Neurons and glia

Also diseases of the NS
Nerve cell terms

• soma, perikaryon
• nerve cells have typical organelles, nucleus, rough ER, Golgi apparatus, mitochondria
• axon hillock,
• dendrites
Terminal (terms)

- terminal bouton,
- Synapse
- vesicles (small, electron lucent)
- post-synaptic density
- Spines (with tubulin and actin)
Figure 42.2b
How Does Information Flow in a Neuron?

Information flow through neurons

Dendrites
Collect electrical signals

Cell body
Contains nucleus and organelles

Axon
Passes electrical signals on to dendrites of another cell or to an effector cell
Muscle fibers innervated by a single motor neuron
Axon transport

- Cytoskeleton microtubules 25 nm diameter
- Axon transport as fast as 400 mm/day
- Paul Weiss (American) 1940's
- Kinesin toward + end anterograde orthograde
- Radioactive proline in eye - use autoradiography for neuroanatomy
- Dynein toward - end, retrograde
- Herpes and rabies
- Slow (1 mm / day)
(A) Astrocyte

(B) Oligodendrocyte
- Cell body
- Glial processes

(C) Microglial cell
Myelin

- CNS oligodendrocyte
- PNS Schwann cell
(A) Myelinated axon

Node of Ranvier

Oligodendrocyte

Myelin sheath

(B) Action potential propagation

$t=1$

Axon

$Na^+$

Point A

$t=1.5$

$K^+$

$Na^+$

Point A

Point B

Point C

Point B

Point C

$Na^+$

$Na^+$

NEUROSCIENCE, Third Edition, Figure 3.13 (Part 1) © 2004 Sinauer Associates, Inc.
Myelin

- cytoplasm squeezed out
- membrane, high resistance, high capacitance
- Channels at nodes of Ranvier
- osmium tetroxide "stained" TEM
- nodes of Ranvier 1-2 micro meters (microns), Schwann cells 1 mm
- "Saltatory" (leaping) conduction
- oligodendrocyte myelinates several axons
- major dense line - cytoplasm squeezed out
Recent reading: J. K. Huang et al.

- OMgp (oligodendrocyte glycoprotein)
- decrease in axonal sprouting after injury
- not in myelin but in "oligodendrocyte-like cells wrapping around nodes of Ranvier.
- may be important in therapy
- relates to the long standing dogma that there is no regeneration in the mammalian CNS.
Polio (poliomyelitis) PNS

- Viral, damages PNS myelin causing paralysis
- then the nerve cell degenerates.
- Salk (1955, injected) then Sabin (sugar cube)
- Before, passive immunity - gamma globulin
- Serious cases required an iron lung.
- FDR had polio.
- Neuron's trophic effect on muscle is seen as muscle (not directly diseased) deteriorates.
- Garrett Oppenheim Golden Handicap
Halstead, post-polio syndrome

- recovery where motor neurons branch more
- (they already branch to innervate all of the muscle cells [fibers] of one motor unit)
- surviving neurons innervate muscle cells "abandoned" by lost nerve cells.
- But at middle age, there is increased fatigue, pain and weakness (post-polio syndrome).
- Cause: those sprouts are lost.
Multiple sclerosis (MS)

- Anette Funicello, Montell Williams, Richard Prior, "president" in West Wing
- Damages myelin in the central nervous system
- Might afflict motor function, vision, or others
- Hits people 20-40, with deterioration but sometimes episodic, i.e. with remissions
- Animal model - EAE (experimental allergic [autoimmune] encephalitis) to myelin basic protein.
More

• EAE - Such a disorder used to happen with rabies vaccination when virus was grown in brain (before it was grown in eggs).

• As you see from the box, there is lots of speculation as to the cause
Guillain-Barre syndrome

- peripheral myelin immune attack
- lose sensation and have weakness,
- sometimes severe, sometimes goes away,
- comes after illness,
- difficult to diagnose,
- controversy over whether it came after immunization for swine flu in Ford administration
Autism etc

• Suggested reading
• (desperate for a cure)
• Suggested Link
• About Andrew Wakefield MMR study
• (related to thimerosal controversy)
• Boston Legal Jerry Espinsson Asperger Tourette