

Physiology Team

430

Musculoskeletal Block

5th lecture

Properties of nerve fibers

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* هذا العمل شامل لجميع نقاط المحاضرة مع بعض الإضافات
للتوضيح

****All or nothing principle:**

i.e The nerve respond to a threshold stimulus maximally or does not respond at all(there are no half solutions)
--Once threshold stim applied it gives AP produced & spread all over the nerve ,its intensity can not increased by increasing stimulus intensity (or by suprathreshold)
-subthreshold stimulus can not elicit action potential (but a local response (EPSP) can be produded it does not obey this law)

All or nothing principle

العصب لكي يعطي استجابة يجب أن يتلقى محفز لا يقل عن الحد الأقصى وأن قل فإن العصب لن يستجيب أما إذا كان المحفز أكبر من الحد الأقصى فأن استجابة العصب لن تزيد ويتبع هذا المبدأ ال action potential أما local response فلا يتبعه.

**** Direction of propagation of AP:-**

-In one direction from axon hillock to nerve terminal
-(experimentally)if nerve stimulated at its midportion , AP pass in both directions. Under Artificial condition of electrical stimulation in the laboratory

في الوضع الطبيعي يمر AP في اتجاه واحد فقط ، أما في التجارب يمر AP في اتجاهين .

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*** Na & K conductance (flow) during action potential:-**

1-At resting state , before AP:-

K conductance through K leak channels is 50-100 times as Na.

2-At onset of action potential:-

voltage gated Na channels activated & Na conductance is 5000 folds, at the same time voltage gated K channels begin to open slowly

-At depolarization Na conductance/ K conductance >1000 fold

3-At peak of AP Na channels close & voltage gated K channels open, K conductance increase

--At repolarization the ratio Na conductance/ K conductance decreases.

4-At end of AP, return to $-v_{\text{rest}}$ potential, close K channels & no K^+ conductance

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Excitability changes

the ability to respond to a second stimulus

**** Latent period (خامل) NO second respond**

1-absolute refractory (متمرد) period :-

-During depolarization & early repolarization

-during it the nerve can not be excited by a second stimulus & a second action potential can not be elicited whatever strength of the stimulus (even suprathreshold)

-(because all Na channels are already opened & Na influx occurred & a new stim can not open further

2-Relative refractory period:-

-It is $\frac{1}{2}$ to $\frac{1}{4}$ absolute refractory period, late third of repolarization

-it is the period during which a second action potential of low amplitude can be elicited (انتزاع) by stimulus stronger than normal suprathreshold)

because: _

1-some Na channels still inactive so need stronger stim to open

2-rapid flow of K to outside during repolarization

	Latent period	absolute refractory (period متمد)	Relative refractory period
The response to the second stimulus	NO	NO	yes
period	—	During depolarization & early repolarization	late third of repolarization
Second AP	—	NO حتى لو كان المحفز قوي (suprathreshold) (^_^)	Yes by a stronge stimulate (suprathreshold) &&&

(^_^) والسبب لان كل قنوات الصوديوم مفتوحة مسبقا. وذلك لوجد سببين

:

1-some Na channels still inactive so need stronger stim to open

لان بعض قنوات الصوديوم

فتحتاج محفز قوي inactive مازالت

2-rapid flow of K to outside during repolarization

ولسرعة خروج البوتاسيوم خلال ال depolarization.

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Types of Nerve Fibers :

**Classification According to Myelination:

1-myelinated: have myelin sheath
(diameter more than 1um)

-**type A** : (e.g.somatic (motor) nerves to skeletal muscles)

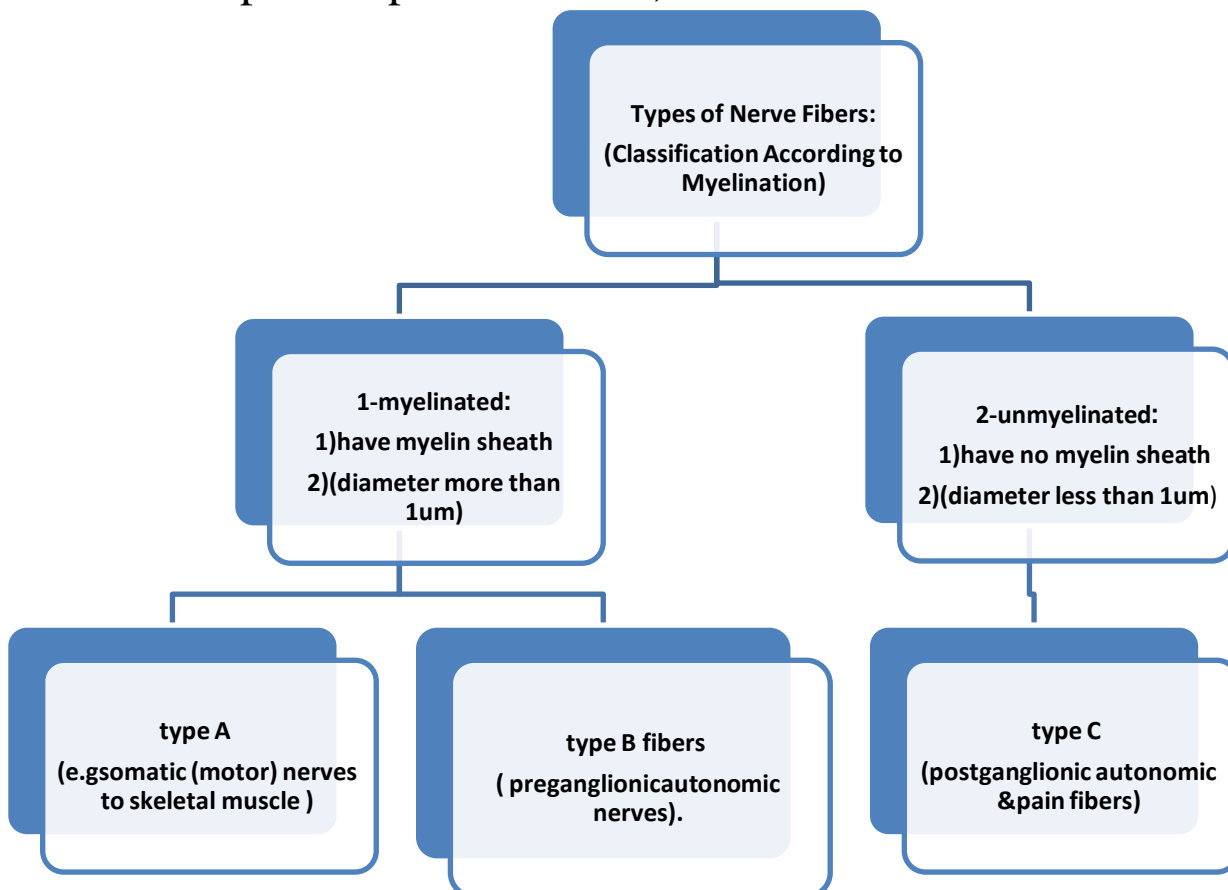
-**type B** : (as preganglionic autonomic nerves).

2-unmyelinated : have no myelin sheath
(diameter less than 1um)

-**type C**: (postganglionic autonomic & pain fibers)

A, B & C fibers

* Diameter : $A > B > C$ Because conduction velocity depends upon diameter , A are fastest and C are slowest



**** Classification According to Diameter:**

A FASTER > B > C SLOWEST

--**Myelin sheath** is formed by schwanncell which deposit lipid substance called sphingomyelin

--Interrupted at nodes of Ranvier (2-3 micron) at the junction between 2 cells.

Functions of myelin sheath

1-insulator(عازل)

2-decrease ion flow through the membrane

3-increase conduction velocity

4-protection

5-conserve energy during transmission of AP. نقطة مهمة جدا

Propagation of action potential (Transmission of depolarization process along a nerve =spread of nerve impulse

1-in myelinatednerve fibers:-

Saltatoryconduction (jumping)

-AP occurs at nods of Ranvier& directed from node to node, through axoplasminside & ECF outside by jumpingAPs can develop only at the Nodes of Ranvier Where (1) ions can relatively easily flow in & out (2) there are voltage-gated channels .

Value:-

1-↑ velocity of conduction

2-Conserve energy for axon because only nodes depolarize

3-Insulation by myelin sheath allow repolarizationto occur rapidly

2-Non-myelinated nerves:-

(local circuits) = Continuous Conduction = point to point

-depolarization pass by local circuits.

-depolarization in an area, + ve charge carried inward by Na ions flow for several 1-3 mm in the axon core & increases the voltage inside the nerve to threshold value to cause depolarization in a new area & Na channels open & depolarization spread to new areas.

1-myelinated nerve fibers	2-Non-myelinated nerves
Saltatory conduction (jumping)	(local circuits)=Continuous Conduction =point to point
Occurs at Nods of Ranvier.	All the chananls on the axon core
Direction From node to node through axoplasm inside and outside by jumping.** يعني يعمل القنوات الموجودة فقط في node Ranvier ال	Point to point يعني يعمل جميع القنوات (chanals) الموجودة على ال axon core ولن ينتقل إلى أي قناة قبل أن يمر بالقناة التي تسبقها
Conserve energy لأنه يشتغل فقط في منطقه وحده وهي nodes depolarize	Not conserve لأنه يمر على جميع القنوات الموجودة على axon core
Rapidly لأنه ما راح يفتح كل nodes فقط يفتح الذي يوجد في chanals	Slow نفس السبب السابق

**اكشن بوتنشيل يحدث فقط في nodes of ranvier

AP سواء في **myelinated** or the **NON myelinated** عندما يمر بالقناة سوف يعمل depolarization ومن ثم

repolarization وخلال ال repolarization ينتقل إلى قناة أخرى ويعمل depolarization ويستمر هكذا .

Recording of AP:- by cathode ray oscilloscope

1-Monophasic AP:- one microelectrode outside & one inserted into nerve fiber

2-Biphasic AP:- 2 microelectrodes placed on outside of nerve fibers(biphasic mean in one direction then in second direction