MYELINATED NEURONS CONDUCT IMPULSES MORE RAPIDLY THAN UNMYELINATED NEURONS

Scientists have been able to learn more about the conduction of nerve impulses along axons because of an interesting fish, the puffer or fugu fish. (The puffer fish is considered a culinary delicacy in Japan.) The puffer fish produces a highly potent poison called tetrodotoxin which binds tightly to the voltage-gated Na^+ channels, thereby blocking impulse conduction. The lethal dose for a mouse is about 0.01 μg.

The densities of Na^+ channels in neuronal membranes have been determined by measuring the binding of highly radioactive tetrodotoxin. Unmyelinated nerve fibers, which lack a myelin sheath, have low densities of Na^+ channels (typically 20 per μm^2). In contrast, myelinated nerve fibers have a very high density of channels (10^4 per μm^2), in specialized regions called nodes of Ranvier. These nodes, spaced at intervals of 2 mm, are the only sites at which the axonal membrane of a myelinated nerve is exposed to the extracellular fluid. The axonal membrane between the nodes has a very low density of channels and does not participate in conduction. Rather, the action potential jumps from node to node, and so the impulse is transmitted more rapidly than in an unmyelinated fiber. Much of the membrane in the node area is occupied by Na^+ channels.