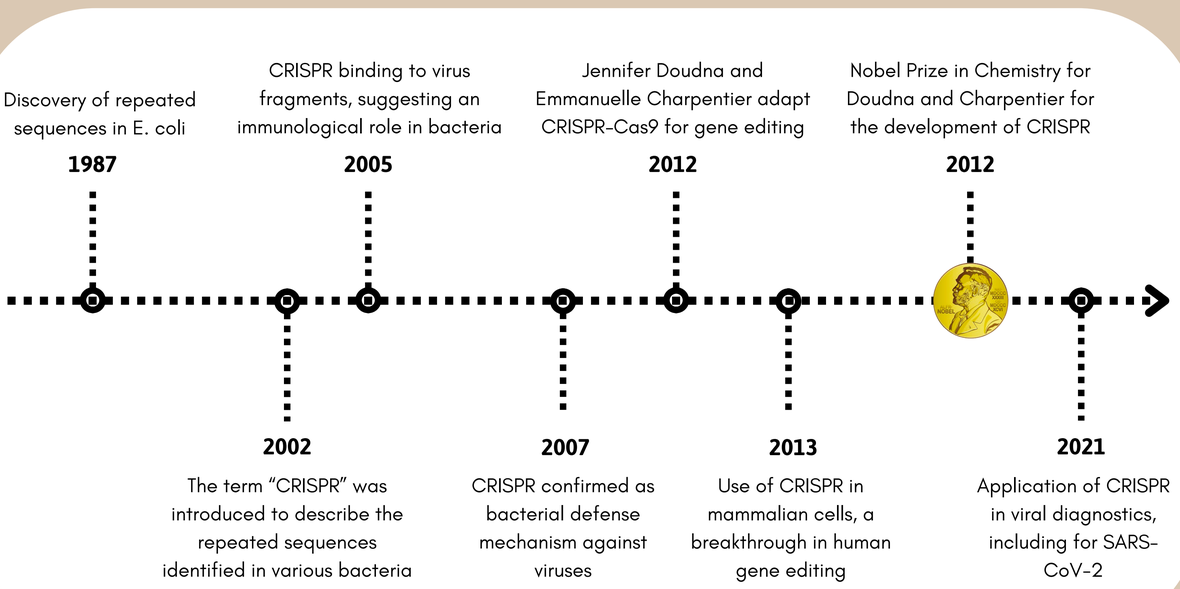
2020 *Nobel Prime of Chemistry*

SCAN ME!

Introduction

Nanotechnology is revolutionizing the approach to brain cancer, enabling earlier diagnosis and more precise treatment. With nanoparticles capable of crossing the blood-brain barrier, it is possible to target drugs directly to cancer cells, increasing efficacy and reducing adverse effects [1].



Brain cancer is described as a condition in which there is an abnormal growth of cells in the brain, giving rise to tumors. These can be benign (non-cancerous) or malignant (cancerous) and can disrupt abnormal brain functions due to their growth and pressure on surrounding tissues [1].

Statistical data

Based on statistics from the" National Brain Tumor Society" [1]

78.000 Diagnosed with malignant brain tumors in the US each year

16.616 Brain cancer deaths

Classification of brain tumors [1]

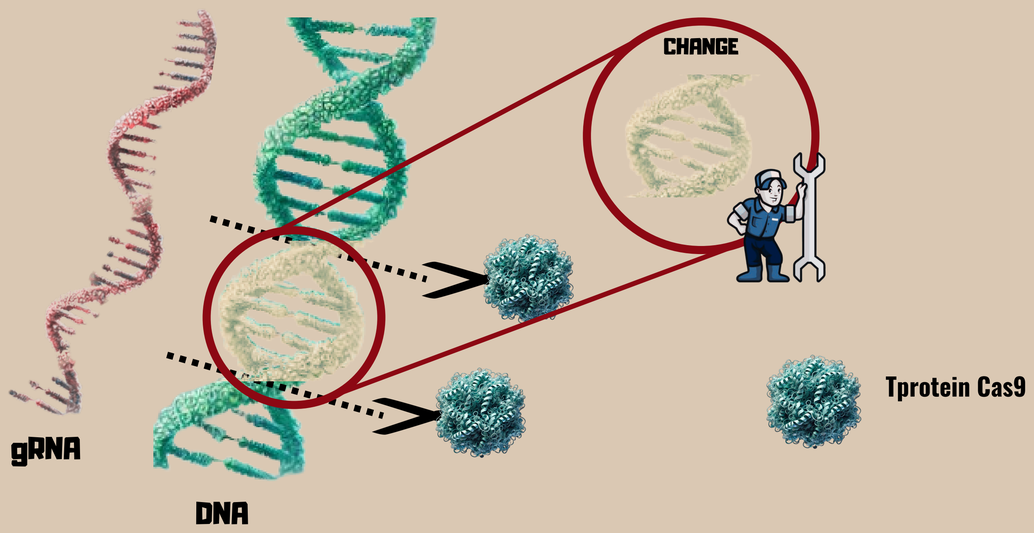
Low Grade
- *Grade I*
- *Grade II*

High Grade
- *Grade III*
- *Grade IV*

World Health Organization

Technique

The CRISPR/Cas9 technique is a genetic editing tool that allows DNA to be modified in a precise and targeted manner [4].



Solution

Personalized Treatments [5]

Regenerative Medicine [5]

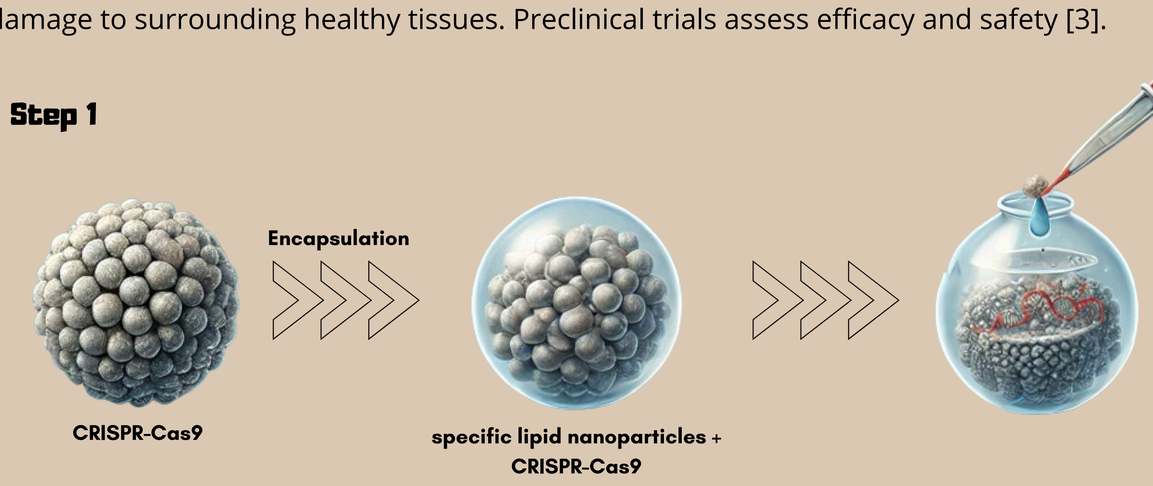
Genetic Disease Correction [5]

Cancer Therapies [5]

Experience

The CRISPR method for treating brain cancer identifies target genes in the tumor and uses guide RNA (gRNA) to direct the Cas9 enzyme, enabling DNA editing to inactivate oncogenes or correct mutations. Delivery to the brain is achieved through nanoparticles or viral vectors. It can also modify immune cells to attack the tumor, enhancing the body's natural defense mechanisms. Additionally, CRISPR allows for precise and targeted treatment, minimizing damage to surrounding healthy tissues. Preclinical trials assess efficacy and safety [3].

Step 1



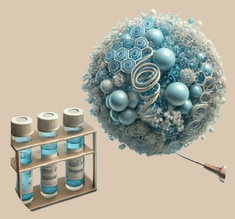
CRISPR-Cas9

specific lipid nanoparticles + CRISPR-Cas9

Step 2

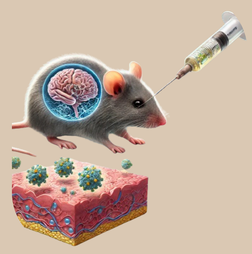
Selection and identification of target genes, inactive using the CRISPR-Cas9 system [3].

Step 3



They designed specific guide RNAs (sgRNAs) for the target gene [3].

Step 4



Implants of glioblastoma cells were made and then administered nanoparticles with CRISPR-Cas9 [3].

Step 5

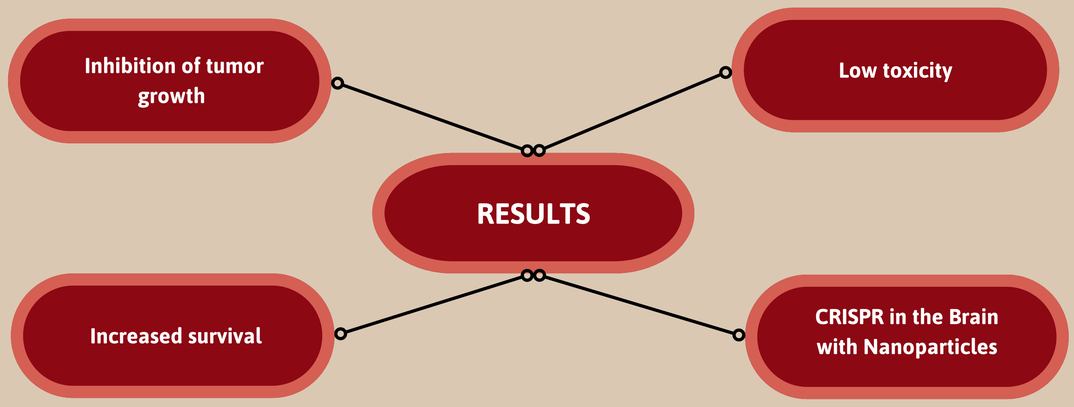
CRISPR-Cas9 was successfully delivered to the tumor cells, editing the target gene [3].

Step 6

They measured the volume of the brain tumor over time using imaging techniques such as magnetic resonance imaging.
The survival of the mice was monitored to check the impact of the therapy [3].

Results

The delivery of CRISPR-Cas9 by lipid nanoparticles significantly reduced tumor growth and increased survival in mice, demonstrating efficacy and safety in the treatment of glioblastoma (an aggressive type of brain cancer that originates in glial cells) [3].



Conclusion and future prospects

CRISPR technology promises to revolutionize cancer treatment with personalized therapies, T-cell modification and advances in immunotherapy. Studies focus on safety and efficacy, addressing challenges such as off-target mutations, aiming for more precise and safer treatments [2].

REFERENCES

[1] Mukhtar, M., Bilal, M., Rahdar, A., Barani, M., Arshad, R., Behl, T., Brisc, C., Banica, F., & Bungau, S. (2020). Nanomaterials for diagnosis and treatment of brain cancer: Recent updates. In Chemosensors (Vol. 8, Issue 4, pp. 1-31). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/chemosensors8040117

[2] Stefanoudakis, D., Kathuria-Prakash, N., Sun, A. W., Abel, M., Drolen, C. E., Ashbaugh, C., Zhang, S., Hui, G., Tabatabaei, Y. A., Zektser, Y., Lopez, L. P., Pantuck, A., & Drakaki, A. (2023). The Potential Revolution of Cancer Treatment with CRISPR Technology. In Cancers (Vol. 15, Issue 6). MDPI. https://doi.org/10.3390/cancers15061813

[3] Mao, X.-Y., Dai, J.-X., Zhou, H.-H., Liu, Z.-Q., & Jin, W.-L. (n.d.). Brain tumor modeling using the CRISPR/Cas9 system: state of the art and view to the future (Vol. 7, Issue 22). www.impactjournals.com/oncotarget

[4] Bruns, A.-F., Rippaus, N., Droop, A., Al-Jabri, M., Care, M., Jenkinson, M., Brodbelt, A., Chakrabarty, A., Ismail, A., Short, S., Stead, L. F., Diksin, M., Rowlinson, J., Kondrashov, A., Denning, C., Hughes, J., Constantin-Teodo, T., Cui, W., Gell, C., … Stead, L. (n.d.). CHARACTERISATION OF THE INVASIVE TUMOUR NICHE USING ASTROCYTE-GLIOBLASTOMA ORGANOIDS AND DECELLULARISED HUMAN BRAIN CRISPR/CAS9 GENE EDITING OF BRAIN CANCER STEM CELLS USING LIPID-BASED NANO-DELIVERY CHOLESTEROL PROTECTS GLIOBLASTOMA CELLS AGAINST PREMATURE MITOSIS USING NANOBIOPSY OF SINGLE BRAIN TUMOUR CELLS TO INVESTIGATE TRANSCRIPTIONAL REPROGRAMMING DURING STANDARD TREATMENT.

[5]Mendes, L. M. C., Lino, L. A., Bordignon, T. M., Castro, M. M. de, Bartholomeu, L. M. D. de O., Almeida, R. Z. S. de, Carneiro, I. M. V., Silva, I. M. da, Martins, I. D. R., Honorato, M. P. P., Antero, A. C. de A., Colares, G. L. G. S., & Pereira, B. R. (2024). Edição de genes CRISPR-Cas9 e suas aplicações terapêuticas: Uma revisão de literatura. Research, Society and Development, 13(8), e11513846681. https://doi.org/10.33448/rsd-v13i8.46681