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Introduction

Pancreatic cancer is one of the deadliest diseases in the world. It is a rare condition that produces 200,000 cases a year in the United States with a 10% five-year relative survival rate when all SEER stages are combined. The main treatments for pancreatic cancer are chemotherapy, surgery, and radiation therapy. These current treatments have many adverse effects that decrease the quality of life for the patient. The proposed project uses a new technique called Targeted Osmotic Lysis (TOL). This approach kills cancer cells without affecting non-cancerous cells, thereby reducing adverse effects. We assessed the efficacy of TOL on a murine model of pancreatic cancer.

Background

TOL targets cancer cells that are known to overexpress voltage-gated sodium channels (VGSCs) relative to non-cancerous cells. By stimulating VGSCs while concurrently blocking Na⁺K⁺ATPase (sodium pumps) pharmacologically, TOL selectively targets cancer cells. The cells are stimulated using a custom-engineered coaxial ring device and the sodium pumps are inhibited with digoxin. This allows Na⁺ to enter the cell, leading to the subsequent influx of water. Because digoxin treatment prevents sodium pumps from removing Na⁺ from the cell, water influx continues unabated, causing an osmotic lysis of the cancer cells.

Coaxial Ring is a custom-engineered device that provides a stimulation using a pulse electric field (PEF).

Digoxin inhibits ion transport through Na⁺K⁺ATPase. It is an FDA-approved drug that at one time was widely used to treat heart failure and atrial fibrillation.

Murine Model of Pancreatic Cancer uses an immunodeficient mouse model, NU/J, that were subcutaneously injected with human pancreatic cancer cells, Panc-1. The NU/J nude mice lack a normal immune system and thymus gland. The nude mice are used for many different types of tumor and tissue studies.

Panc-1 cells are a ductal pancreatic carcinoma isolated from a human male.

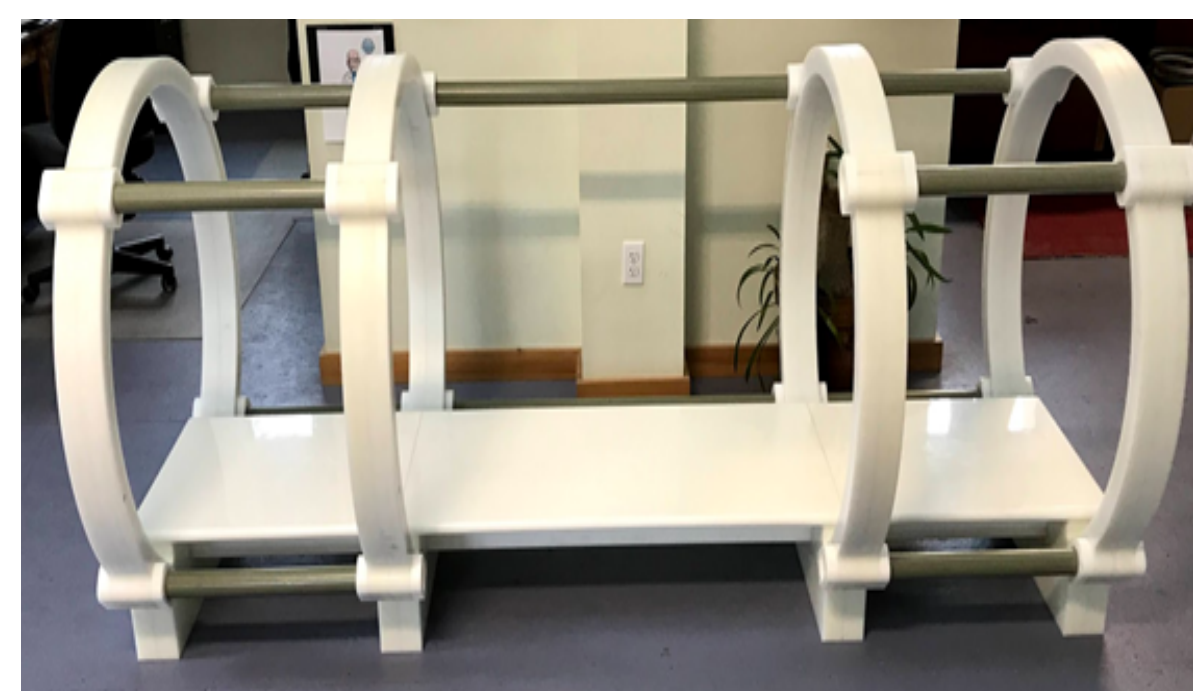
Methods and Materials

Methods for this experiment included:

- Culturing the cells
- Harvesting the Panc-1 cell line.
- Injecting the cells into the mice
- Waiting until tumors appeared on the mice
- Injecting the drug and vehicle into the mice in those groups
- Treating the stim group with the PEF
- Weight the mice
- Measure the mice tumor
- Sacrificing the mice
- Exposing all organs and tumor to fixative
- Send to Pathology

Materials for this experiment included:

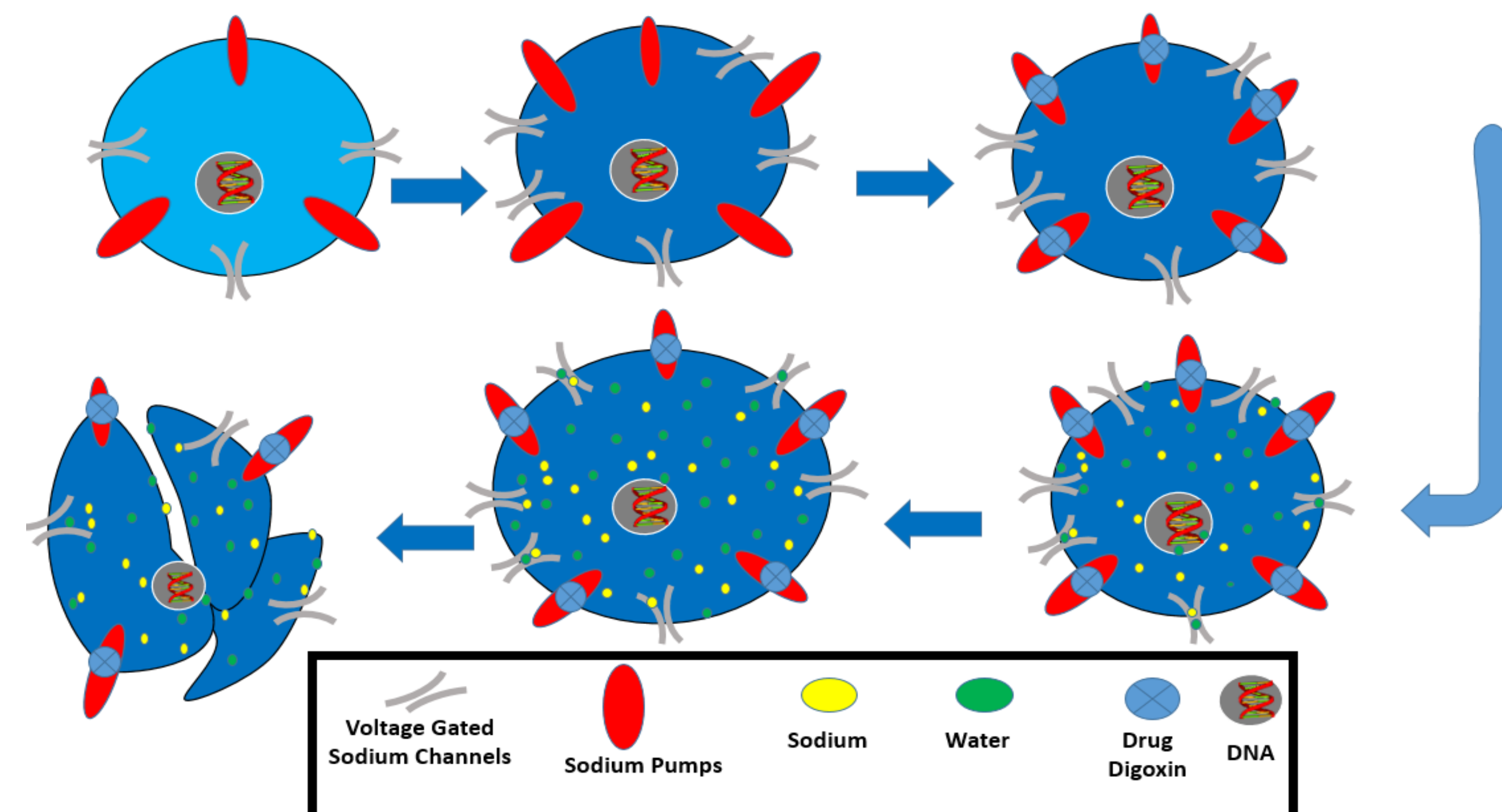
- T25 Flask
- T75 Flask
- Nude Mice
- Panc -1 Cells
- Coaxial Ring Device
- Needles
- Weight Scale in grams
- Caliper



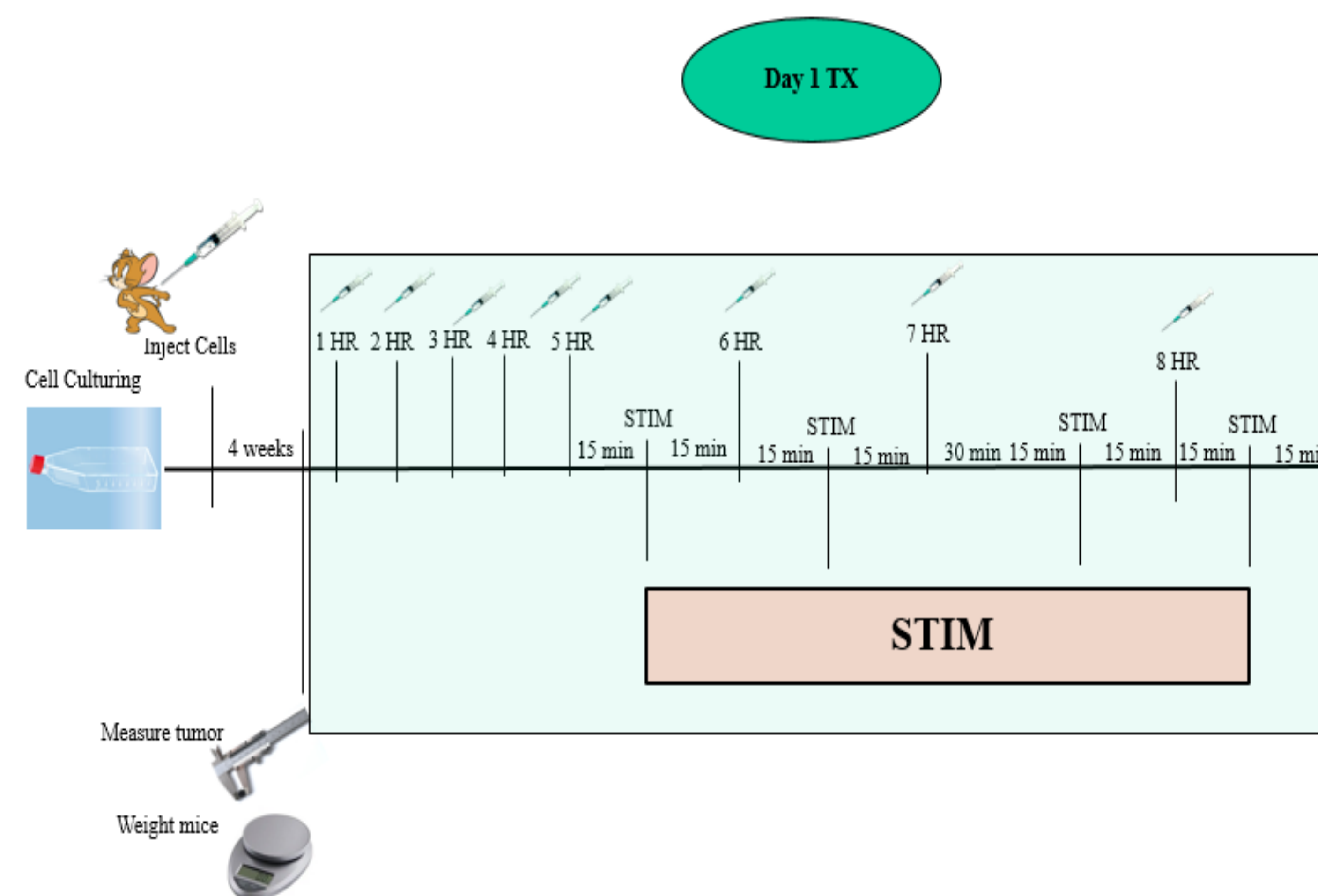
Coaxial Ring Device



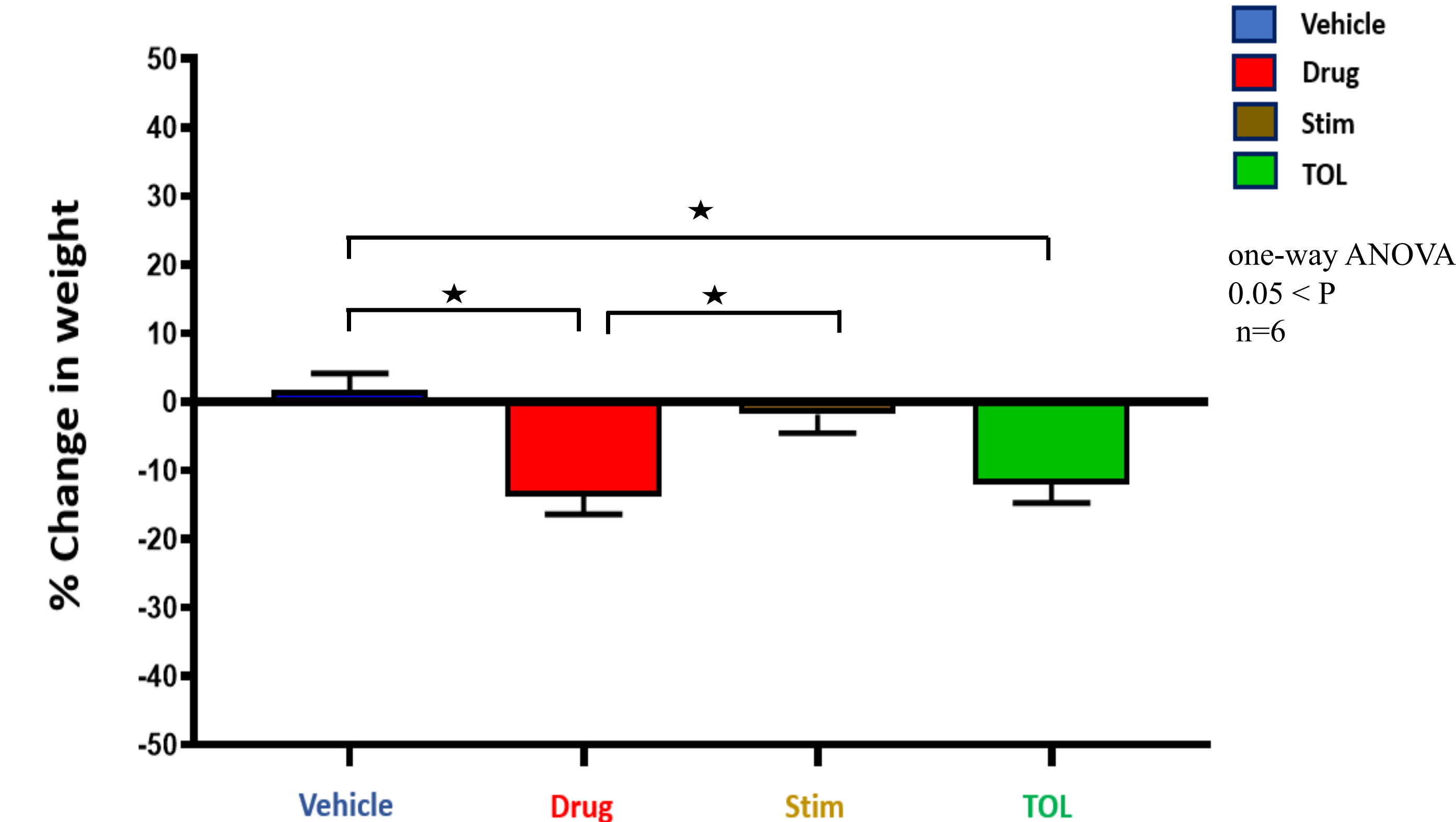
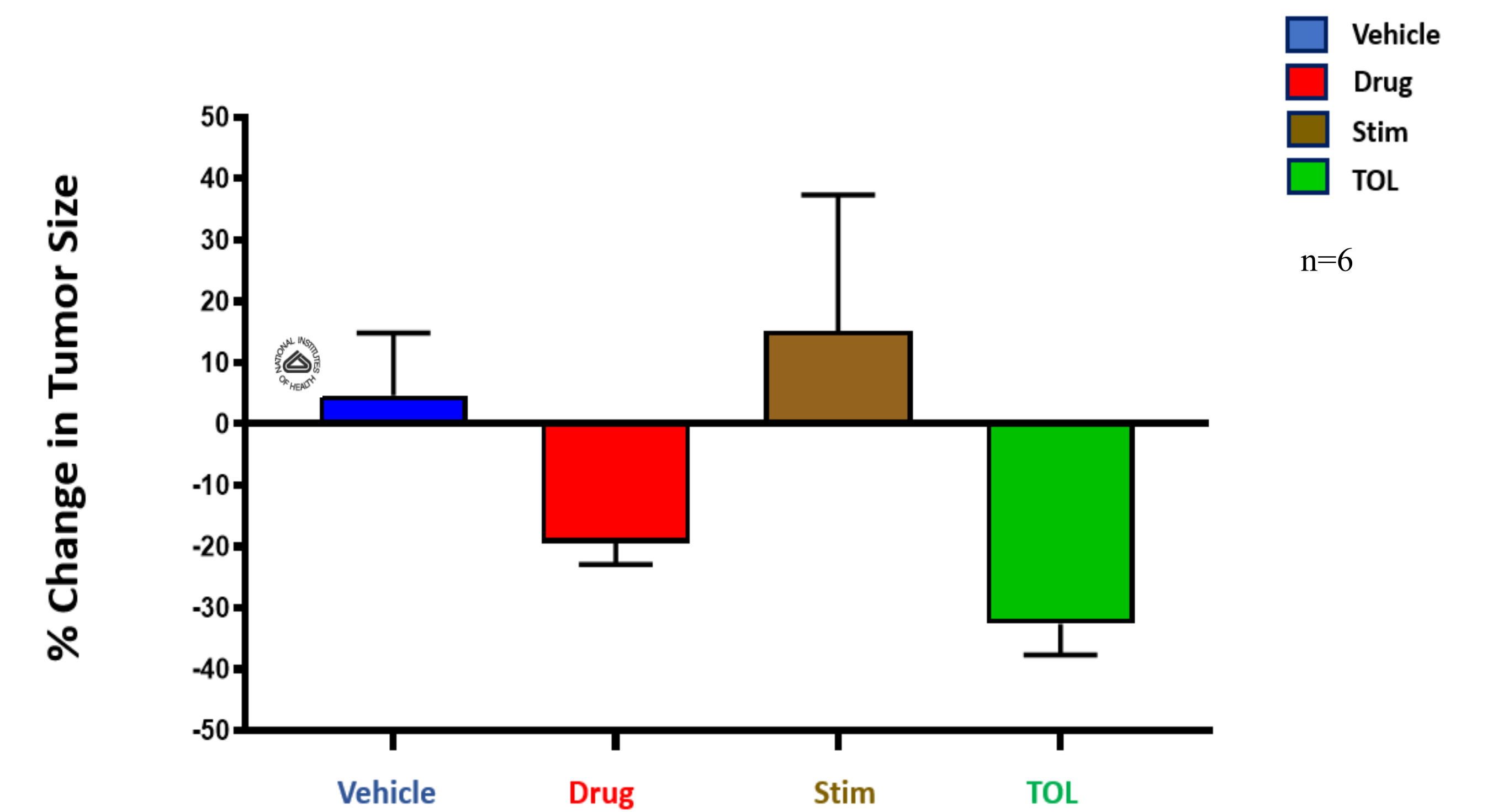
TOL



Experimental Design



Results



Conclusion

- There was no significant difference in tumor size when treatment groups were compared; however, the TOL treated group showed a trend in decreased tumor size when compared to the other treatment groups.
- There was a significant difference when the groups were compared for weight. Drug-only treatment group lost significantly more weight compared to vehicle and stim-only treatment groups, and TOL treated group lost significantly more weight compared to vehicle.