B FIBER

Authored by
mohammad looti

October 28, 2025

RECOMMENDED CITATION

mohammad looti (2025). *B FIBER*. PSYCHOLOGICAL SCALES. Retrieved from https://scales.arabpsychology.com/?p=64955

ARABPSYCHOLOGY.COM

B Fiber

Primary Disciplinary Field(s): Neuroscience, Physiology, Anatomy

1. Core Definition

The **B fiber** is a specific classification of nerve axon within the peripheral nervous system, categorized primarily by its diameter, degree of myelination, and corresponding conduction velocity. This classification system, originally developed by Erlanger and Gasser, groups nerve fibers into three main categories--A, B, and C--each possessing distinct structural and functional characteristics. B fibers occupy an intermediate position, being myelinated but with a relatively thin sheath compared to the faster A group fibers. They are functionally defined by their role as preganglionic efferents within the autonomic nervous system (ANS), transmitting signals that regulate involuntary visceral functions.

The core physiological function of the B fiber is to carry nerve impulses from the central nervous system (CNS)--specifically, the intermediate horn of the spinal cord or certain cranial nerve nuclei--to the autonomic ganglia located peripherally. Here, the B fiber axon terminal synapses with the postganglionic neuron, which is typically a C fiber, completing the two-neuron chain characteristic of the ANS pathway. This transmission mechanism is essential for the timely and coordinated control of internal organ systems, including cardiac output, smooth muscle activity, and glandular secretion. The moderate speed of B fibers ensures that these critical regulatory signals are delivered efficiently, striking a balance between the speed needed for quick response (A fibers) and the resource efficiency afforded by small-diameter axons (C fibers).

Structurally, B fibers possess a small diameter, cited in physiological literature as typically ranging from 1 to 3 micrometers (µm). While the source content suggests they are "approximately 2mm or less in diameter," this figure must be understood in the context of classification criteria emphasizing their small physical size relative to A fibers, and often interpreted as 2 micrometers (µm) in standard neurophysiology. This compact size allows the B fiber pathways to conserve space within the confined bundles of peripheral nerves while maintaining sufficient space for the thin myelin sheath. This thin myelination facilitates saltatory conduction, though less rapidly than in A fibers, resulting in characteristic conduction velocities ranging from 3 to 15 meters per second (m/s).

2. Classification and Structural Characteristics

The distinction of B fibers is rooted deeply in the Erlanger-Gasser classification scheme, which remains a fundamental organizing principle in neuroscience. This scheme rigorously correlates three physical parameters--axon diameter, degree of myelination, and subsequent conduction velocity--to define functional groups. B fibers are inherently defined by their thin myelin sheath,

ARABPSYCHOLOGY.COM

which is critical for their physiological performance. Myelination is not uniform across all nerve types; the B fiber myelin is derived from Schwann cells in the periphery, but the thickness and length of the internodes are less than those seen in the fast-conducting A-alpha and A-beta fibers, leading to a decreased efficiency in the 'jumping' action of the impulse across the Nodes of Ranvier.

The physical constraints of the B fiber's small diameter necessitate a specialized structure. Small axons typically have high internal resistance, which would drastically slow impulse transmission. However, the presence of even a thin myelin layer significantly lowers the capacitance of the axon membrane and increases the membrane resistance, thereby compensating for the small size and preventing the drastic speed loss seen in unmyelinated C fibers. The energy expenditure required to propagate an action potential in a B fiber is also optimized. Because the signal only needs to be regenerated at the nodes, the metabolic cost of transmission is lower than it would be for a continuous conduction process over an unmyelinated axon of similar size, making B fibers efficient transporters of sustained autonomic commands.

Furthermore, the B fiber classification is intrinsically tied to its excitability profile. Due to their specific size and myelination characteristics, B fibers exhibit a distinct threshold for activation and a unique susceptibility to external factors, such as pressure, hypoxia, and particularly, local anesthetic agents. The relatively narrow diameter means they are often more susceptible to chemical blockade than the large motor A fibers, but less susceptible than the completely unmyelinated C fibers, depending on the specific anesthetic and concentration used. This differential sensitivity is a key element in understanding pharmacological intervention in pain management and surgical procedures, as clinicians rely on the predictable order of nerve fiber blockade to achieve desired effects while minimizing unwanted side effects.

ARABPSYCHOLOGY.COM

3. Role in Autonomic Transmission

The functional significance of B fibers lies almost exclusively within their capacity as **preganglionic fibers** of the entire autonomic nervous system--serving both the sympathetic and parasympathetic divisions. In the sympathetic division, B fibers originate from the lateral gray horns of the spinal cord (T1 to L2 or L3) and project to the adjacent sympathetic chain ganglia or, in some cases, to collateral ganglia. These fibers are characteristically short, reflecting the close proximity of the sympathetic chain to the vertebral column. Upon reaching the ganglion, they release acetylcholine (ACh), which acts on nicotinic receptors to excite the postganglionic neuron, initiating the final, frequently systemic, response.

Conversely, in the parasympathetic nervous system, B fibers typically originate from the brainstem (via cranial nerves III, VII, IX, and X) or the sacral spinal cord (S2-S4). Unlike their sympathetic counterparts, parasympathetic preganglionic B fibers are often considerably longer, projecting all the way to terminal ganglia located near or embedded within the wall of the effector organ (e.g., the heart, lungs, digestive tract). Despite the difference in length and anatomical destination, the neurotransmitter used at the synapse within the ganglion remains acetylcholine acting on nicotinic receptors, preserving the chemical consistency of the preganglionic-postganglionic junction across the entire ANS.

The ability of B fibers to convey impulses at a moderate speed (3-15 m/s) is perfectly tailored to the requirements of the autonomic system. Autonomic responses, while involuntary, do not typically require the instantaneous signaling necessary for conscious reflexes or skeletal muscle control (mediated by A fibers, potentially reaching speeds over 100 m/s). Instead, autonomic function demands continuous, reliable, and smooth modulation of organ activity. The conduction velocity of the B fiber is fast enough to initiate systemic responses, such as a sympathetic response to stress, in a rapid, coordinated fashion, without necessitating the heavy metabolic investment required for the highest conduction speeds, demonstrating evolutionary efficiency in neural design.

4. Key Functional Characteristics

Intermediate Conduction Velocity: B fibers conduct impulses at speeds ranging from 3 m/s to 15 m/s. This intermediate rate is sufficient for efficient visceral control but significantly slower than the fastest A fibers (up to 120 m/s).
Thin Myelination: The presence of a myelin sheath allows for saltatory conduction, enhancing speed compared to C fibers, but the thinness of this sheath and the small diameter limit the maximum velocity achievable.
Preganglionic Function: B fibers are overwhelmingly associated with preganglionic communication in both the sympathetic and parasympathetic divisions of the ANS, connecting the CNS to peripheral ganglia.
Cholinergic Nature: They are fundamentally cholinergic fibers, utilizing **acetylcholine (ACh)** as the neurotransmitter released at the synapse within the autonomic ganglia, acting upon **nicotinic receptors** on the postganglionic neuron.
Differential Sensitivity to Anesthesia: Due to their specific ratio of surface area to volume and thin myelination, B fibers exhibit a high degree of sensitivity to many local anesthetic agents, often being blocked early in the sequence of nerve function loss.

5. Comparison with A and C Fibers

Understanding the B fiber requires a direct comparison with the two other principal groups defined by Erlanger and Gasser: the A fibers and the C fibers. **A fibers** represent the fastest group, characterized by the largest diameters (up to 20 µm) and the heaviest myelination. This group is functionally diverse, including A-alpha fibers (motor efferents and proprioception), A-beta fibers (touch, pressure), A-gamma fibers (muscle spindle control), and A-delta fibers (fast, sharp pain and temperature). Their speeds can exceed 100 m/s, making them essential for rapid motor execution and immediate sensory awareness. The B fiber's diameter and speed are significantly smaller, reflecting the lower speed requirement of involuntary visceral control versus immediate skeletal muscle action.

In contrast, **C fibers** are the smallest in diameter (typically 0.5 to 1.5 µm) and are completely unmyelinated. Lacking the insulating layer of myelin, C fibers rely on continuous conduction, which is slow, generally less than 2 m/s. Functionally, C fibers primarily mediate slow, dull pain, chronic temperature sensation, and crucially, serve as the postganglionic fibers in the ANS, receiving input from preganglionic B fibers. The structural difference--myelinated B fiber versus unmyelinated C fiber--is the key determinant that dictates their distinct roles as preganglionic (faster, preparatory signal) and postganglionic (slower, terminal signal) elements in the autonomic pathway.

The physiological hierarchy between the three groups highlights the specialization of neural tissue. The B fiber acts as the efficient bridge, utilizing minimal resources (small size, thin myelin) to maintain a speed necessary for coordinating systemic responses. The A group prioritizes speed above all else for survival and movement, demanding large axons and heavy myelination. The C group prioritizes resource conservation and ubiquity, sacrificing speed for the ability to occupy small spaces and perform sustained, low-speed regulation, such as localized pain signaling and hormonal release modulation. This spectrum of fiber types allows the nervous system to allocate resources precisely according to functional necessity.

6. Clinical Significance and Pharmacology

The unique physical characteristics of B fibers render them particularly important in clinical neurophysiology, especially in the fields of anesthesiology and the diagnosis of autonomic neuropathies. Local anesthetics, such as lidocaine and bupivacaine, work by blocking voltage-gated sodium channels, thereby preventing the propagation of the action potential. Studies have repeatedly shown that nerve fibers are blocked sequentially, often correlating with their size and myelination status. B fibers, being small and myelinated, often demonstrate a high sensitivity to these agents. They are frequently blocked earlier than the larger A-alpha motor fibers, meaning a patient may lose autonomic control (e.g., blood pressure regulation) before losing gross motor function, a phenomenon critical for monitoring during regional anesthesia.

Furthermore, conditions leading to autonomic neuropathy, such as diabetes mellitus or Guillain-Barré syndrome, often affect B fibers preferentially or early in the disease course. Damage to the B fibers impairs the vital communication between the CNS and peripheral viscera, leading to severe clinical manifestations. These can include orthostatic hypotension (due to impaired sympathetic signaling to blood vessels), gastrointestinal motility disturbances, or bladder dysfunction. Specialized testing, such as quantitative sudomotor axon reflex testing (QSART) or heart rate

ARABPSYCHOLOGY.COM

variability analysis, often indirectly assesses the integrity of the B fiber pathways by examining the resulting autonomic dysfunction.

The sensitivity of B fibers to damage or blockade also extends to non-chemical insults. Given their relatively small size, B fibers are susceptible to the effects of ischemia (lack of blood supply) and compression, though perhaps less so than the unmyelinated C fibers. Their role in critical life-sustaining functions--regulating heart rate, breathing, and vasomotor tone--means that any compromise to B fiber integrity can rapidly escalate into life-threatening autonomic instability, underscoring the necessity of these intermediate fibers in maintaining homeostasis across the body's internal environment.

7. Further Reading

Nerve Conduction Velocity (Wikipedia)
Autonomic Nervous System (Wikipedia)
Erlanger-Gasser Classification (Wikipedia)
Neuroscience (Purves et al.): Chapter on Peripheral Nervous System

ARABPSYCHOLOGY.COM