Nanotechnology Innovations & New Cancer Treatments

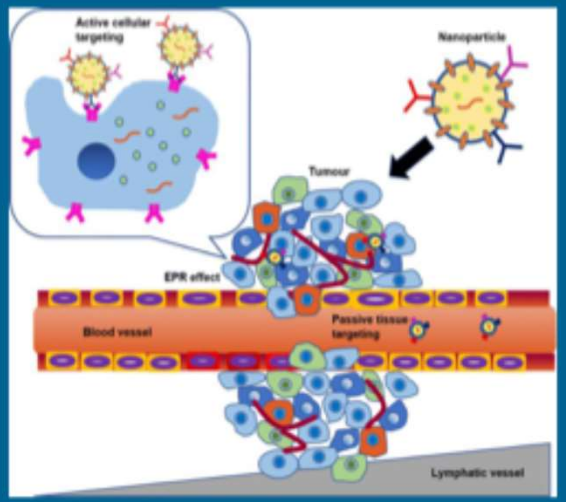
Jannette Cruz Vallellanes, CSPT, CPhT | Moffitt Cancer Center

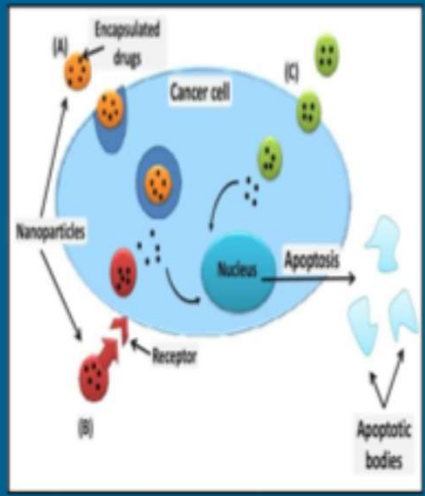
Background

- Since 1882, when the first radical mastectomy was performed by William Halsted, oncologists, and researchers have been looking for innovations in cancer treatment.
- For centuries, diagnostic tools, resources, and chemotherapy have been constantly evolving to better treat cancer diseases.
- Nanotechnology emerges as a new approach to improve the drawbacks of conventional treatment and avoid drug resistance and toxicity.
- Nanotechnology, as defined by the National Nanotechnology Initiative, is the understanding and control of matter at dimensions of roughly 1–100 nm, where unique phenomena enable novel applications (Jain, 2017, p.1)
- The use of different materials as drug carriers increases target treatment and accurate early detection.

Methods

- Nanoparticles emerged as a new option to develop safer and more effective treatment and diagnostic tools.
- There are several materials for the design of nanoparticles that can deliver a certain drug to a target area or tumor site.
- To modify this particle, factors like size, shape, surface qualities, targeting, composition, and drug payload need to be evaluated to determine an optimal option to approach the specific objectives and site to be treated.
- External factors such as response to endogenous and exogenous stimuli by the cell that can affect the drug and nanoparticle integrity are part of the methodology design.





Objective

- Conventional chemotherapy has several drawbacks that can be improved with the use of nanocarriers.
- Failure with traditional methods included drug resistance, toxicity, and poor target delivery.
- Nanotechnology objectives look to achieve increased therapeutic index, tumor tissue concentration, extended blood circulation, cellular uptake.

References
National Nanotechnology Initiative. https://www.nano.gov/. Accessed September 20, 2024.
University of Rochester. https://www.mchester.edu/umaou/. Accessed September 20, 2024.
Wang B, et al. Current advance of nanotechnology in diagnosis and treatment for malignant tumors. *Sig Transduct Target Ther* 9, 200 (2024). https://doi.org/10.1038/s41392-024-01889-y.
National Cancer Institute. https://www.cancer.gov/nano/cancer-nanotechnology/treatment. Accessed September 20, 2024.
BioRender. https://www.biorender.com/template/nanotherapeutics-in-cancer. Accessed September 20, 2024.

Discussion

- The use of nanotechnology in cancer treatment and diagnostics open a wide new door of options, improvements but also challenges.
- It is necessary to develop additional research and studies to understand in a better and wider way the different nanomaterials biological behavior and pattern distribution, evaluate nanotoxicity to avoid the healthy surrounding tissue to be affected.
- National investment to create conjunctions between government and institutions for the creation of different initiatives to impulse the market to grow.
- A feasible economic around nanotechnology will help improve areas in research , investigation, clinical trials, FDA regulations ,and government policies for a safer manage using nanomaterials.

Conclusion

- Future cancer treatment will be improved with the addition of new technology such as nanotechnology and bioengineering in areas of diagnostics, drug therapy, and imaging.
- We will be able to introduce new therapeutics options such as multi drug loading, vaccines, artificial intelligence use and nano formulated imaging dyes.
- This will reduce death rates, increase early cancer detection and new alternatives for drug delivery in therapeutic options.