بسم الله الرحمن الرحيم

Physiology Team 436
Renal Block

Values and Equations File

Color Index:
Equation
Number
Unit
Notes
Only female slides
Only males slide
Both female and males slides

Done by:

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دعواتكم لنا بالتوفيق

Lectures:
Renal Functions, GFR, Clearance, Micturition, Acid base balance, Buffer systems.

THIS IS THE MAIN EQUATION: **Clearance = U . V / P**
GFR: we use creatinine
125 ml/min or 180 L/day

RPF: we use PAH because it is completely secreted.
Renal blood flow = RPF / 1 – hematocrit (the high RBF is a feature of renal circulation)
(around 1200) = 625 / (1 – 0.45)
(20% of cardiac output is renal blood flow, and 20% of renal plasma flow will be filtered)

ml/min

Filtration Fraction = GFR / Renal plasma flow (no unit)
0.2 = 125 / 625

Amount of substance excreted = filtration rate +- tubular handling
(filtered – reabsorbed + secreted)

U . V (EXCRETION RATE) **= C . P** (FILTERED)

Reabsorption = Filtered load (C . P) – Excretion rate (U . V)

Secretion rate = Excretion rate – Filtration load

mmol/min

$$GFR = \frac{K \times (140 - age) \times Body\ weight\ (kg)}{Serum\ creatinine\ (\mu mol/L)}$$

(this is the Cockcroft-Gault equation for clearance)
K = 1.23 for males 1.04 for females

GFR = Kf x net filtration pressure
125 = 12.5 x 10
GFR = Kf x [(PG-PB)-(πG- πB) P = Hydrostatic π = Colloid

Net filtration pressure = Glomerular hydrostatic – Glomerular colloid – Bowman's hydrostatic (mmHg)
10 = 60 – 32 – 18

CONVERSION IN BIOCHEMISTRY: 1 mg/dl = 88.4 micro mol / l

Laplace Law: P = 2T / r

Acid [AH] ↔ conjugate base [A-] + [H+]
Dissociation constant: K = [H+] x [A-] / [AH]

pH = - Log [H+]

pH = pK + Log HCO3- / 0.03 x PCO2 pK = dissociation constant = 6.1
(Dr.Maha said we don't need to know the steps that lead up to it)

Lecture #1 Renal functions & GFR

KIDNEYS weight	**150 grams**
Each kidney has	**1 million nephrons**
Blood flows through juxta medullary nephrons	**1-2 %**
Renal blood flow to the kidney represents	**20% of cardiac output**
Blood flow rate of renal circulation	**1200 ml/min**
GFR	**125 ml/min = 20% renal plasma flow.**
Glomerular hydrostatic pressure	**60 mmHg**
Hydrostatic pressure in bowman's capsule	**18 mmHg**
Colloid osmotic pressure of glomerular plasma proteins	**32 mmHg**
Net filtration pressure	**60-18-32= 10 mmHg**
Kidney filter	**200 liters of blood daily**

Lecture #2 Regulation of GFR

The volume of filtrate produced by both kidneys per min	**Averages 125 ml/min Totals about 180L/day (45 gallons)**
GFR remains constant over a large range of values of BP	**75-160 mmHg**
systemic cardiac output flows through the kidneys each minute	**1200 ml**
plasma entering the glomerulus is filtered	**20%**
filtered fluid	**125 ml/min**
Sodium reabsorption of filtered sodium is absorbed	**99.5%** • **Proximal tubules (67%)** • **Loop of Henle (25%)** • **Distal/Collecting tubules (8%)**
Forces in capillaries: hydrostatic pressure PGC	**60mmHg**
oncotic pressure GC	**- 29 mmHg**

Lecture #2 Regulation of GFR

Net outward pressure	**60 – 29 = 31mmHg**
Forces in capsule: hydrostatic pressure PBS	**-15mmHg**
oncotic pressure GBS	**0 mmHg**
Overall	**31 – 15 = 16 mmHg outward**
Male adults GFR	**~ 90 – 140 ml/min**
Female GFR	**80 – 125 ml/min**

Lecture #3 Renal clearance

Tm for Glucose	**60 – 29 = 31mmHg**
[Inulin]urine	**= 30 mg/ml**
[Inulin]plasma	**= 0.5 mg/ml**
urine flow rate	**= 2 ml/min**

Lecture #4 Physiology of micturition

A nervous reflex called the micturition reflex occurs that empties the bladder at	150-200mls of urine volume
[Inulin]urine	= 30 mg/ml
[Inulin]plasma	= 0.5 mg/ml
urine flow rate	= 2 ml/min
urge to void urine	150-300 ml
sense of fullness of U.B	300-400 ml
sense of discomfort	400-600 ml
sense of pain	600-700 ml
micturition can't be suppressed	700 ml

Lecture #5+6 Renal Transport Process

Reabsorped daily by renal tubules	**25,000 mEq/day Na+ 179 L/day water**
Normal plasma level of urea	**2.5-6.5 mM/L (15-39 mg/100ml)**
Potassium in blood	**3,500-4,000 mmol 98 % is intracellular, [150mM] 2% K extra-cellular [3.5-5mM]**
K+ Intake	**80-120 mmol/day**
K content of average meal	**30-40mmol**
Dietary K excreted via the kidneys	**90-95%**
K in Sweat & Feces (This is unregulated and may become significant in diarrheas)	**5-10%**
Filtered load of potassium	**720 mmol/day**

Lecture #8 Urine Concentration Mechanism

diluting tubule fluid	**150 mOsm/kg water**
Water reabsorption %	**65% in Proximal convoluted tubule** **20-25% in Thin Descending limb** **ZERO in thick and thin Ascending limb**
Osmolality of medullary tissue high up to	**1200 mOsm/kg**
Bu medullary blood flow	**less than 5%**

Lecture #9 Basics acid base

pH of water	**7**
Normal pH	**-log [0.00000004] M=7.4**
ECF [Na+]	**145 mM/L**
Normal BLOOD pH	**7.35 – 7.45**
pH range Compatible with human life	**(6.8-7.8)**

Lecture #10 Buffer system

total chemical buffering of body fluids	**60 - 70%**
HCO3 - FREELY FILTERABLE at glomeruli	**(3 mM/min)**
Maximum urine acidity	**pH 4.5 ⇒ equates to urine [H+] of only ~ 0.03 mM/L.**

Lecture #11acid base disorder

Respiratory Acidosis	**ACUTELY** **1 mEq/L [HCO3-] per 10 mm Hg ↑ in Pco2** **CHRONICALLY** **3.5 mEq/L [HCO3-] per 10 mm Hg ↑ in Pco2**

How to Analyze an ABG

	PO2	pH	PCO2	HCO3
normal	80-100mmHg	7.35_7.45	35-45 mmHg	22-26 mmol/L
acidotic	-	<7.35	>45	< 22
alkalotic	-	>7.45	<35	> 26

YOU ARE DONE!

إن أصبنا فهو من الله سبحانه، وإن أخطأنا فهو منا ومن الشيطان، وجل من لا يخطأ.

لا تنسون قول: اللهم إنّي استودعتك ماحفظت وماقرأت وماتعلمت فردّه لي وقت حاجتي إليه، إنك على كل شيء قدير.

Good luck our DOCTORS!

See you next year!

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