



Medicine

Course: Nephrology and Urology

Year: 2023-2024

Period: 1st semester

Credits: 7

Faculty: Gabriella Moroni (coordinator, N), Francesco Reggiani (N), Marta Calatroni (N), Nicolò Buffi (U), Giovanni Lughezzani (U), Piergiuseppe Colombo (P), Salvatore Lorenzo Renne (P), Federica Catapano (R)

Legend: N=Nephrology, U=Urology, P=Pathology, R=Radiology

Contents

Objectives	3
Nephrology	3
Urology	4
Radiology	4
Pathology	4
Prerequisites	6
Contents.....	7
Nephrology	7
Urology	10
Radiology	11
Pathology	12
Teaching Methods	14
Assessment	15
Resources for studying.....	16
Nephrology	16
Urology	16
Radiology	16
Pathology	16

Objectives

Nephrology

This module is designed to provide comprehensive teaching of the pathophysiology and clinical aspects of kidney diseases. The objectives of the course are:

1. Identify and describe common kidney diseases and conditions.
2. Familiarize students with the diagnostic methods used in nephrology, including laboratory tests, imaging, and kidney biopsies.
3. Comprehend the principles of fluid, electrolytes and acid-base balance.
4. Gain familiarity with primitive and secondary glomerular diseases, recognizing the pathophysiology, clinical presentation and syndromes (e.g., isolated urinary abnormalities, nephrotic syndrome, nephritic syndrome and rapidly progressive glomerulonephritis), the histological features and the clinical/immunological diagnostic tests for differential diagnosis. Learn treatment strategies for glomerular diseases.
5. Define acute kidney injury (AKI), classify its different types, and recognize their etiology. Understand pathophysiology and clinical presentation. Learn how to perform a diagnostic evaluation and interpret the results for patients with AKI. Develop skills in managing and treating patients with AKI, including understanding potential complications and prognostic factors.
6. Define chronic kidney disease (CKD) and classify its stages. Identify the etiology and risk factors associated with CKD development. Understand the pathophysiology and recognize the clinical manifestations of CKD. Perform a diagnostic assessment and interpret the results for patients with CKD. Gain knowledge of medical management strategies for CKD, including dietary modifications and pharmacotherapy. Understand and manage complications associated with CKD.
7. Learn the principles and indications for hemodialysis, peritoneal dialysis, and renal transplantation. Recognize the techniques, complications, and management strategies associated with hemodialysis and peritoneal dialysis. Understand the evaluation and selection process for potential renal transplant recipients and donors. Recognize the complications associated with kidney transplantation.
8. Understand the etiology, pathophysiology, diagnosis, and management of hypertension, focusing on renal causes of hypertension and consequences of hypertension on kidney health.
9. Develop knowledge of renal involvement in other diseases, such as diabetes mellitus, heart failure, liver disease and dysproteinemias.
10. Understand the physiological adaptations of the renal system during pregnancy. Recognize and describe common renal pathologies associated with pregnancy and their implications for maternal and fetal health.
11. Identify different types of cystic and genetic kidney diseases, such as polycystic kidney disease (PKD) and Alport syndrome. Understand the underlying pathophysiology, clinical



presentation, diagnostic evaluation, and management options for cystic and genetic kidney diseases.

The course aims to provide the basic knowledge of nephrology while also promoting critical thinking towards nephrology topics. Upon achieving the aforementioned objectives, the student will be able to discuss nephrological clinical cases by providing diagnostic hypotheses and differential diagnoses, as well as developing appropriate diagnostic and therapeutic pathways.

Urology

1. Acquire an understanding of the normal anatomy and physiology of the urinary tract, as well as the aging effects on the male genital tract.
2. Understand the epidemiology, clinical manifestations, and diagnostic work-up of the most common urological malignancies.
3. Familiarize with the pathological classification of the most common oncological conditions of the urinary tract.
4. Provide an overview of the different therapeutic options available according to disease and patients' characteristics.
5. Understand the epidemiology, pathogenesis, and risk factors associated with UTIs.
6. Describe the symptoms and diagnostic work-up of patients suffering from UTIs or BPH and provide an overview of the potential therapeutic options.

Radiology

1. Provide students with a comprehensive understanding of the principles and applications of radiological imaging techniques in the evaluation of kidney and urinary system disorders.
2. Equip students with the necessary skills to interpret various types of nephrological radiological images, including X-rays, CT scans, MRI, and Ultrasound.
3. Foster critical thinking abilities in correlating clinical findings with radiographic images.
4. Encourage discussions on the implications of radiological findings on treatment plans and patient management in nephrology.

Pathology

At the end of the Course, students should have knowledge and understanding skills to be able to describe what is Urological Pathology; how does Pathology integrates in the management of a patient. The final goal will be to interpret all the information listed in the pathological report. In particular, students should be able to:

1. Interpret the terminology used in Urological Pathology report (histotype, grade; diagnosis, prognosis and prediction)
2. Explain the clinical significance of immunohistochemistry to diagnose a renal, urothelial, prostatic and testicular tumor.
3. Discuss the advantages and limits of cytology in urinary bladder neoplasm.



4. Discuss the significance of intraoperative examination in guiding surgeon's hand during surgery for prostatic and urinary bladder tumors.
5. Explain the role of biopsy sampling and surgical resection as regard the pathological staging and grading of tumors.



Prerequisites

Propaedeutic prerequisites: Mechanisms of diseases II.

General prerequisites

A good level of knowledge and understanding of the anatomy and physiology of the kidney and urinogenital system is an important prerequisite to fully understand and profit of the course content.

Contents

Nephrology

1. Fundamentals of nephrology

1.1. Description of the physiology and the major functions of the kidneys:

1.1.1. Excretion of waste products.

1.1.2. Control of body fluids and pressure.

1.1.3. Electrolyte homeostasis and acid-base balance.

1.1.4. Production of hormones.

1.2. How to perform a detailed clinical history collection and in-depth physical examination to diagnose renal diseases and their causes.

1.3. Glomerular filtration rate (GFR) regulation under physiological and pathological conditions. GFR measurement and estimation, considering the pros and cons of estimated GFR formulas.

1.4. Urinalysis and urine sediment interpretation.

1.5. Overview of main diagnostic methods used in nephrology, including laboratory tests and imaging.

2. Potassium disorders

2.1. Causes, clinical features, diagnostic approach and principles of therapy of hyperkalemia and hypokalemia

3. Disorders of water homeostasis and sodium

3.1. Causes, clinical features, diagnostic approach and principles of therapy of disorders of water homeostasis (hypernatremia and hyponatremia) and sodium (hypervolemia and hypovolemia).

4. Calcium, phosphorus and magnesium disorders

4.1. Physiology of calcium and phosphorus metabolism.

4.2. Causes, clinical features, diagnostic approaches and principles of therapy related to calcium and phosphorus.

4.3. Causes and consequences of hypermagnesemia and hypomagnesemia.

5. Acid Base Disorders

5.1. Acid-base balance assessment in clinical practice.

5.2. Causes, clinical features, diagnostic approach and principles of therapy of:

5.2.1. Metabolic acidosis.

5.2.2. Metabolic alkalosis.

6. Glomerular Disease Syndromes

6.1. Definition and pathophysiology of:

6.1.1. Isolated urinary abnormalities and macroscopic and microscopic hematuria of glomerular origin.

6.1.2. Nephrotic syndrome with its major primary and secondary causes.

- 6.1.3. Nephritic syndrome and rapidly progressive renal insufficiency with their major primary and secondary causes.
 - 6.2. Indications for renal biopsy, the contraindications and the potential harmful consequences.
 - 6.3. Description of renal pathological histology:
 - 6.3.1. Normal renal histology, underlining the possible sites of damage (endothelium epithelium, visceral epithelium, glomerular basement membrane, mesangium, urinary space and Bowman capsule).
 - 6.3.2. Main histological patterns of glomerular diseases:
 - 6.3.2.1. Classification of glomerular damages: focal, diffuse, segmental and global.
 - 6.3.2.2. Description of the following lesions: increase in mesangial cells and matrix, intracapillary and extra-capillary hypercellularity, glomerular capillary thrombosis, necrosis, collapsing capillary lesion and presence, type, and location of the immune deposits.
 - 6.4. Major Primitive Glomerulonephritis:
 - 6.4.1. Definition of glomerulopathy and of glomerulonephritis (GN).
 - 6.4.2. Demographic clinical and histological presentation of:
 - 6.4.2.1. Minimal change disease.
 - 6.4.2.2. Membranous nephropathy.
 - 6.4.2.3. Focal and segmental glomerulosclerosis.
 - 6.4.2.4. IgA nephropathy.
 - 6.4.2.5. Acute postinfectious glomerulonephritis
 - 6.4.3. Clinical course, complications, therapy, and prognosis.
 - 6.5. Secondary Glomerular Diseases:
 - 6.5.1. Vasculitis:
 - 6.5.1.1. Classification of systemic vasculitis, identifying those of renal significance.
 - 6.5.1.2. Description of demographic and clinical manifestations of systemic vasculitis with kidney involvement, with particular attention to etiopathogenesis.
 - 6.5.1.3. Kidney histopathological patterns of kidney vasculitis.
 - 6.5.1.4. Treatment and prognosis
 - 6.5.2. Systemic lupus erythematosus (SLE):
 - 6.5.2.1. Epidemiology, etiopathogenesis and clinical features of SLE.
 - 6.5.2.2. Renal involvement in SLE (lupus nephritis).
 - 6.5.2.3. Renal histopathological patterns of SLE.
 - 6.5.2.4. Main therapies for SLE and lupus nephritis prognosis.
 - 6.5.3. Anti-GBM disease.
 - 6.5.4. Henoch-Schoenlein purpura.
- 7. Acute Kidney Injury (AKI)**
- 7.1. AKI severity classification (KDIGO Clinical Practice Guideline for Acute Kidney Injury) and etiopathogenetic classification (pre-renal, intra-renal, post-renal).
 - 7.2. Pathophysiological bases of kidney damage and main causes of pre-renal, intra-renal and post-renal AKI.
 - 7.3. Epidemiology of AKI.

7.4. Symptoms and signs of AKI.

7.5. Diagnostic and therapeutic approach to AKI.

8. Pregnancy related kidney changes and diseases

8.1. Main kidney physiological changes in normal pregnancy.

8.2. Urinary changes during pregnancy, both physiological and pathological.

8.3. Pathophysiology, clinical course, and principles of therapy of hypertensive disorders of pregnancy (preeclampsia-eclampsia, chronic hypertension, gestational hypertension).

8.4. Pathophysiology, clinical presentation, clinical course, and principles of therapy of the main complications of pregnancy in patients with kidney diseases.

9. Dysproteinemias and Amyloidosis

9.1. Pathogenesis and diagnostic approach of monoclonal gammopathy of renal significance (MGRS) with focus on renal involvement in multiple myeloma and amyloidosis.

10. Hypertension

10.1. Hypertension definition and classification.

10.2. Pathophysiological mechanisms through which parenchymal renal disease may lead to the development of hypertension.

10.3. Clinical features and diagnostic approach of renovascular disease.

10.4. Blood pressure management with focus on management of hypertensive nephropathy (focus on role of RAAS inhibitors and SGLT-2 inhibitors).

11. Diabetic nephropathy

11.1. Brief description of the main types of diabetes mellitus (causes, symptoms, diagnostic approach and principles of therapy).

11.2. Epidemiology, clinical presentation and clinical course of diabetic nephropathy.

11.3. Histopathological patterns of diabetic nephropathy.

11.4. Strategies to slow diabetic nephropathy progression.

12. Cystic diseases and other hereditary kidney disorders

12.1. Clinical presentations, diagnosis and natural course of the main hereditary kidney disorders:

5.1.1 Autosomal dominant polycystic kidney disease (ADPKD).

5.1.2 Autosomal recessive polycystic kidney disease (ARPKD).

5.1.3 Alport syndrome.

5.1.4 Fabry disease.

12.2. Clinical manifestations of the inherited disorders associated with tubular dysfunction (Fanconi syndrome, Bartter syndrome, Gitelman syndrome, Liddle syndrome and renal tubular acidosis).

13. Hepatorenal and Cardiorenal Syndrome

13.1. Pathophysiology, clinical features, diagnostic approach and principles of therapy of hepatorenal syndrome.

13.2. Classification, pathophysiology and management of cardiorenal syndrome.

14. Chronic Kidney Disease (CKD)

14.1. Definition and staging of CKD, according to KDIGO guidelines.

14.2. Clinical and laboratory features of CKD, including those of terminal uremia.

- 14.2.1 Consequences of CKD on water and electrolyte homeostasis (volume expansion, hyperkalemia, acidosis, hypocalcemia and hyperphosphatemia).
- 14.2.2 Effects of CKD on mineral metabolism, including secondary and tertiary hyperparathyroidism and renal osteodystrophy.
- 14.2.3 Clinical features of anemia in CKD patients.
- 14.3. Differential diagnosis between CKD and AKI through the patient's history, laboratory tests and imaging.
- 14.4. Treatments of CKD, including nutritional therapy and treatments to slow the progression of CKD and improve symptoms.

15. Dialysis

- 15.1. Indications for dialysis in the setting of AKI and CKD.
- 15.2. Features of hemodialysis and peritoneal dialysis, recalling the underlying physical principles.
- 15.3. Continuous renal replacement therapy types, recalling the underlying physical principles.
- 15.4. Vascular access for hemodialysis.

16. Kidney Transplantation

- 16.1. Description of the steps and the procedures that allow the introduction to the transplant waiting list, for both the donor and the recipient.
- 16.2. Description of the immunosuppressive drugs used to protect transplanted kidney from rejection, outlining pros and cons of these drug.
- 16.3. Pathophysiology of the different types of rejection (hyperacute, acute and chronic; cellular and antibody-mediated) in kidney allotransplantation.
- 16.4. Complications other than acute rejection in the early and in the late post-transplant period.
- 16.5. Short- and long-term outcome of kidney transplant.

Urology

1. Urothelial Carcinoma

- 1.1 Epidemiology and etiological factors
- 1.2 Clinical manifestations of bladder and upper urinary tract carcinomas
- 1.3 Diagnostic work-up of hematuria
- 1.4 Non-muscle invasive bladder cancer:
 - 1.4.1 Pathology, natural history, and treatment options
- 1.5 Muscle-invasive bladder cancer:
 - 1.5.1 Natural history and treatment approaches

2. Kidney Tumors

- 2.1 Natural history of kidney cancer and available treatments
- 2.2 Epidemiology and clinical manifestations of renal cancer
- 2.3 Pathological classification of benign and malignant renal cancers, including renal cysts
- 2.4 Diagnostic work-up of renal cancer
- 2.5 Surgical and minimally-invasive treatments for localized renal cancer
- 2.6 Metastatic kidney cancer:

2.6.1 Natural history, sites of metastasis, and role of surgery

3. Benign Prostatic Hyperplasia (BPH)

- 3.1 Anatomy and physiology of the prostate gland
- 3.2 Physiopathology of micturition and aging effects on the male genital tract
- 3.3 Clinical presentation of bladder outlet obstruction and impact of lower urinary tract symptoms
- 3.4 Diagnostic work-up of patients with BPH
- 3.5 Medical and surgical therapeutic options for BPH

4. Prostate Cancer

- 4.1 Epidemiology and natural history
- 4.2 Pathological characteristics:
 - 4.2.1 Classification, Gleason score grading, and staging
- 4.3 Screening protocols and diagnostic work-up
- 4.4 Treatment options for localized prostate cancer
- 4.5 Natural history of advanced prostate cancer and medical therapies

5. Testicular Cancer and Penile Cancer

- 5.1 Epidemiology and clinical manifestations of testicular cancer
- 5.2 Histological classification and risk factors
- 5.3 Diagnostic work-up of testicular cancer
- 5.4 Surgical treatments: orchiectomy and retroperitoneal lymph node dissection
- 5.5 Follow-up strategies and systemic therapies
- 5.6 Epidemiology and clinical manifestations of penile cancer
- 5.7 Risk factors and histological classification
- 5.8 Diagnostic work-up of penile cancer
- 5.9 Surgical management: local and lymph node management
- 5.10 Systemic therapies

6. Urinary Tract Infection (UTI)

- 6.1 Epidemiology, pathogenesis, and risk factors
- 6.2 Classification of infections: anatomical and clinical perspective
- 6.3 Clinical presentations and associated pathogens
- 6.4 Diagnostic work-up of UTIs
- 6.5 Therapeutic options for UTIs

Radiology

1. Introduction to Nephrology Diagnostic Imaging: overview of X-ray, CT, MRI, and Ultrasound techniques, their applications, benefits, and limitations in nephrology.
2. Normal Radiographic Anatomy and Main Pathological Appearances: detailed review of the normal radiographic appearance of the kidneys and urinary system. Kidney stones, renal cysts, tumors, infections, and other renal and urinary system disorders.
3. Main techniques of Interventional Radiology in Urology: nephrostomy, arteriography and renal stenting, embolization of renal bleeding and embolization of varicocele.

4. Prostate Imaging: Introduction to prostate imaging techniques, including MRI, Ultrasound, and their use in prostate diseases.
5. Role of scintigraphy in the diagnosis of renal diseases.
6. Case-based Discussions: Review and discussion of clinical cases, correlating radiographic findings with clinical presentation and management in nephrology.

Pathology

1. Renal pyelonephritis and nephrosclerosis. Acute and chronic Prostatitis.

- 1.1. Describe the macroscopic anatomy of the kidney and its relationship with surrounding structure.
- 1.2. Describe the microscopic anatomy of the kidney and its relevance to pathology.
- 1.3. Describe epidemiology, clinical features, risk factors, macroscopic and microscopic features of acute pyelonephritis.
- 1.4. Describe epidemiology, clinical features, risk factors, macroscopic and microscopic features of chronic pyelonephritis.
- 1.5. Illustrate most common complications of pyelonephritis.
- 1.6. Describe the pathogenesis and morphologic features of nephrosclerosis and end-stage disease.
- 1.7. Illustrate etiology and pathological findings of prostatitis.

2. Kidney tumors

- 2.1. Describe the main symptoms and signs of renal tumors.
- 2.2. Illustrate and describe the gross and microscopic features of the clear cell renal cell carcinoma.
- 2.3. Describe the impact of grade and sarcomatoid change in renal cell carcinoma.
- 2.4. Illustrate the features used in renal cell carcinoma staging.
- 2.5. Describe the microscopic features of the papillary renal cell carcinoma.
- 2.6. Describe and compare gross and microscopic features of chromophobe renal cell carcinoma and oncocytoma.
- 2.7. Illustrate the role of immunohistochemistry in differential diagnosis of renal tumors.

3. Urinary bladder and urinary tract tumors

- 3.1. Describe the microscopic anatomy of the muscular layers of the urinary bladder.
- 3.2. Define a (bladder) diverticulum.
- 3.3. Indicate the epidemiology, risk factors and the morphological features of the neoplasms of the urothelium.
- 3.4. Describe the natural history of papillary and non-papillary neoplasms of the bladder with emphasis on in situ carcinoma, muscle invasiveness, multifocality, grading and staging;
- 3.5. Indicate the potential and limits of the different cytological and histological procedures in the diagnostics of urogenital tract tumours;
- 3.6. Indicate what information are needed for a pathological report of a urinary tract tumor to be complete.

4. Prostate pathology

- 4.1. Describe the zonal anatomy of the prostate, considering the different diseases and symptoms related to it.

- 4.2. Illustrate the morphological characteristics of benign prostatic hyperplasia.
- 4.3. Illustrate the epidemiology, risk factor and natural history of prostatic neoplasms.
- 4.4. Illustrate the diagnostic strategy of prostate cancer.
- 4.5. List the prognostic parameters of prostate cancer.
- 4.6. Illustrate staging in prostate adenocarcinoma and define its role as prognostic factor.
- 4.7. Define and compare the Gleason pattern, the Gleason score and the Grade group.
- 4.8. Indicate what information are needed for a pathological report of prostate carcinoma to be complete.

5. Testicular tumors

- 5.1. Describe the epidemiology of testicular tumor.
- 5.2. Describe the age distribution of different histotypes.
- 5.3. Illustrate the rationale for classification in testicular tumor.
- 5.4. Define germ cell neoplasia in situ and describe its pathogenetic role in germ cell neoplasia.
- 5.5. Define the terms prepubertal-type, postpubertal-type, pure, mixed and regressed germ cell tumor.
- 5.6. Illustrate the clinical, serological, gross, microscopic and immunohistochemical features of seminoma, embryonal carcinoma, yolk sac tumor, choriocarcinoma, teratoma.
- 5.7. Describe the staging system of testicular tumor.

6. Case-based Discussions

- 6.1. Discussion on clinical-histological cases.
- 6.2. Describe and correlate pathological findings with clinical presentation.
- 6.3. Illustrate peculiar microscopic findings as key elements for diagnosis in different topics of Uro-pathology.



Teaching Methods

This course will employ frontal lessons with interactive discussions of clinical cases, and quizzes. These methods will serve to assess the students' prerequisites and ensure their progressive acquisition of content.

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



Assessment

The final exam consists of a multiple-choice test with 60 questions (5 possible answers, only one correct answer). Proportionally to the CFU of each module, there will be 36 nephrology questions, while there will be 8 questions each for urology, radiology, and pathology. The content of the questions will assess the learning objectives described in the syllabus and will focus on the topics covered in class and present in the suggested textbooks. The questions may be structured both around clinical cases and more knowledge-based aspects. The time for completing the multiple-choice test will be 90 minutes.

To pass the exam, it is necessary to answer correctly at least 60% (36/60) of the questions. The grade for the written exam will be calculated as follows:

1. Each correct answer will be awarded one point.
2. There will be no negative marking for incorrect answers or unanswered questions.
3. The final grade will be assigned based on the following scale:

Points	Final Grade
<36	Failed
36	18
37-38	19
39-40	20
41-42	21
43-44	22
45-46	23
47-48	24
49-50	25
51-52	26
53-54	27
55-56	28
57-58	29
59	30
60	30 cum laude

Students who have attained a minimum of 60% correct answers in the written section will have the option to voluntarily undergo an oral examination, which may positively influence their final grade (max 4 points). However, it's important to note that a poor performance in the oral examination may also have a negative impact on the final mark (max 4 points).

This oral examination entails engaging in discussions on a selected nephrology topic and a urology topic with an evaluation committee, consisting of at least one professor of nephrology and one professor of urology.

Resources for studying

Nephrology

1. Textbook

1.1. National Kidney Foundation Primer on Kidney Diseases, 8th Edition, Elsevier

2. Teaching materials provided by the professors on the dedicated platform.

3. Online resources

3.1. National Kidney Foundation (www.kidney.org): provides information on various kidney diseases, patient resources, and educational materials.

3.2. UpToDate (www.uptodate.com): a comprehensive clinical resource that covers nephrology topics, including pathophysiology, diagnosis, and treatment approaches.

3.3. AJKD Core Curriculum in Nephrology (<https://www.ajkd.org/content/corecurriculum>)

3.4. AJKD Atlas of Renal Pathology II (<https://www.ajkd.org/content/atlasofrenalpathologyii>)

3.5. KDIGO Guidelines (<https://kdigo.org/guidelines/>)

Urology

1. Textbooks

1.1. Porpiglia Francesco; Urologia; Editore: Minerva Medica

1.2. Smith & Tanagho's General urology, Editore: Lange – McGraw Hill

2. Online resources: <https://uroweb.org/guidelines>

Radiology

1. William Herring. Learning Radiology (Third Edition). Elsevier.

2. Gunderman et al. Essential Radiology. Thieme

Pathology

1. Textbook

1.1. Aster, J. C., Abbas, A. K. (2020). Robbins & Cotran Pathologic Basis of Disease. Elsevier.

2. Teaching materials provided by teachers.

3. Online platform: <https://www.pathologyoutlines.com/>