Use of Porous Elastomer Foams to Support Long Term Three Dimensional Neuronal Cultures

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Introduction

Certain neurodegenerative diseases, including Multiple Sclerosis, are caused by a loss or decrease in interaction between neural cells like neurons, oligodendrocytes, and astrocytes. These cells interact in three dimensional (3D) space. In order to study these interactions it is necessary to culture these cells in 3D spatial arrangements. This can be done using an elastomer that is porous in structure.

Objective

- Create a porous elastomer for spatial 3D growth of neuroblastoma cells
- Create a 3D culture which includes multiple types of neural cell types
- Induce neurodegeneration of 3D cultures
- Stimulate re-myelination of neurons through the use of different additives

Methods

- Human neuroblastoma cells (SH-SY5Y) were cultured and seeded on the porous elastomer
- Samples were grown for over 60 days
- The neuroblastoma cells were stained using DAPI and Nueroflavin staining fluorescent stains
- Cells were imaged using confocal microscopy

Porous Elastomer Synthesis

- Elastomer begins as a Nickel foam manufactured by American Elements
- Ni foam is then dipped in a mixture of poly-ethylene oxide (PEO), poly-caprolactone (PCL), and poly-(D,L-lactide) (PDL) at room temperature
- Heated at 140°C for 24 hours to create cross links
- Nickel is removed using FeCl3 leaving behind a hollow porous elastomer
- Porous elastomer is synthesized from caprolactam with chloride side chains
- Elastomer follows below structure: [P(CL-LD)]- – PEO₉₉₉₉ – [P(CL-LD)].

Results and Discussion

- Neurite extension at set time points 2, 4, 6, 8, and 10 weeks with and without RA treatment
- AVG Extension Length (in μm) without RA: 11.425 ± 4.98, 14.68 ± 4.23, 13.88 ± 2.22, 16.34 ± 9.03
- AVG Extension Length (in μm) with RA: 38.98 ± 13.29, 51.20 ± 12.34, 49.72 ± 15.24, 32.96 ± 10.13

Conclusion

- Porous elastomer can be synthesized and used to support neuroblastoma cell growth over 60 days
- Cells show signs of maturing and extend neurites on elastomer

Future

- Cell cultures using primary cells containing multiple cell types will be performed
- Stimulating neurodegenerative effects and promoting re-myelination will be performed on the cell cultures containing multiple cell types

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References