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WBPGMEE 2015 AT A GLANCE



Highlights

Based on the latest editions of standard textbooks (Harrison 19th, Park 23rd, Nelson 20th, KDT 7th, Katzung 12th, etc.)

Latest neonatal resuscitation guidelines (2015) and CPR guidelines (2015) included

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Physiology

2

1. **Basic Physiological requirement of water needed per day for survival of an individual is:**
   a. 5 Liters a day
   b. 500 ml a day
   c. 50 ml a day
   d. 2 Liters a day

   Ans. d *Ref: Ganong: Review of medical physiology 23/e p441*

   Basic Physiological requirement of water needed per day for survival of an individual is. 2 Liters a day.

   The intestines are presented each day with about 2000 mL of ingested fluid plus 7000 mL of secretions from the mucosa of the gastrointestinal tract and associated glands. Ninety-eight percent of this fluid is reabsorbed, with a daily fluid loss of only 200 mL in the stools.

Daily water turnover (mL) in the gastrointestinal tract		
Ingested		**2000Q**
Endogenous secretions		7000
Salivary glands	1500	
Stomach	2500	
Bile	500	
Pancreas	1500	
Intestine	1000	
	7000	
Total Input		9000
Reabsorbed		8800Q
Jejunum	**5500Q**	
Ileum	2000	
Colon	1300	
	8800	
Balance in stool		**200Q**

2. **Cyanide causes:**
   a. Histotoxic hypoxia
   b. Anoxic hypoxia
   c. Stagnant hypoxia
   d. Anemic hypoxia

   Ans. a *Ref: Ganong: Review of medical physiology 23/e p621*

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Cyanide causes: Histotoxic hypoxia

Hypoxia is O_2 deficiency at the tissue level. It is a more correct term than **anoxia,** with there rarely being no O_2 at all left in the tissues

Traditionally, hypoxia has been divided into four types:

	Hypoxic	Anemic	Stagnant	Histotoxic
Description	In which the PO_2 of the arterial blood is reduced	In which the arterial PO_2 is normal but the amount of hemoglobin available to carry O_2 is reduced	In which the blood flow to a tissue is so low that adequate O_2 is not delivered to it despite a normal PO_2 and hemoglobin concentration	In which the amount of O_2 delivered to a tissue is adequate but, because of the action of a toxic agent, the tissue cells cannot make use of the O_2 supplied to the
Arterial PO, (PaO_2) (Dissolved O_2)	Low	Normal	Normal	Normal
Arterial O_2 content	Low	Low	Normal	Normal
Cyanosis	Present (if hypoxia is severe)	Absent	Present	Absent
Stimulation of respiratory chemoreceptors	Yes		Yes	Yes
Causes	• Hypoventilation[Q] • (COPD and restrictive disease) • High altitude[Q] • Cyanotic CHD[Q] • Reduced diffusion capacity of O_2 • Right to left shunt[Q] • V/Q mismatch[Q]	• Anemia[Q] • CO poisoning[Q]	• Shock[Q] • CHF[Q]	• Cyanide poisoning[Q]
Oxygen therapy	Useful (except in cyanotic HD)[Q]	Useless	Useless	Useless

3. The area involved in conversion of Short term to long term memory is:

a. Hipocampus
b. Neocortex
c. Cingulate gyrus
d. Amygdala

Ans. a

Ref: Ganong: Review of medical physiology, 23/e p621; Harrison 18/e p26; Guyton 12/e p706-709;

'The area of brain responsible for the consolidation, i.e. processing of short-term memory into long-term memory, is the medial temporal lobe/Hippocampus, parahippocampal gyrus'.— Principles of medical physiology

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Area of Brain	Function
Basal ganglia	**Planning and programming[Q] of voluntary movements, thought is converted into action**
Thalamus	Sensory relay station
Hippocampus	**Short-term memory[Q]**
Cerebellum	Coordination of movements[Q]

Also Know

Frontal lobe area	Clinical feature (After lesion)
Area 4 or primary motor cortex (*Brodman's area)*	*Irritative lesions* ***—Cause siezures*** *Destructive lesions —Produces* **contralateral *flaccid paralysis*** *Spasticity occurs if area 6 is also involved*
Area 6 and 8	***Causes release of sucking, Grasping[Q]***
Area 8 *(Frontal eye field)*	***Lesion causes paralysis of contralateral eye[Q].***
Area 44 and 45 *(Broca's speech area in inferior frontal gyrus)*	***Broca's aphasia[Q]***
Paracentral lobule	***Urinary incontinence***
Prefrontal area *(Area 9, 10, 11, 12 multimodal association*	***Frontal lobe syndrome:*** • ***Disinhibition*** • Antisocial and impulsive ***Behavior[Q]*** • *Poor judgment and insight and distractibility[Q]*

Parietal lobe area	Clinical feature (After lesion)
Primary Sensory Cortex (1, 2, 3)	***Contralateral sensory*** *loss* (exception pain, thermal)
Sensory association area 5, 7, 40	*Lesion of area 40 produces* ***tactile agnosia*** **(Astereognosis)[Q]** and tactile aphasia.
Angular Gyrus and supramarginal Gyrus (sensory speech area)	***Gerstmann Syndrome*** • *Sensory agraphia[Q]* • *Finger agnosia[Q]* • *Rt to Lt. confusion[Q]* • *Acalculia[Q]*
Taste area (43) along with insula	*Ageusia or Hypogeusia[Q]*
Optic Radiation	***Homonymous hemianopia[Q]*** ***Defect in optokinetic nystagmus***

4. Primary function of basal ganglia is:

a. Planning voluntary movements
b. Short-term memory
c. Neuroendocrine control
d. Sensory integration

Ans. a *Ref: Ganong: Review of medical physiology 23/e p251*

- Basal ganglia are involved in planning and programming of movements, particulary two types of movements

i. Complex patterns of motor activity, e.g. writing of letters of the alphabet.
ii. Skilled movements e.g. cutting the paper with scissors, passing a football, hammering nails, etc.

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- The basal ganglia consist of **caudate nucleus, *Putamen (tml), Globus pallidus, Subthalamic nucleus and substantia nigra.***
- Substantia nigra is divided into ***pars compacta*** and ***pars reticulata.***
- Caudate nucleus and putamen are collectively called the **striatum** which ***receive most of the afferent input coming to the basal ganglia.***
- ***Globus pallidus and Substantia nigra are the principal output nuclei, i.e. the efferents arise from these.***

Functions

- **The basal ganglia are involved in planning and programming of movement or more broadly, in the process by which on abstract thought is converted into a voluntary action.** Like, lateral cerebellum, neurons in the basal ganglia discharge before the movements begin. They influence the motor cortex via the thalamus, and corticospinal tract is the final common pathway to motor neuron. ***Putamen circuit*** is involved in complex pattern motor activity and **skilled movement.**
- Basal ganglia is a part of extrapyramidal system and therefore is involved in ***regulation of tone and posture.***
- The basal ganglia, particularly the caudate nuclei, also play a role in some cognitive proces —So, ***caudate nucleus plays a major role in cognitive control of motor activity.***

Disease	Part of basal ganglia involved	Mnemonic
Parkinsonism	Substantia nigra pars compacta - Nigrastriatal pathway	
chorea	Striatum (mainly caudate nucleus; may be putamen)	C for chorea C for caudate
BaLlism	SubthaLamic nuclei	**BaL** for ThaL
Athetosis	**Globus pallidus (mainly)** and Subthalamic nucleus	A for Athetosis A for pAllidus

5. Delta wave in EEG is seen in:

a. Fully awake and alert and eyes open
b. Awake but less attentive
c. REM sleep
d. Deep sleep

Ans. d

Ref: Ganong 23/e p233-235, 24/e p273-274

Delta wave in EEG is seen in–deep sleep

Waves	Frequency	Amplitude	Stage	Location	Characteristics
Alpha rhythm	(8–13 Hz)Q	50–75	0,1 NREM	ParietofrontalQ	Relaxed—Awake but less attentiveQ Thinking present but subconscious
Beta rhythm	(13–30 Hz)	20	0,1 NREM	Frontal	Fully awake and alertQ Conscious thinking
Theta rhythm	(4–7 Hz)	10	IV NREM	HippocampusQ	More relaxed than alpha rhythm Less attentive than alpha rhythm state Transition from awakefulness to sleep (stage I NREM)Q
Delta rhythm	(3–5 Hz)Q	100	Deep stage 3 of NREM	Thalamus/ CortexQ	Fully relaxed deep sleep, Unconscious (NREM stage III and IV)Q No thinking
Gamma	32–100	10	REM	Visual cognition	

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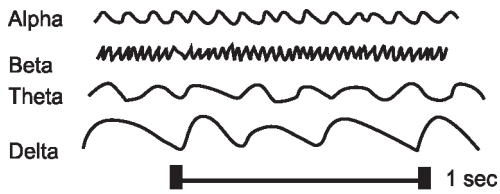

Fig. 2.1: EEG waves

According to increasing frequency of waves: Delta > Theta > Alpha > Beta > GammaQ

Sleep Stages:

Sleep Stages	TST, Total Sleep Time	EEG	EOG	EMG	Other Variables	Events	Mnemonic
Stage awake (relaxed wakefulness)		Alpha activity (8–12 Hz) or low-amplitude beta (13–35 Hz), mixed-frequency waves	REM (in sync or out of sync deflections), eye blinks	Relatively high tonic EMG activity	Alpha activity in occipital leads compared with central leads, eye opening suppresses alpha activity, movement artifacts		
N1, formerly known as stage 1	2–5	Low-voltage, mixed-frequency waves (2-7 Hz range), mainly irregular theta activity, triangular vertex waves	SEMs, waxing and waning of alpha rhythm	Tonic EMG levels typically below range of relaxed wakefulness	Alpha ≤ 50%, vertex sharp waves in central leads, absence of spindles and K complexes		
N2, formerly known as stage 2	45–55	Relatively low-voltage, mixed-frequency waves, some low-amplitude theta and delta activity	No eye movement	Low chin muscle activity	Sleep spindles (7 to 14 Hz) and K-complexes occur intermittently		
N3, formerly known as stages 3 and 4	5–20	≥ 20–50% of epoch consists of delta (0.5–2 Hz) activity	No eye movement	Chin muscle activity is lower than N1 and N2	Sleep spindles may be present	i. Somnambulism (Night walking. Patient walks during sleep.Q ii. Sleep terror or night terrors (pavor nocturnus)Q iii. Sleep-related enuresis (Nocturnal enuresis/bedwetting)Q	Delta for deep sleep

Contd...

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Contd...

Sleep Stages	TST, Total Sleep Time	EEG	EOG	EMG	Other Variables	Events	Mnemonic
						iv. Bruxism (Teeth grinding)Q v. Sleep-talking (Somniloquy).Q	
Stage REM (rapid roving movements of eye) paradoxical sleep	20–25	EEG is relatively low voltage with mixed frequency resembling N1 sleep	Episodic rapid, jerky, and usually lateral eye movements in clusters	EMG tracing almost always reaches its lowest levels owing to muscle atonia	Phasic and tonic components, presence of sawtooth waves, alpha waves are 1–2 Hz slower than waves occurring during wakefulness and non-REM sleep	Generalized muscular atonyQ **Nightmares**Q **Narcolepsy** **Nocturnal penile tumescence**Q Autonomic hyperactivity **(Increased pulse rate and BP**	M-**Mares** N-**Narcolepsy** O-Aut**O**nomic P-**penile tumescence**

EEG, Electroencephalography; EMG, electromyography; EOG, electrooculography; REM, rapid eye movement; SEMs, slow eye movements; TST, total sleep time.

6. Which of the following plasma protein is not synthesized in liver?

a. Angiotensinogen
b. IGF-1
c. Fibrinogen
d. Angiotensin converting enzyme

Ans. d *Ref: Ganong: Review of medical physiology 23/e p672*

- The renin released from the JG cells enters the circulation and **acts on an alpha2-globulin, angiotensinogen (secreted by liver to convert it into a decapeptide, angiotensin I** by **spliting Leucin-Valin bond** of angiotensinogen.
- The enzyme **angiotensin converting enzyme (ACE)** then acts on angiotensin **I** and convert it into an **octapeptide angiotensin II,** by **spliting phenylalamine-histidyl bond of angiotensin II. ACE is found on the surface of capillary endothelium of lung (not in liver)** therefore **angiotensin II is formed on lung capillary endothelium.** Angiotensin **11** is degraded into **angiotensin III** by spliting **aspargine-arginine bond by aminopeptidase.**

Functions of Angiotensins:

Angiotensin	Functions
Angiotensin I	Appears to function solely as the precursor of angiotensin II and does not have any other established action.
Angiotensin III [(des-Asp^1) angiotensin II]	Has about 40% of the pressor activity of angiotensin II, but 100% of the aldosterone-stimulating activity.
Angiotensin IV,	Though some researchers have argued that it has unique effects in the brain.

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Functions of Angiotensin II

Blood vessels	Adrenal cortex	The brain	Additional actions
• *Arteriolar constriction and a rise in* SBP and DBP. • It is one of the ***most potent vasoconstrictors known,***[Q] • Its pressor activity is decreased in *Na^+-depleted individuals and in patients* with cirrhosis and some other diseases. In these conditions, circulating angiotensin II is increased, and this down-regulates the angiotensin receptors in vascular smooth muscle	• *Increase the secretion of aldosterone,- promotes Na and water reabsorption- expands ECF*[Q]	• It does not penetrate the *blood–brain barrier,* but it triggers these responses by acting on the circumventricular organs,[Q] • The area postrema, is primarily responsible for the pressor potentiation. It decrease the sensitivity of the baroreflex, and this potentiates the pressor effect of angiotensin II. • In addition, it acts on the brain to increase water intake and increase the *secretion of vasopressin and ACTH.*[Q] • The subfornical organ (SFO) and the organum vasculosum of the lamina terminalis (OVLT), are responsible for the increase in water intake (*dipsogenic effect*).[Q]	• Facilitation of the release of *norepinephrine by a direct action on* postganglionic sympathetic neurons,[Q] • contraction of mesangial cells with a resultant decrease in glomerular filtration rate, a direct effect on the renal tubules to *increase Na^+ reabsorption*[Q]

Extra kick
Few endocine secretions:

Tissue/organ	Hormones secreted
Lung	Angiotensin II[Q] is produced due to presence of ACE
Heart	Atrial natriuretic peptide[Q]
Adipose tissue	Leptin, Adiponectin[Q]
Intestine	Secretine, Cholecystokinin, glucagon like peptide, GIP[Q]
Prostate	Dihydrotestosterone (DHT)[Q]
Kidney	Renin, Erythropoietin[Q],1, 25 dihydroxycholecalceferol
Liver	25-hydroxycholecalceferol, angiotensinogen, IFI-1[Q] Testosterone

7. All are true about juxtaglomerular apparatus except?

a. Macula densa acts as negative barroreceptor

b. The epithelial cells of the distal convoluted tubule at sites, where they touch an efferent glomerular arteriole, form a spot called macula densa

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c. The tunica media cells of arterioles lying in contact with the macula densa becomes epithelioid and show two types of granules instead of microfilament
d. Macula densa Senses Na+ load

Ans. b

The part of the distal tubule which comes in contact with the afferent arteriole (not efferent) is made of a specialized epithelium called the macula densa.

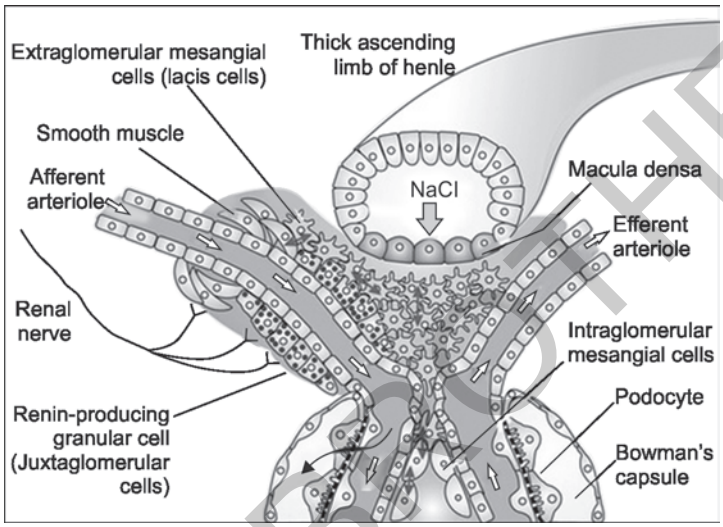

Fig. 2.2: Juxtaglomerular apparatus

JUXTAGLOMERULAR APPARATUS

- The ascending limb of the loop of Henle proceeds **towards its own glomerulus.** So that a portion of the distal convoluted tubule comes to lie very close to the afferent and efferent arterile.
- The juxtaglomerular apparatus is located at the angle of the ***afferent and efferent arterioles,*** where it comes in contact with the **distal tubules.**
- It comprises the **macula densa juxtaglomerular** (**JG cells), and the lacis cells.**♀
- The part of the **distal tubule which** comes in contact with the **afferent arteriole (not efferent)** is made of a specialized epithelium called the **macula densa.**♀
- **The juxtaglomerular (granular) cells are modified smooth muscle cells** in the scala media of the terminal part of the **afferent arterioles.**
- **They contain large granules and secrete renin.**

- ***JG cells*** are densely innervated by sympathetic nerve terminals and **they release renin in** response to sympathetic discharge
- The **lacis cells (extraglomerular mesangial cells)** that are located in the angular space between the junction of afferent and efferent arterioles. The lacis cells also **contain some renin.**

Function:

- **Decreases GFR causes delivery of less NaCl to distal tubule, which is sensed by macula densa cells and the signal is transmitted to *juxtaglomerular (JG) cells which secrete renin.***
- **As a result renin angiotensin system is activated and there is generation of angiotensin-II which causes constriction of efferent arteriole. This results in increased glomerular capillary hydrostatic pressure and increased GFR.**

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8. GFR is measured in clinical practice using:

a. Inulin clearance
b. Creatinine
c. PAH clearance
d. Urea

Ans. b *Ref: Ganong: Review of medical physiology 23/e p866*

GFR is measured in clinical practice using creatinine though inulin clearance is the standard for measuring GFR.

- If there be a substance that passes freely across the glomerular membane but is neither reabsorbed nor secreted by tubular activity, urinary excretion would represent the amount filtered and nothing but the amount filtered.
- Hence, its clearance would indicate how much plasma gets filtered every minute.
- One such substance is Inulin, a polysaccharide of small enough (molecular weight about 5,200) to get filtered as easily as crysalloids or water. It is neither reabsorbed nor secreted by the kidney. Further, it is neither metabolized nor synthesized by the kidneys, is nontoxic and can be easily measured. All these features make it a very suitable substance for estimation of glomerular filtration rate. ***Inulin*** clearance is equal to the GFR, i.e. 126 ml/min.
- Beside inulin, the ***clearance of vitamin B_{12}, EDTA,*** and ***polyfructosan*** are also quite reliable as indicators of GFR.
- ***Creatinine is not as accurate as the above substances because it is secreted*** in small amounts. But since it is a product of metabolism and its level is fairly constant, creatinine is very convenient to determine its clearance. That is why, clinically, creatinine clearance is used an index of GFR quite frequently.

CRUX:

- Inulin is more accurate measure of GFR, but is inconvenient because it has to be injected intravascular,
- Creatinine is not as accurate as inulin, But creatinine is already present in the blood in steady-state, so the endogenous creatinine clearance can be used without the necessity of having to infuse inulin.
- PAH clearance is used to measure renal plasma flow, not GFR.Q

9. Extracellular fluid compartment includes all except:

a. Plasma
b. Interstitial fluid
c. Transcellular fluid
d. Fluid inside RBC

Ans. d *Ref: Ganong: Review of medical physiology 24/e p2 23/e p2*

BODY FLUIDS: At a glance:

- **Water constitutes approximately 60% of total body weight**. **Of this 60%, 40% is present in cell, i.e. intracellular fluid (ICF)** and **20% is present outside the cells constituting extracellular fluid (ECF)** 20% of body weight of water in ECF is divided into **interstitial fluid (15% of body weight** and **plasma (5% of body weight.**
- Fluid inside RBC **is intracellular**. (not extracellular)

Total body Water (42 liters) 60% of body weight		
Intracellular fluid (28 liters) • **40% of body weight** • 67% of total body water	**Extracellular fluid (14 liters)** • **20% of body weight** • **33% of total body water**	
	Interstitial fluid (10.5 liters)	**Plasma (3.5 liters)**
	• **15% of body weight** • 25% of total body water • 75% of ECF	• **5% of body weight** • 8% of total body water • 25% of ECF

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- **Most of the fluid are calculated directly by dilution method, except for intracellular fluid (ICF) and interstitial fluid. Both these are calculated indirectly by calculating other body fluids.**

ICF = Total body water volume - ECF volume
Interstitial fluid = ECF volume - Plasma volume

Fluid volume	Dye/indicator used
• **Total body water (TBW) volume**	• **Deuterium oxide^{Q}: D20 (most commonly used)^{Q}** • tritium oxide (3H20), • Aminopyrine, • Antipyrine
• **Extracellular fluid (ECF) volume**	• **Inulin (most accurate)^{Q},** • Sucrose, • Mannitol, • Sodium thiosulfate,
• **Plasma volume (PV)**	• **Evans Blue^{Q},** • Serum albumin labeled with radioactive iodine(I125)
• **Blood cell volume**	• **Cr51 labeled RBC^{Q}**

- **Predominent ions in ECF: Na, Cl, HCO_3, Ca^{+2}**
- **Predominent ions in ICF: K^+, organic anion (organic phosphate, protein)**

10. Largest muscle protein:

a. Actin
b. Myosi
c. Troponin
d. Titin

Ans. d *Ref: Ganong: Review of medical physiology 23/e p96*

- Some additional structural proteins that are important in skeletal muscle function include **actinin, titin,** and **desmin.** Actinin binds actin to **the Z lines.**
- **Titin, the largest known protein (with a molecular mass near 3,000,000 Da), connects the Z lines to the** M lines and provides scaffolding for the sarcomere.
- It contains two kinds of folded domains that provide muscle with its elasticity.
- At first when the muscle is stretched there is relatively little resistance as the domains unfold, but with further stretch there is a rapid increase in resistance that protects the structure of the sarcomere.
- Desmin adds structure to the Z lines in part by binding the Z lines to the plasma membrane. Although these proteins are important in muscle structure/function, by no means do they represent an exhaustive list.

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AT A GLANCE

Our new concept is to provide the PG aspirants with the authentic explanations of WBPGMEE-2015. The authentic answers are prepared in consultation with experts and referenced from standard textbooks. Explanations contain up-to-date information and high-yielding facts. We hope you would feel benefited after reading this book.

Salient Features

- Facts and concepts based on the latest editions of standard textbooks (Harrison 19th, Park 23rd, Nelson 20th, KDT 7th, Katzung 12th, etc.)
- Precise and updated coverage of the topics in 'At-a-Glance' pattern
- Latest neonatal resuscitation guidelines (2015) and CPR guidelines (2015) included
- Only relevant information incorporated
- Useful figures and tables.

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