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Med Lab Sci

Ana 204

The filtration barrier of the glomerulus consists of a fenestrated capillary epithelium with a negatively charged surface that repels many plasma proteins. Note that in contrast to fenestrated epithelia in other parts of the body, the fenestrae in the kidney lack a diaphragm. Beneath the capillary epithelium is a thick basement membrane that is also negatively charged. The foot processes of the podocytes forms the final barrier. Note the slit diaphragm between the foot processes. These play a role in filtration of plasma as mutations in genes that encode proteins of slit diaphragms lead to proteinuria. What would happen if the basement membrane lost its negative charge?

The main function of the glomerulus is to filter [plasma](https://en.wikipedia.org/wiki/Blood_plasma) to produce glomerular filtrate, which passes down the length of the [nephron](https://en.wikipedia.org/wiki/Nephron) tubule to form urine. The rate at which the glomerulus produces filtrate from plasma (the [glomerular filtration rate](https://en.wikipedia.org/wiki/Renal_function#Glomerular_filtration_rate)) is much higher than in systemic capillaries because of the particular anatomical characteristics of the glomerulus. Unlike systemic capillaries, which receive blood from high-resistance [arterioles](https://en.wikipedia.org/wiki/Arteriole) and drain to low-resistance [venules](https://en.wikipedia.org/wiki/Venule), glomerular capillaries are connected in both ends to high-resistance arterioles: the [afferent arteriole](https://en.wikipedia.org/wiki/Afferent_arteriole), and the [efferent arteriole](https://en.wikipedia.org/wiki/Efferent_arteriole). This arrangement of two arterioles in series determines the high [hydrostatic pressure](https://en.wikipedia.org/wiki/Hydrostatic_pressure) on glomerular capillaries, which is one of the forces that favor filtration to the Bowman's capsule.

If a substance has passed through the glomerular capillary endothelial cells, [glomerular basement membrane](https://en.wikipedia.org/wiki/Glomerular_basement_membrane), and [podocytes](https://en.wikipedia.org/wiki/Podocyte), then it enters the [lumen](https://en.wikipedia.org/wiki/Lumen_(anatomy)) of the tubule and is known as glomerular filtrate. Otherwise, it exits the glomerulus through the efferent arteriole and continues circulation.

The structures of the layers determine their [permeability](https://en.wikipedia.org/wiki/Vascular_permeability)-selectivity (*perm selectivity*). The factors that influence perm selectivity are the [negative charge](https://en.wikipedia.org/wiki/Negative_charge) of the basement membrane and the podocytic epithelium, and the effective pore size of the glomerular wall (8 nm). As a result, large and/or negatively charged molecules will pass through far less frequently than small and/or positively charged ones. For instance, small ions such as [sodium](https://en.wikipedia.org/wiki/Sodium) and [potassium](https://en.wikipedia.org/wiki/Potassium) pass freely, while larger proteins, such as [hemoglobin](https://en.wikipedia.org/wiki/Hemoglobin) and [albumin](https://en.wikipedia.org/wiki/Albumin) have practically no permeability at all.

The [oncotic pressure](https://en.wikipedia.org/wiki/Oncotic_pressure) on glomerular capillaries is one of the forces that resist filtration. Because large and negatively charged proteins have a low permeability, they cannot filtrate easily to the Bowman's capsule. Therefore, the concentration of these proteins tends to increase as the glomerular capillaries filtrate plasma, increasing the oncotic pressure along the length of a glomerular capillary.