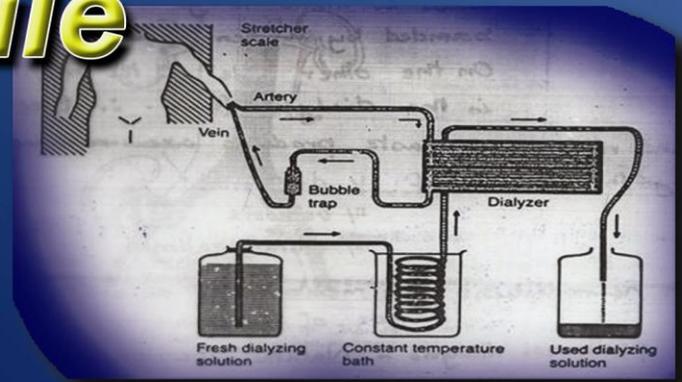


# Renal Module

## Phase I



FACULTY OF MEDICAL SCIENCES  
UNIVERSITY OF SRI JAYEWARDENEPURA



# RENAL MODULE PHASE I

# INTRODUCTION

You have learnt about how the body maintains the internal environment of the body constant in relation to extra cellular fluid volume(ECF), osmolality, electrolytes and pH. Subsequently, you have learnt about maintaining blood volume and blood pressure. Have you thought of any single system, which plays a major role in maintaining homeostasis that is vital for survival? You are welcome to find out how the urinary system performs this function.

Within the next 3 weeks you will learn about the structure and function of the kidney and the urinary tract. It is important for you to have a sound knowledge on this system as kidney diseases are common and can affect a person at any stage of their life. This knowledge will be applied when managing patients with renal and urinary tract disorders and indeed managing fluid and electrolyte balance in general.

# COMMITTEE

	<b>Name</b>	<b>Department</b>
<b>Chairperson</b>	<b>- Dr.D.M.S Fernando</b>	<b>Physiology</b>
<b>Convener</b>	<b>- Dr. M.A.M.N. Gamage Dr.N.R. Jazeel-</b>	<b>Paediatrics Physiology (current)</b>
<b>Members</b>	<b>- Dr. P. Hettiarachchi - Dr. S. Chandrasekara - Dr. J.K.P. Wanigasuriya - Dr. Nishantha Kumarasinghe - Dr. S Yasawardene</b>	<b>Physiology Surgery Medicine Anatomy Anatomy</b>

**Cover Page by – K.M.P.A Bandara. (Dept. of Medical Education)**

# **Overall Aim**

**At the end of the renal module you should acquire the knowledge in basic sciences of the normal structure and function of the urinary system in order to identify and manage the common signs and symptoms associated with its malformation and malfunction.**

## **General Objectives**

**The student should be able to**

1. Explain the development of the kidney and the urinary system and the basis of common urinary tract abnormalities
2. Describe the structure and the relations of the kidney, ureter bladder and urethra in the male and the female.
3. Describe the functions of the kidney and its role in homeostasis.
4. Describe the basis of features (Anatomical and Physiological and Biochemical) seen in common kidney disease.
5. Describe the normal mechanism of micturition and the functional/structural abnormalities that produce common voiding dysfunction.

# Contents

1. Embryological development of the kidneys and the urinary system
2. Developmental anomalies of the urinary system
3. Macroscopic and microscopic structure of the urinary system
4. Functions of the kidney and its role in regulating,
  - Extra cellular fluid volume
  - Sodium balance,
  - Potassium balance
  - Acid base balance
5. Mechanism of micturition and its abnormalities
6. The basis of common clinical features due to altered structure and function of the renal system

<b>Intermediate objectives</b> At the end of the module the learner should be able to	<b>Content area</b>	<b>Learning activity</b>	<b>Learning material</b>	<b>Duration</b>	<b>Department</b>
1. Describe the development of the urinary system	<ul style="list-style-type: none"> <li>• Explain development of the kidney, ureter, prostate, bladder and urethra (male, female) (A)</li> </ul>	Lecture and tutorial		2hrs	Anatomy and Surgery
2. Explain the embryological basis of the developmental anomalies of the urinary system	<ul style="list-style-type: none"> <li>• Developmental anomalies of the kidney, ureter, bladder and urethra (male and female) (A)</li> </ul>				
3. Describe the structure of the kidney in relation to its function	<ul style="list-style-type: none"> <li>• Explain the position, relations, poles, borders, hilus and contents (A)</li> <li>• Explain clinical significance of renal fascia and perinephric fat (A)</li> <li>• Structure: cortex, medulla, pelvis and calyces (A)</li> <li>• Structure of a nephron (A)</li> <li>• (Bowman's capsule, PCT, LOH, DT, CD) and its relation to the function</li> </ul>	2 dissection sessions	Practical manual	6 hrs	Anatomy
		1 Histology practical/ demonstration		3 hrs	Anatomy
		1 lecture		1hr	Anatomy
4. Explain the renal blood supply and the role of renal nerves in relation to its function	<ul style="list-style-type: none"> <li>• Renal artery and its branches, renal vein (A)</li> <li>• Renal plexus of nerves (A)</li> <li>• Measurement of renal blood flow (A)</li> <li>• Autoregulation of renal blood flow (A)</li> <li>• Lymphatic drainage (A)</li> </ul>	Lecture		1 hr	Physiology

A- must know  
B-good to know  
C-nice to know

<p>5. Explain the structure of the glomerular capillary membrane and the process of forming the filtrate</p>	<ul style="list-style-type: none"> <li>• Components of the glomerular capillary membrane and its structural adaptations (A)</li> <li>• Define Glomerular filtration rate (GFR) (A)</li> <li>• List the factors affecting GFR (A)</li> <li>• Outline the characteristics of a substance used to measure the GFR and explain the principle of using such a substance to measure GFR (A)</li> <li>• Define renal clearance of a substance (A).</li> <li>• Assessment of renal function in clinical practice using, Blood urea Serum creatinine Creatinine clearance (A)</li> </ul>	<p>Lecture</p>		<p>1hr</p>	<p>Physiology</p>
<p>6. Describe the structural adaptations of different parts of the tubule and its functions</p>	<ul style="list-style-type: none"> <li>• Define the renal threshold and tubular maximum (A)</li> <li>• Outline the absorptive and secretory functions of different parts of the nephron in relation to glucose, Na<sup>+</sup>, Ca<sup>++</sup>, K<sup>+</sup>, Phosphate, H<sup>+</sup>, urea, Uric acid and water (A)</li> <li>• It's application to tubular dysfunction (B)</li> </ul>	<p>Lecture</p> <p>Tutorial</p>		<p>1hr</p> <p>1hr</p>	<p>Physiology</p>



10.Explain the role of kidney in forming concentrated and diluted urine	<ul style="list-style-type: none"> <li>• Countercurrent mechanisms in renal medulla &amp; papillae (A)</li> <li>• The role of the LOH as a counter current exchange system and vasa recta as a counter current multiplication system and the role of these in maintaining medullary hypertonicity (A)</li> <li>• Actions of ADH &amp; its role in concentrating and diluting urine (A)</li> </ul>	Lecture		1hr	Physiology
		Practical		3hrs	Physiology
11. Describe the mechanism of diuresis	<ul style="list-style-type: none"> <li>• Definition of diuresis.(A)</li> <li>• Water diuresis and osmotic diuresis with examples. (A)</li> <li>• Describe how the following produce a diuresis (B) Water, ethanol, mannitol, glucose, caffeine, carbonic anhydrase inhibitors, loop diuretics and K<sup>+</sup> sparing diuretics</li> </ul>	Lecture		1hr	Physiology
		SGD		2hrs	Physiology
12. Describe the role of the kidney in maintaining acid base balance	<ul style="list-style-type: none"> <li>• Urinary buffers &amp; explain briefly functions of each buffer in acidifying the urine (A)</li> <li>• Renal contribution in regulating H<sup>+</sup> balance (A)</li> <li>• Renal compensation in acid base disorders (A)</li> </ul>	Lecture		1hr	Physiology



<p>16. Describe the normal mechanism of micturition and the functional/structural abnormalities that produce common voiding dysfunction</p> <p>16a. Describe the normal and abnormal constituents of urine</p>	<ul style="list-style-type: none"> <li>• The mechanism of micturition (A)</li> <li>• The anatomical /physiological basis of voiding dysfunction (A)</li> </ul> <p>*cells *deposits *calculi (A)</p>	<p>Lecture</p> <p>Demonstration during Physiology practical</p>		<p>1 hr</p> <p>3hrs</p>	<p>Physiology</p> <p>Surgery</p> <p>Physiology</p>
<p>17. Explain the structural/functional derangement that produce the signs and symptoms of common renal diseases (Nephrotic syndrome, ARF, CRF)</p>	<ul style="list-style-type: none"> <li>• Nephrotic syndrome-Proteinuria , Oedema,</li> <li>• ARF- Oliguria, Hypertension, Oedema Hyperkalaemia</li> <li>• CRF-Polyuria, Uremia, Electrolyte imbalances. Hormonal abnormalities, Anaemia, Bone disease</li> </ul>	<p>Seminar</p> <p>Real patient/ case scenario</p>		<p>2hrs</p>	<p>Physiology</p> <p>Medicine</p> <p>Paediatrics</p> <p>Surgery</p>

## Reading materials

1. Review of medical Physiology, by William F Ganong  
Sections :Formation and excretion of urine, Regulation of extracellular fluid composition and volume .
2. Langman's medical embryology by T.W. Sadler ,  
Chapter Urogenital system
3. Human embryology by Inderbir Singh and G.P. Pal  
Chapter Urogenital system
4. Cunningham's manual of practical anatomy : Volume 02
5. Clinical Anatomy by Harold Ellis
6. Wheater's functional Histology ; Chapters: Urinary and Male reproductive systems.
7. Clinical Medicine by Praveen Kumar and Michael Clark :  
Chapters Renal disease, Water, electrolyte and acid base balance.

## **Case Scenario 01**

One of your friends developed severe pain in the lower back which radiated from loin to groin ,was colicky in nature and intermittent(comes and goes). He was admitted to Colombo South Teaching Hospital.

At the ward he was given an intra muscular injection and the pain subsided. The medical officer has explained to him that the pain was most probably due to a stone in the ureter and advised to take a X-Ray. The doctor confirmed the presence of a stone in the ureter. He was discharged after giving a date for an ultrasound scan.

**You came to know about these details when you visited him. After you returned home you wanted to know the relationship between the stone in the ureter and the nature of the pain and why it was radiating from loin to groin. You also wanted to know the pathway of the ureter and the common sites for stones.**

## Case Scenario 02

One of your uncles met with an accident and had severe bleeding from multiple wounds. You went to see him and found that he was given blood and intravenous fluids. Having learned that you are a medical student, the house officer gave you permission to look at his case notes. Following details were documented on admission to the casualty surgical ward.

- Pulse-110 beats/min
- BP- 80/70 mmHg
- Urine output (low) 10ml/hour
- Bleeding+++ from the leg wound

### Management

Immediate suturing of leg wound

Monitor pulse and blood pressure quarter hourly

Monitor urine output hourly

Maintain input output chart

Continue IV fluids

Blood for grouping

Cross match 4 units of blood

**You like to know why the medical officer has made the above notes following an acute haemorrhage**

## **Case Scenario 03**

Mrs. Ekanayaka is your O/L mathematics teacher. She spoke to you about her 18 year old grandson's long term renal problem. She inquired about regular blood tests that were done on him such as blood urea, serum electrolytes, Haemoglobin. They have been asked to get prepared for a kidney transplantation. You asked her the details she wanted to know and obliged to give her the information.

She wanted to know,

**Why her was on various drugs and why there were dietary restrictions when there is long term renal disease?**

**Why were regular blood tests done?**

**What was assessed by collecting urine for 24 hrs and a blood sample?**

**Why does he need a kidney transplant?**

**Who can donate a kidney?**

**Where will he have the skin scar?**

**Will he need to take any medicine after the kidney transplant? If so for how long?**