

Microfluidic droplet generator for lymph node microphysiological models

Progress Report 6

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Client: Dr. Cristina Sanchez de Diego

Advisor: Prof. Monica Ohnsorg

Team:

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Project Website: [Link](#)

Problem Statement: Prostate cancer (PCa) commonly metastasizes through the lymphatic system. Understanding how cancer cells spread through lymph nodes is therefore critical to developing therapies that can prevent or limit metastasis. However, current lymph node models primarily represent tissue in two dimensions and cannot fully replicate its complex three-dimensional structure and cellular interactions. This project aims to fabricate a microfluidic droplet device capable of producing B- and T-cell-containing collagen microspheres, which will serve as building blocks for a realistic 3D lymph node model to more accurately study cancer metastasis.

Brief status update: The team went to the lab at WIMR this week and mixed collagen and fluorinated oil on a device. The flow rate was adjusted to generate consistent collagen microspheres. The team is now waiting for the microspheres to incubate and then will see the results. The team also created another PDMS microfluidic device, bringing the total number of devices on-hand for testing up to 5 devices.

Current design: SolidWorks Mask Design

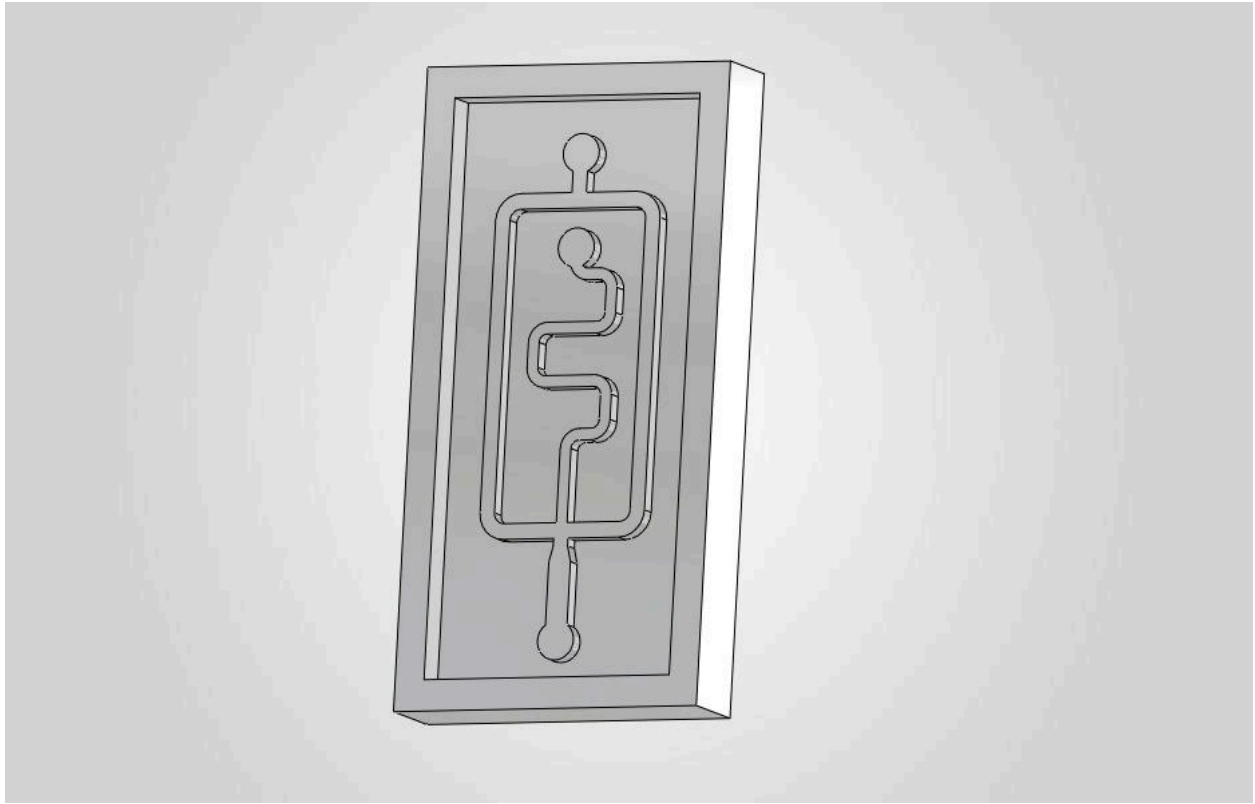


Figure 1: Current Microfluidic CAD design for 0.5uL Droplets

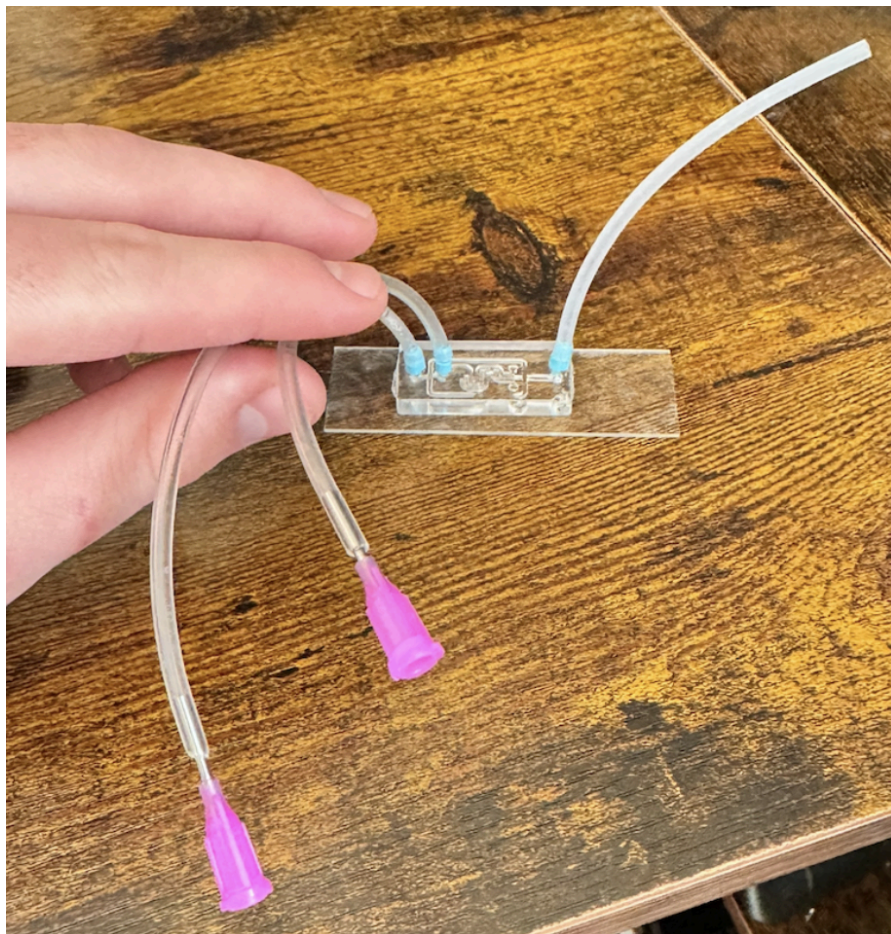
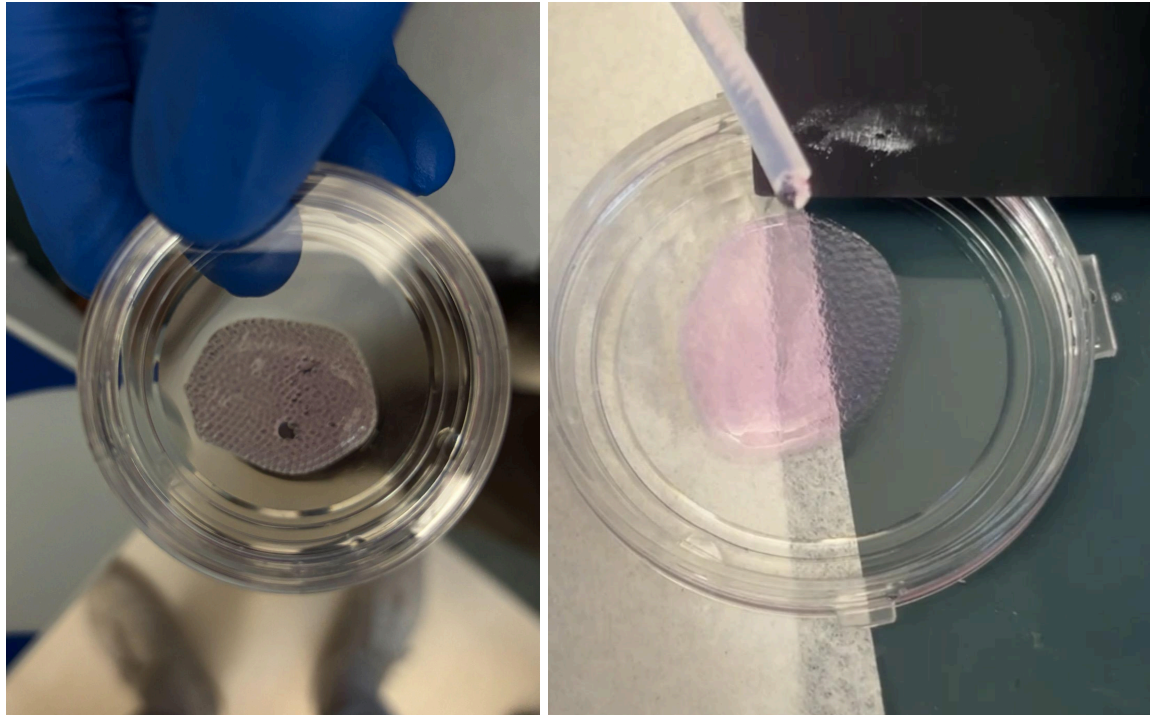


Figure 2: Assembled Microfluidic Device



Figures 3A (left) and 3B (right): Close-up Images of The Collagen Microspheres

Previous Week's Accomplishments

- Sam Kamin (4 hours)
 - Researched more ISO 10993-5 for in vitro cytotoxicity testing and how we will ultimately apply this to our materials and system
 - Researched NTC Thermistors and other temperature sensing possibilities for generating data for the team to analyze in the final report and poster presentation
 - Created three temperature sensing circuit design ideas in LTspice that include an NTC thermistor and evaluated them mathematically
 - Uploaded necessary project files to the team Lab Archives notebook and updated the design matrices
- Murphy Diggins (3 hours)
 - Fabricated multiple microfluidic devices and demonstrated how to fabricate them
 - Researched syringe cooling mechanisms
 - Researched collagen concentration on microsphere formation
- Will McGuire (5 hours)
 - Cad designed a new microdroplet device using solid works
 - Learned how to make PDMS casts in the lab and successfully created two casts
 - Worked with Eduardo to run oil and collagen through the chip successfully creating collagen droplets!
 - Researched b and t cell resilience at 4C with very promising findings

- Researched microfluidic emulsion systems and then implemented the principles into CAD design
- Dylan Libel (2 hours)
 - Researched testing methods for collagen quantification
 - Looked into viscosity traits and methods for collagen type I
 - Continued alternative brainstorming and system set up
- Eduardo Usandivaras (4 hours)
 - Went to WIMR with Will and successfully prototyped microspheres by mixing collagen and oil together.
 - Incubated collagen spheres in 37°C
 - Researched new ways to keep the channels cool and came up with a concept in which the coolant could be on its own device.
 - Researched potential for using thermistors to gain more accurate data on the temperature of the fluids.
- Vir Jaiswal (1.5 hours)
 - Researched how to sterilize collagen as well as the microfluidic chip
 - Continued research on the polymerization of the collagen

Team Goals

- Complete fabrication of cooling methods and begin implementation into the design.
- Order necessary materials needed for running the prototype
- Begin collagen testing on the device and measure collagen bead sizes.
- Continue editing product design specifications based on comments from Dr. Ohnsorg.

Individual Goals

- Sam Kamin
 - Go in to WIMR to learn about PDMS chip fabrication
 - Go in to WIMR to learn about the collagen solution fabrication process
 - Test the current designs with collagen and make iterative design improvements
 - Continue researching and prototyping
- Murphy Diggins
 - Edit CAD file for simpler fabrication
 - Look into obtaining water-glycerol solutions
 - Assemble thermistor circuits for temperature readings
- Will McGuire
 - Spend time learning how to plasma treat the PDMS casts I fabricated to glass
 - Learn how to use the printer to fabricate the multiple throughput chip design mold
 - Begin iterating on cooling system designs

- Dylan Libel
 - On Friday I plan on going into WIMR for a bit and continuing to test flow rates
 - May also start testing on the collagen mixture
 - Continue research on testing methods, assumptions, and ideal qualities
- Eduardo Usandivaras
 - Start making CAD designs for a cooling system for the syringes.
 - Use fluorescent beads in the collagen mixture and observe them under a microscope to see if the spheres can actually hold cells
 - Continue to iterate and improve on designs for our device
- Vir Jaiswal
 - Help teammates at the WIMR with the collagen testing and its fibrillation
 - Help making droplets
 - See if the sterility will be feasible and applicable for our project

Project Timeline

[illegible]

[illegible]

[illegible]