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Bio Sim

Reflection 3

Current Progress:

* Incorporated the full pathway into the simulation

Strategies Used:

* Simplified where possible to reduce the number of agents
  + Body cells are generalized due to the multi-systemic nature of lupus
  + No macrophage (D-cell acts as APC and Phagocyte)
  + Body cells don’t die from any other method than apoptosis
  + Rate of apoptosis is sped up
  + Type 1 IFN is a grouping of a,b,g IFN
  + Type 1 IFN is not shown as it is often coupled and is simplified through contact
  + No memory cells
  + CB4 and CB8 cells are the same for this simulation

Weekend Plans:

* Add locality searching through links
* Make links invisible
* Include auto-reacting antibodies
* Find better way to present relevant information

Updated Abstract:

**Simulation in Biology Project Abstract**

**Group:** Cellular Biology

**Project name:** Systemic Lupus Erythematosus (SLE) & Anifrolumab

**Student name:** Daniel McDonough

**Project description:**

The immune system relies on several cells signaling to one another and passing information, but when distorted, this signaling can result in unintuitive processes. Systemic Lupus Erythematosus (SLE), which tricks antibodies and T-cells into attacking healthy cells. From an unknown cause, healthy cells go under some form of cell death (apoptosis/necrosis) and nucleic antigens become present in the system. When cleaned up through phagocytosis, dendritic cells (D-cells) recognize the DNA as a foreign invader and go through the normal immune pathway. This involves D-cell to T-cell interactions leading to T-cell to B-cell interactions which in tern produce antibodies that alter D-cells and alter T-cells to become autoreactive cell that attacks the hosts’ own healthy cells.

This simulation will look at what would happen across several positions in the SLE pathway and hope to add preventative measures to parts of the pathway in hope to model a potential solutions. The preventative measure, Anifrolumab, attaches to type 1 interferon receptors blocking the passage of antigen presentation signals between T-cells and B-cells preventing them from going autoreactive. Due to the coupled nature of transferring the antigen and cytokines, blocking the cytokines would prevent the transport of antigens, thereby preventing the autoreactive response.

**Agents and rules:**

*World:*

1. 10 ticks ~= 1 day (in the loosest sense possible)

*Healthy Cells:*

1) Agents in simulation representing healthy tissue

2) Is destroyed when attacked by Autoreactive cells

3) Have a chance of becoming Apoptotic

4) If apoptotic, has a chance of releasing a number of Nucleic Antigens

5) Signals “Eat me” to Phagocyte (D –cells) while being apoptotic

*Nuclear Antigens:*

1. Nucleic bits that signal “danger” to APC based on a chance of external factors
2. Can be discovered by APC, B-cells and antibodies

*Dendritic Cell (d-cell):*

1. Can find Antigens and pass on the info to helper T-cells
2. Find and “eat” Apoptotic cells
3. Can “eat” antibody-antigen complex to mature
4. Once Mature it will no longer undergo phagocytosis

*B-cells:*

1. Agents that recognize nucleic antigens
2. Produces autoreactive antibodies in response of the detection of the antigens
3. Can recognize the same info from T-cells
4. Able to be “vaccinated” to prevent the transfer of auto-antigens

*T-cells:*

1. Transfers info between APC and B-cells
2. Able to be “vaccinated” to prevent the transfer of auto-antigens

*Antigen-Antibodies:*

1. Holds the DNA of the antibody that caused it to spawn
2. Attacks all other cells with the same DNA

*Anifrolumab:*

1. Attaches to T-cells & B-cells and prevents them from transferring info from the Dendritic Cells

Autoreactive Cell:

1. When in contact with healthy body cells it takes time destroying them.

**Model validation:**

1. The Autoreactive cells are able to destroy healthy cells
2. Cells replicate
3. Cells die over time

**Hypotheses / Predictions:**

1. By inhibiting one common point of lupus it is possible to slow down or completely stop the inflammation/damage of healthy cells

**Evaluation (graphs, statistics):**

1. Amount of autoreactive antibodies
2. Amount of Anifrolumab
3. Number of dead cells
4. Number of Mature Dendritic Cells

**User Interaction (sliders, buttons):**

1. Predisposition button that effects the rate of apoptosis
2. T-cell vaccination button
3. Initial conditions sliders for D, T, B cells
4. Spawn rates for T, B, D, and body cells
5. Growth rate of cells in apoptosis
6. Number of antigens a dead cell will produce
7. Amount of time anti-production time

**References:**

* <https://en.wikipedia.org/wiki/Antigen-presenting_cell>
* <http://www.genome.jp/kegg-bin/show_pathway?org_name=hsa&mapno=05322&mapscale=&show_description=show>
* <https://en.wikipedia.org/wiki/Antigen-presenting_cell>
* <https://www.youtube.com/watch?v=23M35omW6H4>
* [https://www.astrazeneca.com/media-centre/press-releases/2015/AstraZeneca-presents-positive-new-data-on-anifrolumab-in-lupus-at-American-College-of-Rheumatology-Annual-Scientific-Meeting-10112015.html#](https://www.astrazeneca.com/media-centre/press-releases/2015/AstraZeneca-presents-positive-new-data-on-anifrolumab-in-lupus-at-American-College-of-Rheumatology-Annual-Scientific-Meeting-10112015.html)!

**SLE Pathway**:

