Objectives

To describe the characteristics of urine.
To recap hormones associated with the urinary system.
To explain how the kidney influences blood volume and blood pressure.
To identify factors that cause concentrated or dilute urine.
To describe the effect of diuretics on kidney function.

Characteristics of Urine

I. Physical
   Color
   Clarity
   Odor
   Specific Gravity

II. Chemical
   Composition
   pH

Composition of Urine

Fluid Volume
   Dependent upon water intake
   Water is also lost through perspiration and exhalation.

Fluid Composition
   Dependent upon interstitial fluid concentration of renal medulla.
   Hypotonic urine – more dilute
   Hypertonic urine – more concentrated

Countercurrent Mechanism

An osmotic gradient extending from Cortex > Depths of Renal Medulla
Hypertonic interstitial fluid of kidney medulla facilitates:
.........Concentration of filtrate & water recovery

The kidney strives to keep the solute concentration of body fluids constant.
Around 300 mOsm (same as blood plasma)

Antidiuretic Hormone - ADH

- Involves the reabsorption of water from the distal convoluted tubules & collecting tubule/collecting duct (CD).
- In presence of ADH (CD) is permeable to water. Water moves back into the blood. Due to hypertonic medullary gradient.
- End result is concentrated and scant urine volume.
- Also regulates plasma osmolarity.
- Alcohol inhibits ADH
**Result of Higher Plasma Osmolarity?**

Can occur for instance during periods of dehydration or high salt intake.
- Stimulates osmoreceptors.
- Promotes sensation of thirst.
- Increases ADH secretion.

**Other Hormones associated with excretion**

**Aldosterone:**
- Maintains sodium & potassium balance
- Important in blood volume and blood pressure regulation. Strong vasoconstrictor. *BP.*
- Produced from adrenal cortex.

**Atrial Natriuretic Hormone (ANH):**
Causes the excretion of Na+. When Na+ is excreted so is water. Blood volume and pressure decrease.

**Renal Mechanism & Blood Pressure (pg 16)**

I. ADH
II. Renin-angiotensin system
  - Controls K+ secretion
  - Controls Na+ reabsorption
High Blood Pressure

Occurs when Blood Volume is high. If blood is high in solutes e.g. following intake of heavy salts.

Plasma osmolarity increases

- Water readily leaves the C.D. unless ADH is present and then water will be reabsorbed.
- Water rapidly leaves the filtrate when the C.D. descends into the highly concentrated medulla (tissues).

Retention of water

ADH inhibits urine output i.e. Urine output decreased

Kidneys can Raise Blood Pressure if Low

If blood volume/pressure decreases e.g. during shock or severe dehydration

Renin - Aldosterone mechanism takes action. JGA releases renin

Renin > Angiotensin I & II > Aldosterone

Aldosterone causes:

- K+ loss which increases Na+ reabsorption.
- Water follows Na+ and blood volume is restored.

Summary of Aldosterone’s effect

Produced when:

- low blood volume
- low B.P.
- low plasma Na+
- high plasma K+

Restores B.V., B.P.

Role of Diuretics

Diuretics - chemicals that enhance urinary output.

Examples

- Alcohol - inhibits ADH release
- Caffeine - inhibit Na+ reabsorption and thus water reabsorption.
- Drugs prescribed for hypertension.
- Lasix and Diuril
  - Inhibit Na+ symporting in the ascending loop of Henle or DCT
  - renal medulla less concentrated

Osmotic diuretic - Substance that is not reabsorbed & carries water out with it.

Medical Diuretics are employed to decrease blood pressure by decreasing blood volume. Side effect - frequent urination.

Micturition - Emptying the bladder.

Distension of the bladder signals the PNS via afferent fibers of pelvic nerves. Usually 300 ml creates the desire to void.

Signal received by spinal cord > sent to Dorsolateral Pons. “Switch”

Sympathetic fibers “inhibited” and this causes a relaxation of sphincter muscles that usually close urethra.

External sphincter muscles under voluntary control (within limits).

Disorders of Micturition

Incontinence - inability to control micturition.

May be caused by:

- Emotional Trauma
- Pregnancy (distension of pelvic floor)
- Nervous system problems