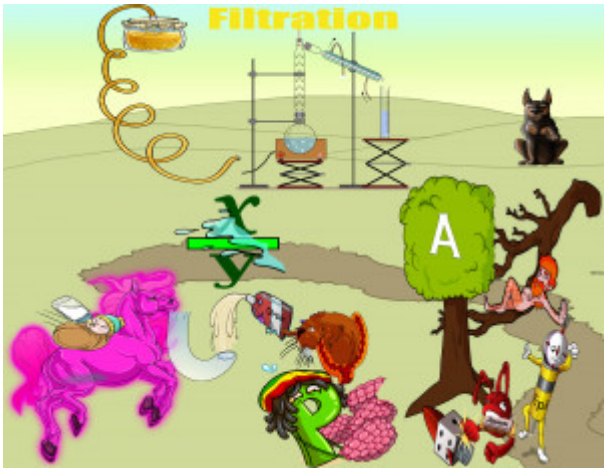
Filtration

Filtration is a physiologic process defined by the transfer of soluble components, such as water and waste, from the blood into the glomerulus. The glomerulus is the primary site of filtration. Creatinine clearance is frequently used to estimate glomerular filtration rate (GFR). Filtration fraction represents the fraction of renal plasma flow that is filtered via the glomerular capillaries. Fractional excretion is the percentage of a substance that is excreted. GFR is regulated by multiple factors. Prostaglandins dilate the afferent arteriole and increase the blood flow to the glomerulus. Renin-angiotensin-aldosterone system regulates the process of filtration by the vasoconstrictive effects of angiotensin II. Some other factors that influence the process of filtration include tubuloglomerular feedback (negative feedback mechanism), atrial natriuretic peptide (promotes natriuresis), antidiuretic hormone (promotes retention of water), norepinephrine (decreases renal perfusion), and dopamine (increases renal perfusion).



PLAY PICMONIC

Filtration

Glomerulus
Glow-mare

The glomerulus is the primary site of filtration. Blood enters the glomerulus through the afferent arteriole, passes through bowman's capsule surrounding the glomerulus, enters the nephron and leaves it through the efferent arteriole. The glomerular filtration barrier consists of fenestrated capillary endothelium, visceral epithelial layer, and basement membrane with type IV collagen and heparan sulfate.

Creatinine Clearance
Gopher clearing Cr-eam

Glomerular filtration rate is defined as the volume of plasma that is filtered by the glomeruli per unit of time. Creatinine clearance is frequently used to estimate GFR, but because creatinine is secreted by the proximal tubule, the clearance of creatinine frequently overestimates GFR. Inulin clearance is the best estimate of GFR because Inulin is freely filtered and is neither reabsorbed nor secreted. Inulin clearance can be calculated by the formula U x V/P where U represents urine concentration of Inulin (mg/mL), V represents urine flow rate (mL/min), and P represents plasma concentration of Inulin (mg/mL).

Filtration Fraction
Filtration-factory

Filtration fraction represents the fraction of renal plasma flow that is filtered via the glomerular capillaries and can be calculated by the ratio of glomerular filtration rate and renal plasma flow (FF=GFR/RPF).

Fractional Excretion
Fraction excretion

The fractional excretion of sodium is the percentage of the sodium filtered by the kidney, which is excreted in the urine. Fractional excretion of sodium is decreased when the perfusion of kidneys is decreased due to a compensatory increase in the reabsorption of sodium.

Regulation

Glomerular Filtration Rate
Gopher

Glomerular filtration rate (GFR) is an estimate of how much blood passes through the glomeruli each minute. GFR is frequently used to assess the function of kidneys.

Prostaglandins
P-rasta

Prostaglandins dilate the afferent arteriole and increase the blood flow to the glomerulus. This increases renal plasma flow (RPF) and glomerular filtration rate (GFR) proportionally. Thus, filtration fraction (FF) isn't affected.

Renin Angiotensin Aldosterone System (RAAS)

RAAS-berries

Renin-angiotensin-aldosterone system regulates the process of filtration. Angiotensin II has effects on afferent and efferent arterioles and regulates glomerular filtration rate (GFR). Preferential constriction of the efferent arteriole induced by angiotensin II increases GFR.

Tubuloglomerular Feedback

Tube Glow-mare Feeding on Back

Tubuloglomerular feedback is one of the mechanisms that regulates glomerular filtration rate (GFR). Increased GFR can result in increased distal tubular sodium chloride concentration, which leads to a release of adenosine from the macula densa cells. Adenosine constricts the afferent arteriole and reduces glomerular filtration rate.

Atrial Natriuretic Peptide

A-tree with Natural-red Haired Man

Atrial natriuretic peptide (ANP) is released in response to the distension of the atria of the heart (e.g., volume overload) while brain natriuretic peptide (BNP) is released in response to ventricular distension. These hormones increase renal sodium excretion (natriuresis) and inhibit renin secretion.

Antidiuretic Hormone

Anti-die-rocket Harmonica

Antidiuretic hormone promotes the insertion of aquaporins in the collecting duct and induces reabsorption of the free water.

Norepinephrine

North-epi-pen

Norepinephrine acts on alpha 1 receptors, which causes constriction of renal arteries, decreased blood flow to the afferent arterioles and decreased filtration. This can result in renal failure.

Dopamine

Doberman

Dopamine causes renal artery dilation, resulting in increased renal blood flow and increased filtration.