**Anatomy and Physiology of the Renal System**

**Introduction**

The Polycystic Kidney Disease (PKD) is a urinary system disorder which leads to the growth of several cysts in the kidneys. Often, these cysts are filled with a fluid substance. If the cysts become too big or if they continue growing they replace the kidney tissues, thus enlarging and damaging them (Germino & Guay-Woodford, 2015). Consequently, the cysts reduce the kidney function and hence lead to kidney failure. There are two types of PKD disorder, namely, the autosomal recessive and autosomal dormant PKD.

**Symptoms and Polycystic Kidney Disease (PKD)**

A majority of individuals with PKD do not develop symptoms until they reach 40 years. Some of the noticeable symptoms of PKD include frequent bladder or kidney infections, back pain or side pain, an appearance of blood in the urine, increased size of the abdomen (Germino & Guay-Woodford, 2015). Again, increased blood pressure is a common sign of PKD; high blood pressure is likely to damage the kidneys. However, patients with PKD may experience chest pain because a majority of them develop a floppy valve in the heart.

**Anatomy of the Urinary System**

The urinary system is one in the human body which deal with excretion of wastes. The system excretes urea from the blood in form of urine. The Urinary system consists of five parts which include the urethra, the urinary bladder, the ureters and the kidneys (Andrade & Knight, 2017). The kidneys and the ureters make the upper urinary tract whereas the urethra and the bladder make the lower urinary tract. The kidneys are bean-shaped organs; their function is to remove urea from the blood.

Below the kidneys are the ureters which have the tube-like structure that transfers urine from the kidneys to the urinary bladder for storage. The tubes run parallel to the vertebral column on the left and right side of the bod (figure 1). Below the ureters is the urinary bladder, which is a sac-like hollow organ whose function is to store urine (Andrade & Knight, 2017). The urinary bladder is located at the inferior end of the pelvis, along with the midline of the body. The last part of the urinary system is the urethra. Its function is to transport urine from the bladder to the exterior of the body.



*Figure 1.* The elements of the urinary system

**Physiology of the Urinary System**

**Maintaining Homeostasis**

One of the functions of the urinary system is to maintain homeostasis. By controlling the excretion of wastes out of the body, the kidneys help to maintain the balance of several important internal conditions. The kidneys also help in balancing ions in the body by controlling the excretion of various ions including chloride, sodium, calcium, potassium and phosphate ions (Deshmukh & Wong, 2009). When the concentration of these ions exceeds the normal concentration, their excretion is increased by the kidneys to enable the body to return to the normal level. Similarly, when the concentration of these ions is below normal, the kidneys increase their reabsorption into the blood during filtration.

**Regulation of Blood pH**

The kidneys enable the body to maintain a normal body pH by regulating the levels bicarbonate and hydrogen ions in the blood. Metabolism of dietary proteins leads to the production and accumulation of hydrogen ions (H+) in the blood (Deshmukh & Wong, 2009). Excess H+ ions are released into the urine by the kidneys, thus facilitating their elimination from the body.

**Regulation of Blood Osmolality**

The kidneys enable the body to maintain the osmotic balance of the body through a process called osmolality. In order for body cells to function well, they need to maintain their fluid and electrolyte balance in an isotonic environment (Deshmukh & Wong, 2009). Therefore, the kidneys regulate the amount of water in the body by allowing excretion of excess water in the urine when an individual takes a large amount of water and stimulate reabsorption of water back into the blood in the case of dehydration.

**Regulation of Blood Pressure**

To maintain homeostasis, the kidneys monitor the blood pressure. When the blood pressure rises above normal, the kidneys respond by reducing the volume of blood in the body by reducing the reabsorption of water into the blood, thus reducing the blood pressure (Deshmukh & Wong, 2009). However, when the blood pressure drops below normal, the kidneys respond by increasing the reabsorption of water into the blood by producing enzyme renin that constricts the blood vessels. Increased reabsorption of water into the blood raises the blood pressure.

**Selective Reabsorption**

The kidney is made up of several tiny structures known as the nephrons which enable the kidney to filter blood and produce urine. These structures are the functional units of the kidney. The blood is delivered into the glomerulus inside the kidney by the arterioles. During this process, much of the blood plasma is filtered out of the blood capillaries into the glomerulus as the blood cells continue to flow through the capillaries (Deshmukh & Wong, 2009). As this liquid filtrate continues to flow, useful substances such as water are selectively reabsorbed into the bloodstream as the waste products are secreted into the filtrate where they are passed out in form of urine.

**Storage and Excretion of Waste**

The ureters, urinary bladder, and the urethra play a significant role in storing and excreting waste in form of urine. Urine which is formed in the kidneys is transferred to the urinary bladder through the ureters where it is stored until the body is ready for excretion (Deshmukh & Wong, 2009). Once the volume of the bladder reaches its maximum, the urine is released out through the urethra.

**How Polycystic Kidney Disease (PKD) Leads to an Abnormal Anatomy and Physiology of the Urinary System**

The Polycystic Kidney Disease (PKD) leads to the growth of several cysts in the kidneys. The cysts damage the tissues of the kidneys by replacing the kidney tissues and enlarging them thus changing the anatomy of the renal system (Cornec-Le Gall et al., 2016). PKD may also change the physiology of the renal system if the disorder is not diagnosed and treated earlier.

 The autosomal dominant polycystic kidney disease may have adverse effects on the kidney. Continued multiplication and enlargement of the cysts cause the normal kidney tissue to be replaced. This condition leads to progressive kidney failure which is a severe renal condition that may require a kidney transplant or frequent dialysis. Kidney (renal) Failure is considered an End-Stage Renal Disease (Cornec-Le Gall et al., 2016). In early childhood, Autosomal Dominant Polycystic Kidney Disease does not lead to End-Stage Renal Disease; the condition arises later in life and causes renal failure.

The physiology of the urinary system is adversely affected once an individual develops acute renal failure because the ability of the kidneys to filter waste products from the blood reduces. Once the filtering ability of the kidneys is lost, thus harmful waste products may accumulate in the blood and affect the normal functioning of body cells.

**Conclusion**

The urinary (renal) system consists of the urethra, bladder, ureters and the kidney. The main function of the urinary (renal) system is to maintain the process of homeostasis within the body, regulate the pH of the blood, regulating the pressure and volume of blood, regulating the blood osmolality, facilitating selective reabsorption of useful substances back into the blood and excreting waste. The normal function of the urinary system can adversely be affected by various urinary system disorders such as the Polycystic Kidney Disease (PKD) which may lead to renal failure that affects the filtering ability of the kidneys. such disorders may lead to the accumulation of harmful waste productions in the blood.

**References**

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