MEDICINE
KING SAUD UNIVERSITY

Physiology Team 436

CNS PHYSIOLOGY

Color index:
Only female slides
Only males slide
Both female and males slides
Number
Text

VALUES FILE

(وأنَّ ليس للإنسان إلا ما سعى)
صدق الله العظيم

Lecture #1 synapses and synaptic transmission

CNS neurons	100 billion
Human brain neurons	86 billion
Chemical synaptic cleft	20-30 nm
Electrical synaptic cleft	2-4 nm
Connexon channel diameter	~1.5 nm
CNS neurons receive up to	20,000 synaptic input
Types of neurotransmitter	>100
Diameter of synaptic vesicles	40 nm
Fast postsynaptic potentials	< 30 ms
Difference in the time scale between fast & slow postsynaptic potentials	10 vs 20 ms
Resting membrane potential	- 65 mv (male) - 70 to –90 mv (female)

Cont.

Functional differences between ionotropic & metabotropic receptors	Ionotropic: Duration of psps is 10-30 ms or less. (Psps develop within 1-2 ms after an AP)
	Metabotropic: Duration from 100 ms to minutes or longer.
Excitatory synapses	20 mv change, to -45 mv
Inhibitory synapses	5 mv change, to -70 mv
Postsynaptic potentials (psps) decline within	15 ms
Number of synapses that can causes psps (yet, not large enough to reach threshold)	4 or 8
Width of synaptic cleft	200-300 angstroms
Synaptic delay	0.5 ms

Lecture #2 Motor Area

Cells of origin of pyramidal tract	• 30% from: motor area 4. • 30% from: 1) premotor area (motor association area). 2) supplementary cortex. • 40% from: parietal cortex. • 3% from: large myelinated fibres.
Velocity of betz cells	70 m/sec
Lateral and ventral corticospinal tracts	• 80%: lateral corticospinal tract • 20%: ventral (anterior) corticospinal tract

Lecture #3 Physiology of the Autonomic Nervous System

Preganglionic neuron synapses with	8-9 postganglionic neurons.
Synapse in adrenal gland	Release adrenaline 80% & noradrenaline 20% in emergencies.
Key characteristics of ANS	- Heart rate can be doubled within 3-5 sec. - Blood pressure can be doubled or decreased low enough to cause fainting within 10-15 sec.

Lecture #4 Spinal Cord Functions and Reflexes

Spinal cord (SC)	45 cm long and 2 cm in diameter. Composed of about 100 million neurons. Each drg has 1000's of cell bodies.
Spinal nerves	31 pairs
Synaptic delay	- 0.5 ms /synapse - > 2 ms in the withdrawal r (polysynaptic reflex) (female)
Synapses in a reflex	• Number of synapses in a reflex = central delay /0.5 ms. • For knee jerk it equals 0.6 msc = one synapse.
Reaction time	For a stretch reflex such as the knee jerk is 19–24 ms.
Crossed extensor reflex	Begin after 200 to 500 milliseconds of initial pain stimulus.

Cont.

Anterior horn cells	Alpha: • 14 micrometers in diameter. • Form 70% of ventral root. • Supply extrafusal muscle fibers (2/3 of skeletal muscle fibers). Gamma: • 5 micrometers in diameter. • Form 30% of ventral root. • Supply intrafusal muscle fibers (muscle spindles 1/3 of skeletal muscle fibers).
Interneurons & interneuron pool	These cells are about 30 times as numerous as the anterior motor neurons.

Lecture #5 stretch reflex & tendon jerks

Muscle Spindles	Consists of 3-12 small intrafusal fibers within a CT capsule. 1-Nuclear bag fibres: 2-3 per spindel (male) 2 spindle (female) 2-Nuclear chain fibers: 3-9 per spindle (male) 4 or more per spindle (female)
Primary (annulospiral) endings (Ia fibres)	17 micrometers in diameter. conduction velocity of 70 to 120 m/sec.
Secondary (flower-spray) (Group II) sensory endings	8 micrometer in diameter.

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Stretch reflex stimulate	• 70% of alpha motor neurons. • 30% of gamma motor neurons.
Golgi tendon reflex	• Receptors are Golgi tendon organs (3-25) present in tendons. • About 10 to 15 muscle fibers are usually connected to each Golgi tendon organ.
IB nerve fibers	16 micrometer in diameter.
Primary (annulospiral) endings (Ia fibres)	• 17 micrometers in diameter. • conduction velocity of 70 to 120 m/sec.

Lecture #7 Physiology of Sleep

Average sleep hours	New born: 15 – 20 hours Children: 10 -15 hours Adults: 6-9 hours Old age: 5-6 hours
Sleep cycle	4-6 sleep cycles per night and 4-6 REM periods per night (and 4-6 REM periods per night).
Distribution of sleep stages	-SWS (NREM sleep) occupies 75-80%. -Rem sleep occupies 20-25 % of sleep time. After 60-100 minutes from sleep onset, the first rem sleep episode start. This cycle is repeated at intervals of 90 minutes throughout the 8 hours. (Rem sleep last 5 to 30 minutes on every 90 minutes).
REM sleep occupies	- 80% of total sleep time in premature infants. - 50% in full term neonates. - 25% from 20-69 years old (it falls further in old age).
Circadian rhythm	Consist typically of 8 hours sleep and 16 hours awake.

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EEG waves	The frequencies of brain waves: 0.5-500 hz (only in Female) • Alpha waves: 8-13 hz • Beta waves: >13 hz (in females) 13-30 hz (in male) • Theta waves: 3.5-7.5 hz • Delta waves: 3 hz or less (in Female) less than 4 hz (in Male)
Physiological changes during sleep	• Respiration: BMR is decreased 10-15% • Blood pressure: decreased by 10-30%
NREM sleep SWS	10-14 hz 50 uv waves.
Sleep disorders	70 million people in the US suffer from sleep problems [50% have chronic sleep disorder] - Insomnia: 30 million (affect approximately 25% of the population occasionally, and 9% regularly) - Sleep apnea: 18 million - Narcolepsy: 250,000 - Motor car accidents: 100,000 - Traffic fatalities: 1500 drowsy driving/annum Approximately $16 billion annually is the cost of health care in the US and result in $50 billion annually in lost productivity.

Lecture #8 Mechanism of Hearing

Hearing sensitivity	15-20 db
Middle ear	Drum to oval window ratio: 17:1 Lever action of ossicles: increase the force of movement 1.3 times Total: 17 x 1.3= 22 times
Functions of the middle ear	- Reflex muscle contraction to loud sounds over 70 db - Protection from constant loud noise, latency of 40-80 ms
Endolymph contains	K^{+}: 150 mm Na^{+}: 1 mm Ca^{+2}: 20-30 µm
Hair cells' resting potential	~60 mv
Hair cells within each cochlea	17500 (Outer hair: 14,000, inner hair 3500)

Cont.

Protruding from surface of each hair cell	up to 100 hairs (stereo cilia)
afferents type 1	95% (30,000)
afferents type 2 (c- fibers)	5%
Spiral ganglion neuron	~30000 neurons
Percent of hair lost by the age of 65	40%
Human ear can detect sound waves with frequency	20-20000 cycle /sec

Lecture #9 Eyes And Refraction

Refractive power of the eye	A total of 59 diopters.
Dioptric power	- The Cornea: 40-45 diopter (2/3 refractive power of eye) - Lens: 15-20 D (1/3 refractive power of eye)
Accommodation by lens	+12 D
Aqueous humor	causes intraocular pressure 10-20 mm Hg. (in glaucoma it exceeds 20 mm hg)
Internal index	- The internal index of air is 1 - cornea: 1.38 - aqueous humor: 1.33 - crystalline lens: 1.40 - vitreous humor: 1.34
Lens-retina distance	15 mm (In F) 17 mm (In M)
Emmetropic eye	59-60 D
Optic nerve fiber	1.2 million

Lecture #10 Accommodation & The Light Pathways And Effects Of Lesions

Normal acuity	6/6
Nearest point to focus an object by accommodation	• At 10 years: 9 cm • At 60 years: 80-100 cm
Dioptric power	• Cornea: 40-45 Diopters • Lens: 15-20 Dipoters • Accommodation: +12 D
Quantity of light changing during a light reflex	X30 folds

Near point and amplitude of accommodation

Amplitude of Accommodation	Near point (cm)	Age (yrs)
11.0	9.0	10
10.0	10.0	20
8.0	12.5	30
5.5	18	40
1.2	83	60
1.0	100	70

Lecture #11 Photo transduction in Light & the Dark

Visible light spectrum	Extends from 397 to 723 nm
Retina (photoreceptors)	• 100,000,000 rods • 5,000,000 cones
Convergence of rods and cons	120 million rode & 6 million cone converge on 1.2 million optic nerve fibers. (126 million receptor on 1.2 million nerve fiber) So convergence is 105 receptor : 1 fiber
High convergence of rods	300 rods synapse with one bipolar cell & one ganglion cell
Photoreceptor	• Depolarization: -40 mv • Hyperpolarization: -70 to -80 mv
Light sensitivity	The cones are about 30 to 300 times less sensitive than rods to light
Visible light spectrum	Extends from 397 to 723 nm
Retina (photoreceptors)	• 100,000,000 rods • 5,000,000 cones

Cont.

Dark adaptation	- First 5 min ↓ threshold of cones
	- 5 to 20 min ↑sensitivity of rods
	- Reaches max in 20 min
	- Sensitivity of rods to light increase, in 1 min increase 10 folds - Rode increase their sensitivity to light by convergence 300:1 ganglion cells
Light adaptation	Adapt in 5 min

Lecture #12 Color Vision

Color vision theory	a.Blue cone system: respond to short wave length 440 nm b.Green cone system: respond to middle wave length 535 nm C. Red cone system: respond to large wave length at > 535 nm (in female) 565 nm (in male) so senses the red & yellow color
Color perception	- Orange: ratio is 99:42: 0 99% of red cones 42% of green cones 0% of blue cones -Yellow: ratio is 50:50: 0 (in female) 83:83:0 (in male) 50% of red cones (in female) 83% (in male) 50% of green cones (in female) 83% (in male) 0% of blue cones - Blue: ratio is 0:0: 97 0% of red cones 0% of green cones 97% of blue cones
Red – green blindness	Green & red cones see different colors between wave length 525-675 nm & distinguish them

Lecture #13 Physiology Of Taste And Smell

Physiology of olfaction	Human can differentiate between 2000-4000 odours.
Methylmercaptan	smelled when only 25x10-12 g is present in each ml of air.
Olfactory Receptor Cells in the olfactory epithelium	100 million cells
Olfactory Receptor Cells	4 to 25 olfactory hairs (cilia) emerge from the knob.
resting membrane potential of olfactory cells	-55 mV
impulses/action potentials rate	very slow rate 0.05 to 3 Hz. Most odorants cause depolarization and an increase in the rate of APs up to 30 Hz.
Smell Sensations Adapt Rapidly	50 % adapt in the first second.

Thank you!

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References:

- Femalrs' And Males' Slides.
- Guyton & Hall Physiology Review (Second Edition).
- Ganong Review Of Medical Physiology (23 Edition).