# Magnetic Iron Oxide Nanoparticles Induce Endothelium Permeability via Magneto-Mechanical Application for Breast Cancer Therapy

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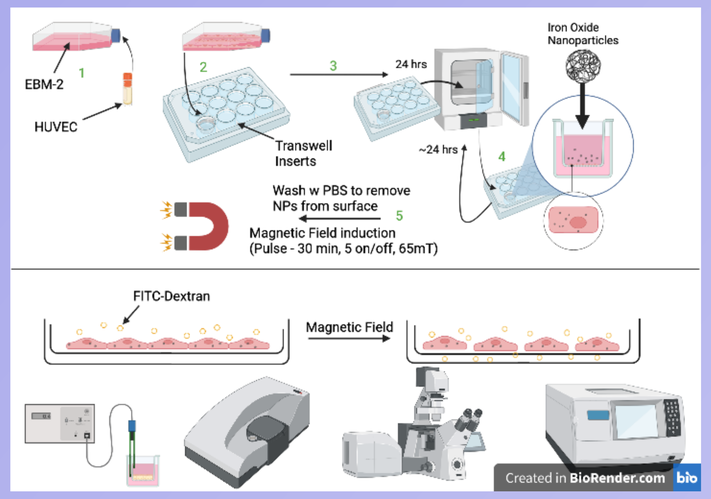
## ABSTRACT




## INTRODUCTION

Terminal breast cancer treatment is known to involve invasive or aggressive approaches such as chemotherapy — which can result in unbearable side effects (pain, nausea/vomiting, hair loss), radiation — which can be harmful to healthy cells/tissue, and surgery — which can lead to total loss of whole, non-specific breast tissue. Specific tissue/tumor targeting and removal has been difficult to conduct, potentially leading to nerve damage or lymph node loss thus causing paresthesia or edema/lymphatic drainage issues respectively. The goal of this study is to introduce a non-invasive treatment to breast cancer utilizing magnetic poly-ethylene glycol (PEG) iron oxide nanoparticles. For this to be accomplished, an endothelial cell barrier must be established and then disrupted with the intention of passing nanoparticle drugs between cells. Human Umbilical Vein Endothelial Cells (HUVEC) are a subcategory of endothelial cells, which are targets for nanoparticle drug delivery. These cells line blood vessels which creates a barrier preventing the passage of various particles by size and charge. With the internalization of super-paramagnetic PEG iron oxide nanoparticles (SPIONs) as well as application of magneto-mechanical properties, disruption of VE-cadherin junctions allows for permeability or leakiness of endothelial cell monolayer thus offering a potential avenue to specific breast tumor therapy.

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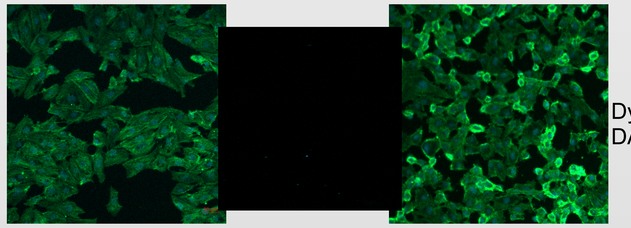
## RESULTS & DISCUSSION

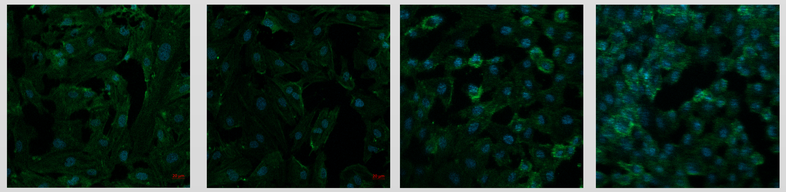
10x Magnification of Transwell Membrane



HUVECs w/ NPs | Clear membrane | HUVECs w/out NPs

Dyes: ActinGreen & DAPI

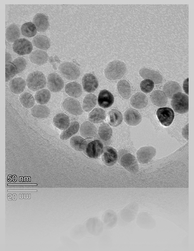
20x Magnification of Transwell Membrane



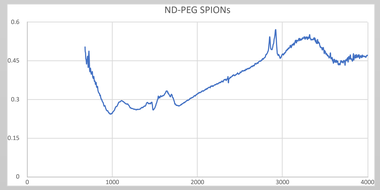
Edge view with NPs | Center view with NPs | Center view without NPs | Edge view without NPs

Characterization of SPIONs

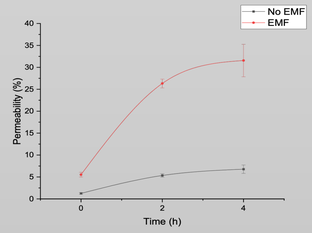
Bio-TEM
Visualization of NPs



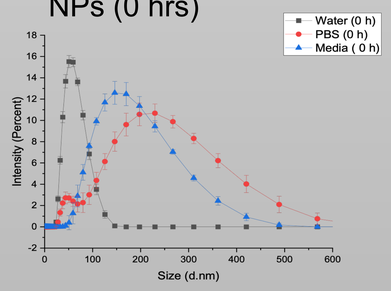
SEM-EDS
Characterization of NPs



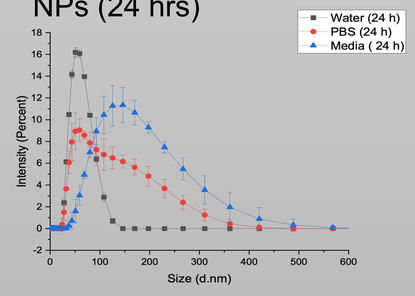

NP Permeability Assay




DLS characterization of NPs (0 hrs)




DLS characterization of NPs (24 hrs)

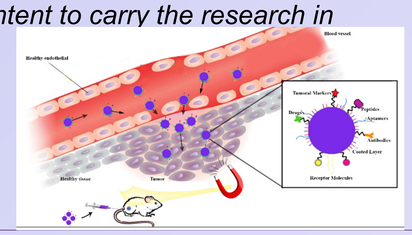



## CONCLUSIONS

- Based on confocal findings, we believe that there is a strong relationship with remodeling of HUVEC actin filament via a Type 2 mechanism.
- As an ongoing project, the observation of VE-cadherin junction disruption will continued to be sought out as an avenue to introduce a therapy to terminal cancer diagnoses.

## FUTURE WORK

*This is an ongoing project. The permeability protocol has already been established and attempted but yet to show ideal results. When data confirms our hypothesis, we intent to carry the research in vivo.*
*The following schematic shows our goal.*

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*Estelrich, J.; Escribano, E.; Queralt, J.; Busquets, M. Iron Oxide Nanoparticles for Magnetically-Guided and Magnetically-Responsive Drug Delivery. Int. J. Mol. Sci. 2015, 16, 8070–8101. [CrossRef] [PubMed]*

## ACKNOWLEDGEMENTS

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