MED-432

Values of Renal Physiology

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#4- MICTURITION

- Ureters have regular peristaltic contraction **1-5/min**
- During filling phase of bladder urine is produced but can be controlled. it means that we can hold urine but within limitation **(0 - 50 ml)**

Urinary bladder pressure Vs. volume (cystometrogram)

- Change in pressure is minimum until 300 ml.

Under our control

Slight increase in pressure + increase of urine volume (**0-50 ml**)..**phase I**

- **Minimum increase** (not very much) in **pressure** + increase in urine volume(**50-400 ml**)..**phase II**
- Sudden sharp rise in pressure (**sense of fullness** at about **400 ml**)..**phase III**

- **>400 ml** we **can't keep urine,** we have to **pass it.**

- urge to avoid urine (**first sensation**) at urine volume of **150-200 ml**

الضغط يزيد لان حجم المثانة صغير فى بداية دخول اليورن لها

الضغط ماراح يزيد بشكل كبير زى الفوليوم، لأن المثانة تتمدد

Abnormal micturition (spinal cord transaction): car accident

- in the first 2 weeks, **5 or 10** ml of urine will pass directly without stimulation (incontinance).
- After 2 weeks, **spinal reflex** for emptying will **resume** with **NO voluntary control.**

5 -TUBULAR REABSORPTION

Calculation of tubular reabsorption (transport) or secretion from renal clearance

- ✓ Quantity filtered = Px × GFR
- ✓ Quantity excreted = Ux ×V

Tx = 0	Tx = positive	Tx = negative
• Filtered = excreted • Inulin • Feely filtered, not reabsorbed nor excreted	• filtered > excreted • glucose • freely filtered & completely reabsorbed	• filtered < excreted • PAH • Freely filtered, not reabsorbed but secreted

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Glucose reabsorption

- **'Renal threshold' :** If plasma glucose (PG) reached **200 mg/dl** **in arterial** **& 180 mg/dl** **in venous**, glucose appear in the urine.
- **Tubular transport maximum for glucose (Tm G)**: the amount of reabsorped glucose at very high filtered glucose, remain constant = **375 mg/min** (**female** **300 mg/min**).
- **Filtered load:** 125 mg/min

Na reabsorption: **65-70** % of filtered Na is reabsorbed in PCT.

Water reabsorption: **60-70** % of filtered water is reabsorbed in PCT.

Bicarbonate reabsorption: **90%** of filtered bicarbonate is reabsorbed in PCT.

Phosphate

- **80%** in bones, teeth & skeleton
- **20%** intracellular P.
- **1 mmol/L** plasma P (freely filtered)
- **1/3** of filtered P is excreted in urine.
- **2/3 reabsorbed** co-transported with Na.

Urea

- Plasma urea concentration = 15-40 mg/ 100ml
- **40-50%** of filtered urea reabsorbed by **passive diffusion following Na & water.**
- **50-60% excreted.**
- In **renal failure** plasma urea **>40mg/100ml**

Amino Acid

- **All** filtered **AAs** are reabsorbed in PCT

NOTES

- ✓ **Glucose** & **AAs** transported from cell to interstitium by **facilitated diffusion**.
- ✓ The **reabsorption** of filtered **HCO3** is **inhibited** by **decreases in arterial PCO2.**
- ✓ **Reabsorption** of filtered **HCO3** is nearly **100%** of the **filtered load.**
- ✓ When **glucose >** the **Tm**, the **renal vein glucose concentration** will be **< artery concentration**, because some glucose is being excreted in urine & therefor is not returned to the blood.
- ✓ The **clearance of glucose** is **zero** at **concentration < Tm** or (threshold) when all of the filtered glucose is reabsorbed, but is **greater than zero** at **concentration > Tm**.
- ✓ **Increased filtration fraction** will **increase the reabsorption of isosmotic fluid** in the **PCT**

6- Tubular secretion

Potassium

- **3.5-5** in plasma, (**>5 toxic**).
- **90%** of filtered **K** is **reabsorbed** in **(PCT).**
- **K** is **secreted** in **DCT** ***passively*** in exchange for Na (under the **control** of **Aldosterone hormone**).

Hydrogen

- **Excretion** exchange for **Na.**

#7 - Dilutions & concentration of urine

- **Normal water intake:**
  - **Urine flow = 1-2 ml/min**
  - **Urine osmolality = 500 – 700 mOsm/kg**
- **Obligatory urine volume = 0.5 ml/min**
- **High water intake:**
  - **Urine osmolality = 50 mOsm/kg**
- **Low water intake:**
  - **Urine osmolality = 1200 – 1400 mOsm/kg**
- **Normal range:**
  - **Urine osmolality = 30- 1200 mOsm/kg**
  - **Urine volume = 0.5 – 20 ml/min**

#9 + #11-Acid Base system & acid base imbalance

Natural chemistry & solutions PH = 7

Normal range of blood PH = 7.35 – 7.45

- Blood PH can be calculated by Henderson-Hasselbach equation:

$$\text{PH} = \text{pKa} + \log_{10}\frac{[Base]}{[Acid]} = \left\{6.1 + \log\frac{HCO_3^-}{0.03\ X\ PCO_2}\right\}$$

(pKa: constant; the bracketed term: In the case of bicarbonate)

Normal range of Extracellular PH = 7.4 (7.3-7.5) – very narrow range -

Normal arterial blood PH = 7.4
Normal venous blood PH = 7.35

Normal H concentration = 40 nEq/L (10-160 nEq/L)

The limits of PH that a person can live more than a few hours = 6.8 – 8.0
Out of this range death accures.

Acid Base imbalances

PH < 7.35 Acidosis
PH > 7.45 Alkalosis

#10- Buffer system

Bicarbonate buffer

HCO3 = 24-28 meq/ml

Phosphate buffer

- **Intracellular PH is more acidic (7.2)**

Respiratory Acidosis

- **The normal partial pressure of CO2 = 35-45**

Metabolic Acidosis

- **Bicarbonate deficit < 22mEq/L**

Metabolic alkalosis

- **Bicarbonate > 26 mEq/L**