REGULATION OF KIDNEY FUNCTION

The intricate functioning of the kidneys is subject to effective monitoring and regulation through hormonal feedback mechanisms, involving key players such as the hypothalamus, juxta glomerular apparatus (JGA), and, to some extent, the heart.

Osmoreceptors within the body respond to alterations in blood volume, body fluid volume, and ionic concentration. When there is an excessive loss of fluid from the body, these osmoreceptors are activated, prompting the hypothalamus to release antidiuretic hormone (ADH), also known as vasopressin, from the neurohypophysis. ADH plays a crucial role in promoting water reabsorption from the latter parts of the renal tubule, effectively preventing diuresis. Conversely, an increase in body fluid volume can deactivate the osmoreceptors, leading to the suppression of ADH release, completing the feedback loop.

It is noteworthy that ADH not only influences water reabsorption but also impacts kidney function through its constrictor effects on blood vessels, contributing to an increase in blood pressure. Elevated blood pressure, in turn, enhances glomerular blood flow and, consequently, the glomerular filtration rate (GFR). This interplay of hormonal regulation and feedback mechanisms highlights the intricate control systems that govern renal function.

The JGA plays a complex regulatory role. A fall in glomerular blood flow/glomerular blood pressure/GFR can activate the JG cells to release renin which converts angiotensinogen in blood to angiotensin I and further to angiotensin II. Angiotensin II, being a powerful vasoconstrictor, increases the glomerular blood pressure and thereby GFR. Angiotensin II also activates the adrenal cortex to release Aldosterone. Aldosterone causes reabsorption of Na+ and water from the distal parts of the tubule. This also leads to an increase in blood pressure and GFR. This complex mechanism is generally known as the Renin-Angiotensin mechanism.

An increase in blood flow to the atria of the heart can cause the release of Atrial Natriuretic Factor (ANF). ANF can cause vasodilation (dilation of blood vessels) and thereby decrease the blood pressure. ANF mechanism, therefore, acts as a check on the renin-angiotensin mechanism.