Glial Cells
Psychology 372
Physiological Psychology
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Overview
- Are very important
- Are not neurons
- Have no action potentials
  - But have threshold charges
- Are there to help neurons
  - Act as a support function
- Greater numbers
  - 2-50 times as many glial cells than neurons

Two Major Groups
- Microglia
- Macrogia

Microglia
- Are phagocytes
  - Eat up dead material and things
  - Will migrate to damaged areas
  - With Lesions get Gliosis
    - Concentrate and clean up material
    - Forms scar tissue
  - Serve as part of the immune system

Macrogia
- Types
  - Astrocytes
  - Oligodendrocytes
  - Ependymal
  - Schwann

Astrocytes
- Hallow stars
  - Appear transparent and look like stars
  - Make contact with both white and gray matter
  - Do not migrate much
- Fibrous Astrocytes
  - Find in Myelinated Tissue
    - (but don’t make myelin)
- Protoplasmic
  - Are star-shaped and have lots of cytoplasm
  - Make function with capillaries
    - Are phagocytic.
Possible Function

- Take up material, digest it, and push it through the capillary blood stream for removal.

Oligodendrocytes

- Are located in the CNS
- Is a many branching cell
- In CNS, will myelinate 30-40 axons

Prob.- Do not regenerate well

Schwann Cell

- Are found in the PNS
- Also make myelin
  - One cell makes one myelin sheath
- Regenerate faster than Oligodendrocytes.
  - Provide conduits for an axon to follow.
  - Hypothesized why you get better neural regeneration when damage occurs.

Schwann Cell

- In CNS
  - When oligodendrocytes are destroyed, axon distribution becomes confused
  - No conduits
  - Growth cones are random

Ependymal

- Forms the lining of ventricles
- Has cilia
  - Appears to aid in the movement of CSF through ventricles
- CSF is made very fast and is very dynamic.
  - Diffusion cannot explain the speed of CSF

Glial Functions

- Myelination - Salutatory Functions
- NT uptake
- Ion uptake
- Glue
- Nutritive
### Myelination
- Oligodendrocytes and Schwann cells
- Myelinates axons
- Has a salutatory function
- Allows electrical conductivity to jump from between Nodes of Ranvier.
- Get a field skipping effect
- Result - makes action potentials go faster

### NT Uptake and Degradation
- Removes NT after exocytotic release from presynaptic elements
- Will also provide compounds to degrade NT
  - Good evidence for uptake and storage
    - Glutamate and Aspartate
  - Weaker evidence for release

### Ion Uptake
#### Communication with Neurons
- Glial cells are only permeable to Potassium (K+)
- Not permeable to Na-, Ca++ etc.
- Membrane potential (Inside to Outside difference) = -80 - -90mv in a concentration of 3mM of K.
- Depends on ion concentrations and diffusion

### Concept
- Have a glial cell (Usually an Astrocyte) in a water bath of 3mM
- Concentration outside cell is 3mM
  - Glial Cell
    - Kco = 3mM

### Increase Kco to 30mM
- More K+ enters the glial cell by diffusion
- Result – Glial cell becomes more positive
  - Glial Cell
    - Kco = 30mM
Increase Kco to 30mM

Measuring Device
-60mv

Glia Cell
Kco = 30mM

Water Bath

Decrease Kco to 0.3mM

Measuring Device
-95mv

Glia Cell
Kco = 0.3mM

Water Bath

More K+ leaves the glial cell by diffusion
Result – Glial cell becomes more negative

Concept 1

Make the membrane more positive called Depolarization

Make the membrane more negative called Hyperpolarization

Concept 2

- By manipulating the concentration of Potassium in the interstitial fluid, you can drive the glial cell.
- Stimulate the Neurons around it.
- Neurons release Potassium
- More action potentials, more Potassium
- Get greater depolarization of glial cells
- As NaK pumps start, decrease K and glial diffuses from the glial and get hyperpolarization.

Conclusion

- Glial Membrane Potential depends on the concentration of K+ in the interstitial fluid
- Glial help to regulate the amount of K
- Helps to buffer the Neurons
- Prevents Seizures