

MEDTEC SCHOOL

Course: Organ system disease 2: Kidney and Genito-urinary system

Year (1st-2nd-3rd-4th-5th-6th): __4th__

Period (1st-2nd semester - annual): __1st semester__

Credits: __5__

Objectives

Nephrology:

This module is designed to provide comprehensive teaching of the pathophysiology and clinical aspects of kidney diseases, electrolytes and acid-base disorders.

The most recent diagnostic and therapeutic tools in the management of patients with kidney diseases, included innovations in dialysis, will be discussed.

Students are invited to refer to the textbooks to deepen the issues covered in the lessons.

Urology:

This module will provide a complete overview on Urology diseases (diagnosis and preoperative staging) and their relative management. Specifically, the topics treated will include: urothelial carcinoma, kidney tumors, benign prostatic hyperplasia, prostate cancer, testicular and penile cancer, urinary tract infections.

General surgery:

This module focuses on the management of patient along the surgical path: from choosing the right candidate for surgery to postoperative follow-up.

Specifically, the student will explore the different phases of the surgical path which comprise three well defined steps: preoperative, intraoperative and postoperative.

- In the preoperative phase the topics will include patients selection, prehabilitation and nutritional status.
- In the intraoperative phase the different operative theater actors will be described. An introduction on surgical training will be developed. Furthermore, information of sterility and surgical materials will be described.
- In the postoperative phase the aspects of Enhanced recovery program will be addressed as well as the more modern concept of telemedicine in terms of follow-up.

This module include also a lecture on robotics in general surgery and a further lesson on artificial intelligence application. Additionally, a lecture on application of technology in the OR will be provided.

Prerequisites

Anatomy, Physiology, General Pathology.

Contents

NEPHROLOGY

Lesson 1 – Introduction to Nephrology

- Describe the physiology and the major functions of the kidneys:
 - excretion of waste products
 - control of body fluids and pressure
 - electrolyte homeostasis and acid-base balance
 - production of hormones
- Discuss glomerular filtration rate (GFR) regulation under physiological and pathological conditions (e.g. intravascular volume depletion or fluid overload)
- Discuss how GFR is measured or estimated, knowing the pros and cons of estimated GFR formulas
- Collect a detailed clinical history and perform an in-depth physical examination in order to diagnose renal diseases and their causes
- Discuss the causes and the differential diagnosis between acute and chronic kidney dysfunction
- Describe normal and pathological urinalysis and normal and pathological urine sediment
- Recall the main immunological investigations required for the diagnosis of some causes of intrinsic acute renal failure

Lesson 2 – Imaging of the urinary tract

- Describe the main techniques used to assess the genitourinary tract (conventional radiography and intravenous urography/pyelography, ultrasound, computed tomography, magnetic resonance, kidney scintigraphy)
- Discuss how kidney function may be evaluated with kidney scintigraphy
- Briefly describe the main radiological alterations in nephrology: kidney cysts and masses, nephrolithiasis, kidney infections, renal artery stenosis, prostatic disease
- Describe the radiological appearance at renal ultrasound of the kidneys in chronic kidney disease

Lesson 3 – Extracellular Fluid Volume and Sodium Disorders

- Describe causes, clinical features, diagnostic approach and principles of therapy of disorders of sodium and water homeostasis (hypernatremia and hyponatremia)
- Discuss the forces involved in edema formation
- Describe the pathogenesis of edema. Discuss how edema forms in congestive heart failure, cirrhosis and nephrotic syndrome
- Discuss the rationale and the clinical use of diuretics in fluid overload and edema

Lesson 4a – Potassium disorders

- Describe causes, clinical features, diagnostic approach and principles of therapy of hyperkalemia and hypokalemia

Lesson 4b – Calcium and Phosphorus Disorders

- Describe the physiology of calcium and phosphorus metabolism

- Describe causes, clinical features, diagnostic approaches and principles of therapy related to calcium and phosphorus

Lesson 5 – Acid Base Disorders

- Discuss how acid-base balance is assessed in clinical practice
- Describe the causes, clinical features, diagnostic approach and principles of therapy of:
 - metabolic acidosis
 - metabolic alkalosis
 - respiratory acidosis and alkalosis
 - mixed acid-base disturbances

Lesson 6 – The Approach to Glomerular Disease Syndromes and Renal Biopsy

- Define isolated urinary abnormalities and macroscopic hematuria of glomerular origin
- Define nephrotic syndrome and recall the major primary and secondary causes
- Define nephritic syndrome and rapidly progressive renal insufficiency recall the major primary and secondary causes
- Discuss the indications for renal biopsy, the contraindications and the potential harmful consequences
- Describe the histology of the glomerulus, underlining the possible sites of damage (capillaries, endothelial epithelium, basement membrane, visceral epithelium, urinary space and mesangium)
- Discuss the main histologic patterns of glomerular diseases
- Regarding the distribution of glomerular changes, define the terms focal, diffuse, segmental and global
- Describe the definitions: tip lesion, collapsing lesion, endocapillary proliferation, mesangial hypercellularity, extracapillary proliferation and crescents

Lesson 7 – Major Primitive Glomerulonephritis

- Define primary glomerulonephritis (GN)
- Describe the most frequent subtypes of primary GN, focusing on their clinical presentation, physiopathology, and natural course
- Discuss whether, when and how a patient with a defined primary GN should receive “etiologic” treatment to prevent the disease progression
- Recognize the signs or symptoms that may raise suspicion of the presence of a glomerular disease
- Know the clinical approach for the diagnosis of primitive glomerulonephritis
- Discuss the prognosis of primitive glomerulonephritis
- Describe the histology of the most frequent primitive GN

Lesson 8 – Secondary Glomerular Diseases

- Describe the most frequent types of secondary glomerular diseases, focusing on their clinical presentation, physiopathology, and natural course
- Define the classification of vasculitides, identifying those of renal significance
- Discuss the epidemiology, causes, clinical features, diagnostic approach and principles of therapy of vasculitides

- Describe the renal involvement in systemic vasculitides, with particular attention to the etiopathogenesis and to the natural history and prognosis of these diseases
- Briefly discuss the epidemiology, etiopathogenesis and clinical features of systemic lupus erythematosus (SLE)
- Describe renal involvement in SLE (lupus nephritis)
- Describe the renal histopathological patterns of vasculitis and SLE
- Describe the main therapies for SLE and its prognosis
- Discuss anti-GBM disease
- Define pathogenesis of monoclonal gammopathy of renal significance (MGRS), focusing on the different types of renal involvement in B-cell or plasma-cell clonal disorders
- Discuss how to evaluate patients with suspected MGRS
- Discuss the management of MGRS

Lesson 9 – Acute Kidney Injury (AKI): overview and Pre-renal AKI

- Define AKI considering its current classification (KDIGO Clinical Practice Guideline for Acute Kidney Injury)
- Discuss the current epidemiology of AKI, considering the differences between community- and hospital-acquired AKI
- Describe symptoms and signs of AKI and those of the conditions that can precipitate it
- List the most threatening consequences of AKI that may require an urgent dialytic treatment
- Describe the etiopathogenetic classification of AKI (pre-renal, intra-renal, post-renal), bearing in mind the principal causes of AKI in each category
- Describe the diagnostic approach to a patient with AKI
- Describe the pathophysiological bases of kidney damage in pre-renal AKI
- Describe the main causes, the diagnostic approach and the principles of therapy of pre-renal AKI
- Discuss what options are available for volume resuscitation and the guiding principles behind intravenous fluid replacement

Lesson 10 – Acute Kidney Injury (AKI): intra-renal and post-renal AKI

- List the main causes of intrinsic AKI and discuss the etiopathogenetic mechanisms of kidney damage (glomerulonephritis, vasculitis, rhabdomyolysis, hemolysis, radiocontrast agents, hematological and oncological diseases, thrombotic microangiopathy, malignant hypertension, atheroembolic disease and toxins/drugs)
- Discuss the etiopathogenesis of acute tubular necrosis (ATN) and describe the histopathological picture
- Describe clinical picture, diagnostic approach and principles of therapy of ATN
- Describe the main causes of acute and chronic tubulo-interstitial nephritis
- Discuss the mechanisms of drug-induced nephritis
- Describe the different mechanism through which NSAIDs may affect kidney function
- Describe the main clinical features of thrombotic microangiopathy
- Describe the main causes of post-renal AKI
- Discuss the pathophysiology of AKI caused by an obstructive-disease
- Discuss the most useful tests for the diagnosis of urinary tract obstruction
- Discuss the epidemiology, causes, clinical features, diagnostic approach and principles of therapy of retroperitoneal fibrosis

Lesson 11 – Hepatorenal and Cardiorenal Syndrome

- Define hepatorenal syndrome
- Discuss the pathophysiological mechanisms of hepatorenal syndrome
- Describe the clinical features, diagnostic approach and principles of therapy of hepatorenal syndrome
- Define cardiorenal syndrome and its classification
- Discuss the pathophysiological mechanisms of cardiorenal syndrome
- Describe the management of cardiorenal syndrome

Lesson 12a – Diabetic Nephropathy

- Briefly describe the main types of diabetes mellitus (causes, symptoms, diagnostic approach and principles of therapy)
- Describe the epidemiology, clinical presentation and clinical course of diabetic nephropathy
- Discuss the strategies that may be adopted to slow diabetic nephropathy progression
- Describe the histopathological patterns of diabetic nephropathy

Lesson 12b – Hypertension

- Describe the pathophysiology of nephroangiosclerosis and its implications of kidney function Define hypertension and discuss the major classifications
- Describe how BP must be correctly measured
- Discuss the etiopathogenetic classification of hypertension, with particular emphasis on the renal causes of hypertension
- Discuss the pathophysiological mechanisms through which parenchymal renal disease may lead to the development of hypertension
- Define the clinical features and diagnostic approach of renovascular disease, recalling differential diagnosis with other forms of hyperaldosteronism
- Discuss the therapy and clinical outcomes of hypertension in patients with renal disease
- Describe the epidemiology, clinical presentation and clinical course of hypertensive nephropathy
- Describe the histopathological patterns of hypertensive nephropathy
- Discuss the management of hypertensive nephropathy and the strategies that may be adopted to slow its progression

Lesson 13 – Chronic Kidney Disease

- Know the definition and the staging of chronic kidney disease (CKD), according to KDIGO guidelines
- Describe the clinical features of CKD, including those of terminal uremia
- Discuss how to distinguish CKD from AKI through the patient's history, laboratory tests and imaging
- Discuss the two most common causes of CKD in Western countries: diabetic nephropathy and vascular nephroangiosclerosis
- Describe the consequences of CKD on water and electrolyte homeostasis (volume expansion, hyperkalemia, acidosis, hypocalcemia and hyperphosphatemia)
- Discuss the rationale of nutritional therapy in CKD
- Briefly describe what treatments slow the progression of CKD and improve symptoms

- Discuss the most relevant aspects in the preparation of CKD patients for renal replacement therapies
- Describe the effects of CKD on mineral metabolism, including secondary and tertiary hyperparathyroidism and renal osteodystrophy
- Discuss the major therapeutic approaches to bone disorders in CKD
- Discuss the clinical features of anemia in CKD patients
- Discuss the therapeutic approaches to anemia in CKD, including erythropoiesis-stimulating agents (ESAs)
- Discuss the pathophysiological basis of cardiovascular disease in CKD

Lesson 14 – Cystic Diseases and Other Hereditary Kidney Disorders

- Define the clinical criteria for diagnosis of autosomal dominant polycystic kidney disease (ADPKD) and describe the pathogenesis and clinical history of ADPKD, autosomal recessive polycystic disease, cystic disease of the renal medulla, and acquired cystic kidney disease
- Describe inherited disorders associated with generalized dysfunction of the proximal tubule (renal tubular acidosis [RTA] type 2 and Fanconi syndrome)
- Describe inherited disorders associated with specific distal tubule transport defects (RTA Type 1 and 4, Bartter syndrome, Gitelman syndrome, Liddle syndrome)
- Describe the epidemiology, clinical presentation and clinical course of Alport syndrome and Fabry disease

Lesson 15 – Dialysis

- Briefly describe the features of hemodialysis and peritoneal dialysis, recalling the underlying physical principles
- Briefly describe the continuous renal replacement therapy types, recalling the underlying physical principles
- Describe the types of vascular access for hemodialysis

Lesson 16 - Technical approach to the renal replacement therapy: circuit, membrane and prescription in acute and chronic kidney disease

- Describe the dialysis circuit, focusing on its components and their functioning
- Discuss the indications for dialysis in the setting of AKI and CKD

Lesson 17 – Kidney Transplantation

- Briefly describe kidney transplantation, knowing the steps and the procedures that precede the transplantation
- Describe the pathophysiology of the different types of rejection (hyperacute, acute and chronic; cellular and antibody-mediated) in kidney allotransplantation
- Describe the main pathologic events other than acute rejection that can occur in the early and in the late post-transplant period
- Describe the immunosuppressive drugs used to protect transplanted kidney from rejection, outlining pros and cons of these drugs

Lesson 18 – Conclusion of the Nephrology Module (students' questions, clinical cases, exam simulation)

- Learn how to discuss a clinical case
- Self-assessment

UROLOGY

Lesson 1 Urothelial carcinoma

- Describe the epidemiology and main aetiological factors at the basis of urothelial carcinomas
- Discuss the clinical manifestations of bladder and upper urinary tract carcinomas
- Describe the diagnostic work-up of haematuria
- Understand the pathological distinction and natural history of non-muscle invasive bladder cancer and muscle-invasive bladder cancer
- Overview of the main treatment options available for non-muscle invasive bladder cancer (transurethral resection, intravesical chemotherapy)
- Overview of the natural history of muscle-invasive bladder cancer and the available treatments

Lesson 2 Kidney tumors

- Overview of the natural history of kidney cancer and the surgical and medical treatments available
- Describe the epidemiology and clinical manifestations of renal cancer
- Define the pathological classification and natural history of benign and malignant renal cancers, including renal cyst classification.
- Discuss the diagnostic work-up of renal cancer
- Describe the main surgical and minimally-invasive treatments for localized renal cancer
- Describe the natural history of metastatic kidney cancer: sites of metastasis spreading and role of surgery

Lesson 3 Benign prostatic hyperplasia (BPH)

- Describe the anatomy and physiology of the prostate gland
- Understand the pathophysiology of micturition and the effects of aging on the male genital tract
- Understand the clinical presentation of bladder outlet obstruction and evaluate lower urinary tract symptoms impact on quality of life and potential clinical consequences, including the complications of untreated BPH
- Discuss the diagnostic work-up of patients with BPH
- Discuss the main medical and surgical therapeutic options available for BPH

Lesson 4 Prostate cancer

- Acquire knowledge on the epidemiology and natural history of prostate cancer.
- Define the pathological characteristics of prostate cancer: classification, Gleason score grading and staging.
- Analyze the screening protocols and diagnostic work-up of prostate cancer with a focus on laboratory testing, imaging techniques and prostate biopsies.

- Describe the main treatment options for localized prostate cancer
- Describe the natural history of advanced prostate cancer and medical therapy available

Lesson 5 Testicular and Penile Cancer

- Describe the epidemiology of testicular and penile cancer
- Describe the main characteristics of testicular cancer: clinical manifestations, risk factors and histological classification
- Describe the main characteristics of penile cancer: clinical manifestations, risk factors, histological classification
- Describe the diagnostic work-up of patients with testicular and penile cancer
- Describe the therapies available for testicular cancer: surgery, including orchiectomy and retroperitoneal lymph node dissection, subsequent follow-up strategies and systemic therapies
- Describe the therapies available for penile cancer: surgery, including local and lymph node management and systemic therapies

Lesson 6 Urinary Tract Infection

- Describe the epidemiology of urinary tract infections (UTI), their pathogenesis and risk factors
- Describe how to classify infections from an anatomical and clinical perspective
- Describe the clinical presentations of UTI and the most frequently associated pathogens
- Define the approach of a patient with UTI, describing the diagnostic work-up of UTI, including laboratory and imaging tests
- Define the main therapeutic options in patients with UTI

SURGERY

LESSON 1 : Preoperative management of patients undergoing surgery

- Describe the management of patients before surgery, evaluation of risk factor for complication, selection of the right candidate for surgery, prehabilitation, nutritional status, the emotional status as a proxy of complications.

LESSON 2: Intraoperative and postoperative management (minimally invasive surgery and enhanced recovery pathway)

- Describe an operative room set up and tools for minimally invasive approach, basic concepts and definition of minimally invasive surgery, impact of minimally invasive surgery on body homeostasis, advantages of laparoscopic surgery, patients selection in minimally invasive surgery, concept of single incision laparoscopy and possible advantages over multiport laparoscopy, basics concepts of enhanced recovery program after surgery (management of pain, thrombosis risk, postoperative ileus).

LESSON 3: Intraoperative fluid administration during general surgery

- Introduction to the ERAS concepts of fluid balance and pressure optimization, use of fluids in the perioperative period and role in preventing postoperative complications.
- Factors associated to fluid overload and fluid depletion and intraoperative policies of fluid administration.
- Goal-directed vs. liberal/restrictive pathways of fluid administration.

LESSON 4: Application of Robotics:

- Evolution of general surgery in steps (open, laparoscopic, robotic). Definition of robotics, introduction of the first robot and evolution of platforms. Describe potential advantages of robotic platforms. Potential market expansion of robotic platforms. Basic and common characteristics of robotic platforms (arms, docking system, console). General definition of robotics and actual robotic forms in the health system. Actual design of robotic system available in the market. Potential field of improvement with digital platforms (teaching, research). Limits of robotic systems in terms of costs and human responsibility.

LESSON 5: Application of technology

- *Fluorescence angiography*: potential application and benefits, mechanism of action of indocyanine green, main messages of available studies in the literature (retrospective, randomized clinical trial). Other applications besides perfusion assessment (tumor/metastasis detection, anatomy enhancement- urethers). Unmet needs of actual fluorescence technology.
- *Stapling devices*: history of stapling devices, rationale behind its application (standardization of surgery), type of staplers available

LESSON 6: Artificial intelligence

- Definition of AI and potential application fields in health care, expansion market of AI and top applications in healthcare, areas of intervention, advancements expected with AI in health care (access to care, speed of care, methods of diagnosis, continuous learning and improvement)

Teaching Methods

Frontal lessons

Students are encouraged to actively participate to the lectures with questions and comments.

Assessment

Written exam: the written exam is based on a MCQ test divided into 3 blocks of 20 (Nephrology), 5 (Urology), 5 (General Surgery) questions respectively, according to the number of hours of frontal lessons used for each discipline.

To pass the written exam, students must give correct answer to at least 60% of all questions, without scoring less than 50% in each specific discipline.

Example: to pass the written exam, correct answer must be given to 12/20 question for Nephrology and 3/5 for Urology and General Surgery respectively.

Oral exam: student scoring at least 60% in the written exam may, optionally, access the oral exam in order to redefine the final score for whole the module. The oral exam is a discussion of one key topic in Nephrology, Urology and General Surgery. The student will possibly also be asked to contextualize these topics in a clinical case.

Texts

- National Kidney Foundation Primer on Kidney Diseases, 8th Edition, Elsevier (recommended)
- Comprehensive Clinical Nephrology, 6th Edition, Elsevier (just for the deepening of selected topics)

Online resources

- AJKD Core Curriculum in Nephrology (<https://www.ajkd.org/content/corecurriculum>)
- AJKD Atlas of Renal Pathology II (<https://www.ajkd.org/content/atlasofrenalpathologyii>)
- KDIGO Guidelines (<https://kdigo.org/guidelines/>)
- 2018 ESC/ESH Clinical Practice Guidelines for the Management of Arterial Hypertension (<https://www.escardio.org/Guidelines/Clinical-Practice-Guidelines/Arterial-Hypertension-Management-of>)