



**Yarmouk University  
Faculty of Medicine**

**THE ENDOCRINE SYSTEM (MED 321)**

**2020/2021**

**Coordinator:** Dr. Fatimah Almahasneh  
**Contact email:** fatimah.mahasneh@yu.edu.jo  
**Office hours:** Sunday and Wednesday 10-12 am (contact by email only)  
**Lecture's time:** Sun-Thur 8:00-12:00 for lectures  
11:00-12.30 for practical sessions.  
**Lecture's hall:** Online

<b>Course No.</b>	<b>Course Title</b>	<b>Credit hours</b>
MED321	Endocrine System	6

Homeostasis of human body function is achieved through the complex interplay of several chemical messenger systems. These systems achieve a finely tuned coordination between the multiple activities of the cells, tissues and organs of the body. The collective action of these systems results in a stable internal environment compatible with the requirements of human life on this planet. The above system is generally composed of the following:

1. Neurotransmitters
2. Endocrine hormones
3. Neuro-endocrine hormones.
4. Paracrines
5. Autocrines
6. Cytokines

In this module, we will study the role of the endocrine system in maintaining homeostasis of the human body, keeping in mind that the function of this system is completely appreciated in isolation from the role played by the other chemical messenger systems. Indeed, interaction between these systems is an absolute requirement to achieve homeostasis. For example, the adrenal medullae and the pituitary gland secrete their hormones primarily in response to neural stimuli. We will also study how disruption of the endocrine system results in several disease states that could become endemic in nature (i.e: diabetes mellitus). Finally, we will go over major pharmacological remedies that attempt to regain homeostasis by directly modulating different components of this system.

### Textbooks

**\* Anatomy:**

- Principles of Human Anatomy. *G. J. Tortora*, Latest edition.
- Clinical Anatomy for Medical Students. *R.S. Snell*, Latest edition.
- Histology. *Gartner and Hiatt*, Latest edition.
- Before we are born. *K.L. Moore and T.V.N. Persaud*, Latest edition.

**\* Biochemistry:**

- Harper's Biochemistry. *Robert K. Murray and Co.*, Latest edition.
- Supplementary Departmental Handouts.

**\* Physiology:**

- Textbook of Medical Physiology. *Guyton and Hall*, Latest edition.
- Berne & Levy Physiology. *Koeppen and Stanton*, Latest edition.
- Review of Medical Physiology. *William F. Ganong*, Latest edition.

**\* Pathology:**

- Essential Pathology. *Emanuel Rubin*, Latest edition.
- Basic Pathology. *Kumar, Cotran and Robbins*, Latest edition.

**\* Pharmacology:**

- Goodman and Gilman's. The pharmacological basis of therapeutics. Latest edition.
- Lippincott's Illustrated Reviews: Pharmacology, Latest edition.

**\* Community Medicine:**

- Supplementary Departmental handouts.

### Course Objectives

By the end of this course, students are expected to understand:

1. Structures of various endocrine glands, their development, their histology and their blood supply.
2. The nature, functions, physiologic roles and mechanisms of action of hormones.
3. Hormone regulation and effects of deranged endocrine functions.
4. Pathogenesis, morphological changes and complications of diseases affecting the endocrine system.
5. The use of hormones and drugs in diagnosis and treatment of endocrine disorders.

### Assessment Strategy

Evaluation	Percentage of overall grade	Date
Mid exam (MCQs)	50%	10/12/2020
Final exam (MCQs)	50%	24/1/2020
<b>Total</b>	100%	

Course Specific Learning Objectives	
Title	Objectives
Morphology of the endocrine glands  (Anatomy)	<ol style="list-style-type: none"> <li>1. Review differences between endocrine and exocrine glands.</li> <li>2. List the endocrine glands.</li> <li>3. Describe the structure of endocrine glands.</li> <li>4. Describe the location, relation, blood and nerve supply and lymphatic drainage of endocrine glands.</li> </ol>
Introduction to endocrinology  (Biochemistry)	<ol style="list-style-type: none"> <li>1. Understand the nature of hormones.</li> <li>2. Describe hormone biosynthesis, secretion and transport.</li> <li>3. Understand targeting delivery and response of hormones.</li> <li>4. Understand hormonal interactions (systemic, cellular, synergistic and inhibitory).</li> </ol>
Introduction to endocrinology  (Physiology)	<ol style="list-style-type: none"> <li>1. Outline the role of hormones as an integral part of the control mechanism used to regulate different metabolic, developmental, growth and reproductive functions in the human body.</li> <li>2. Characterize the major hormonal biorhythms.</li> <li>3. Describe general aspects that govern regulation of hormone secretion.</li> <li>4. Describe how feedback relationship is important in determining the level of circulating hormones.</li> </ol>
Histology and embryology of endocrine glands - 1  (Anatomy)	<ol style="list-style-type: none"> <li>1. Describe the development of the endocrine glands (thyroid, parathyroid, pituitary, adrenal and pancreas).</li> <li>2. Describe the microscopic structure and cells of the pituitary gland.</li> <li>3. Describe the microscopic structure of thyroid follicle, follicular and parafollicular cells.</li> </ol>
Histology and embryology of endocrine glands - 2  (Anatomy)	<ol style="list-style-type: none"> <li>1. Describe the microscopic structure and cells of the parathyroid gland.</li> <li>2. Describe the zones and cells of the adrenal gland.</li> <li>3. Describe the microscopic structure of the pancreas.</li> </ol>

<p>Mechanisms of hormone actions (Biochemistry)</p>	<ol style="list-style-type: none"> <li>1. Describe the structure of cell membrane receptors and intracellular receptors for different hormones.</li> <li>2. Identify different types of second messengers.</li> <li>3. List the intracellular actions of all 2<sup>nd</sup> messengers.</li> <li>4. Understand the mechanism of 2<sup>nd</sup> messenger actions including PIP2 turnover (Ca<sup>+2</sup>/ protein kinase C systems), diacylglycerol (DAG) and NO.</li> <li>5. Describe the mechanism of action of peptide hormones</li> <li>6. Describe the mechanism of action of amino acid derivative hormones.</li> <li>7. Describe the mechanism of action of cholesterol derivative hormones.</li> <li>8. Describe the mechanism of action of fatty acid hormone derivatives.</li> </ol>
<p>Hypothalamic-pituitary relationship (Physiology)</p>	<ol style="list-style-type: none"> <li>1. List adenohypophyseal &amp; neurohypophyseal hormones.</li> <li>2. Describe how the hypothalamus regulates anterior pituitary hormones.</li> <li>3. Describe the posterior pituitary gland relationship with the hypothalamus.</li> </ol>
<p>Adenohypophyseal hormones - 1 (Physiology)</p>	<ol style="list-style-type: none"> <li>1. Describe growth and metabolic effects of growth hormone.</li> <li>2. List the principal insulin-like growth factors and describe their relationship to the actions of growth hormone.</li> </ol>
<p>Adenohypophyseal hormones - 2 (Physiology)</p>	<ol style="list-style-type: none"> <li>1. Describe the regulation of growth hormone secretion.</li> <li>2. List the factors which stimulates growth hormone secretion</li> <li>3. List the factors which inhibits growth hormone secretion</li> <li>4. Describe the role of the hypothalamus, growth hormone releasing hormone and somatostatin in the control of growth hormone secretion.</li> </ol>
<p>Posterior pituitary hormones (Physiology)</p>	<ol style="list-style-type: none"> <li>1. Discuss the physiological effects of antidiuretic hormone.</li> <li>2. Describe the regulation of antidiuretic hormone secretion.</li> <li>3. List the major physiological effects of oxytocin.</li> <li>4. Describe the regulation of oxytocin secretion.</li> </ol>

<p>Pathology of the anterior and posterior pituitary gland</p> <p>(Pathology)</p>	<ol style="list-style-type: none"> <li>1. Describe the neoplasms of anterior pituitary and their clinical syndromes.</li> <li>2. Know the causes &amp; clinical entities related to hypopituitarism.</li> <li>3. Discuss diabetes insipidus and the syndrome of inappropriate antidiuretic hormone secretion.</li> <li>4. Define craniopharyngioma.</li> </ol>
<p>Pharmacology of the hypothalamic and pituitary hormones</p> <p>(Pharmacology)</p>	<ol style="list-style-type: none"> <li>1. List synthetic analogs of hypothalamic hormones.</li> <li>2. Describe mechanism of action of these synthetic analogs.</li> <li>3. Characterize their clinical uses and routes of administration.</li> <li>4. List their side effects.</li> <li>5. Describe pharmacology of anterior pituitary hormones.</li> <li>6. Review their pharmacological actions.</li> <li>7. List synthetic analogs and describe their routes of administration.</li> <li>8. Describe their clinical uses and adverse reactions.</li> </ol>
<p>Biochemical aspects of thyroid hormones metabolism</p> <p>(Biochemistry)</p>	<ol style="list-style-type: none"> <li>1. Describe thyroid hormone biosynthesis: monoiodotyrosines, diiodotyrosine, T3, T4 and reverse T3.</li> <li>2. Describe metabolism of iodide and iodine.</li> <li>3. Discuss the role of peroxidase, iodinase, coupling, protease, dehalogenase and thyroglobulin.</li> <li>4. Discuss thyroid stimulating hormone action via cAMP.</li> <li>5. Describe the regulation of thyroid stimulating hormone by thyroid releasing hormone and T4, T3, somatostatin and dopamine.</li> <li>6. Discuss T4 and T3 transport.</li> </ol>
<p>Thyroid hormones</p> <p>(Physiology)</p>	<ol style="list-style-type: none"> <li>1. Describe physiological aspects related to the formation and secretion of thyroid hormones.</li> <li>2. Characterize physiological consequences of thyroid hormones binding to transporting proteins.</li> <li>3. List the main physiological actions of thyroid hormones.</li> <li>4. Describe the regulation of thyroid hormones secretion.</li> </ol>

<p>Pathology of the thyroid gland - 1</p> <p>(Pathology)</p>	<ol style="list-style-type: none"> <li>1. Define and describe the pathogenesis and clinical findings of thyrotoxicosis, diffuse hyperplasia of thyroid and Graves's disease.</li> <li>2. Define and describe the pathogenesis of multinodular goitre.</li> <li>3. List types of solitary thyroid nodules and define the meaning of cold and hot nodule.</li> <li>4. Describe the clinical findings and pathology of hypothyroidism and define the terms Cretinism and Myxedema.</li> <li>5. Define and describe the pathogenesis of Hashimoto's thyroiditis, lymphocytic thyroiditis, subacute thyroiditis and Reidle's thyroiditis.</li> </ol>
<p>Pathology of the thyroid gland - 2</p> <p>(Pathology)</p>	<ol style="list-style-type: none"> <li>1. Describe adenomas and carcinomas and their differential diagnosis.</li> <li>2. Discuss various types of malignancies in the thyroid.</li> </ol>
<p>Thyroid and antithyroid drugs</p> <p>(Pharmacology)</p>	<ol style="list-style-type: none"> <li>1. Characterize the pharmacology of thyroid hormones.</li> <li>2. Describe the pharmacology of antithyroid drugs.</li> <li>3. Describe their clinical uses, routes of administration and adverse reactions.</li> </ol>
<p>Hormonal control of calcium metabolism - 1</p> <p>(Physiology)</p>	<ol style="list-style-type: none"> <li>1. Discuss absorption, metabolism and excretion of calcium and phosphate.</li> <li>2. Discuss the role of vitamin in calcium and phosphate absorption</li> <li>3. Outline the effect of calcium ion concentration on the regulation of the active form of vitamin D levels.</li> <li>4. List the major physiological effects of PTH</li> <li>5. Discuss the regulation of PTH secretion</li> </ol>
<p>Hormonal control of calcium metabolism - 2</p> <p>(Physiology)</p>	<ol style="list-style-type: none"> <li>1. Structure of calcitonin</li> <li>2. List the major physiological actions of calcitonin</li> <li>3. Discuss the regulation of calcitonin secretion</li> <li>4. Compare between PTH and calcitonin as regulators of calcium levels.</li> </ol>
<p>Pathology of the parathyroid glands</p> <p>(Pathology)</p>	<ol style="list-style-type: none"> <li>1. Discuss primary &amp; secondary hyperparathyroidism.</li> <li>2. Differentiate between parathyroid hyperplasia &amp; parathyroid adenoma.</li> <li>3. Describe hypoparathyroidism &amp; its clinical manifestations &amp; etiology.</li> </ol>

<p>Pharmacology of parathyroid hormone, vitamin D and calcitonin</p> <p>(Pharmacology)</p>	<ol style="list-style-type: none"> <li>1. Characterize the pharmacology of the parathyroid hormone, vitamin D and calcitonin.</li> <li>2. List synthetic analogs and describe their routes of administration, clinical uses and their adverse reactions.</li> </ol>
<p>Endocrine functions of the pancreas</p> <p>(Physiology)</p>	<ol style="list-style-type: none"> <li>1. Discuss principal hormones that affect blood glucose concentration.</li> <li>2. Discuss metabolic effects of insulin.</li> <li>3. Discuss the regulation of insulin secretion.</li> <li>4. Discuss physiological effects of glucagon.</li> <li>5. Describe the regulation of glucagon secretion.</li> </ol>
<p>Integrated metabolism and hormonal regulation</p> <p>(Biochemistry)</p>	<ol style="list-style-type: none"> <li>1. Describe the metabolic picture in the well-fed state and during starvation in various tissues (liver, brain, muscle and adipose tissues).</li> <li>2. Describe the regulation of glycogen metabolism, glycolysis, hexose monophosphate, gluconeogenesis, lipid and aminoacid metabolism by insulin/counter-regulatory hormones ratio.</li> </ol>
<p>Pathology of the endocrine pancreas, including diabetes</p> <p>(Pathology)</p>	<ol style="list-style-type: none"> <li>1. Discuss diabetes mellitus type I and type II.</li> <li>2. Discuss complications of diabetes.</li> <li>3. Discuss islet cell tumors (in brief).</li> </ol>
<p>Insulin and oral hypoglycemic agents</p> <p>(Pharmacology)</p>	<ol style="list-style-type: none"> <li>1. Discuss the pharmacology of insulin.</li> <li>2. Discuss the pharmacology of oral hypoglycemic drugs.</li> <li>3. Describe their clinical uses, administration and adverse reactions.</li> </ol>
<p>Epidemiology of diabetes mellitus</p> <p>(Community Medicine)</p>	<ol style="list-style-type: none"> <li>1. Describe factors influencing the frequency and severity of DM in various populations.</li> <li>2. Describe the pattern of DM distribution among Jordanians.</li> </ol>



<p>Steroidogenesis (Biochemistry)</p>	<ol style="list-style-type: none"> <li>1. Describe the biosynthesis of steroid hormones.</li> <li>2. Describe the role of cytochromes P-450 in steroidogenesis.</li> <li>3. Describe defects and consequences of congenital adrenal hyperplasia.</li> </ol>
<p>Mineralocorticoids (Physiology)</p>	<ol style="list-style-type: none"> <li>1. Describe the physiological effects of mineralocorticoids (aldosterone).</li> <li>2. Discuss the regulation of aldosterone secretion.</li> <li>3. Describe the clinical consequences of hypo and hyperaldosteronism.</li> </ol>
<p>Glucocorticoids (Physiology)</p>	<ol style="list-style-type: none"> <li>1. Describe the major physiological effects of glucocorticoids.</li> <li>2. Discuss the regulation of cortisol secretion.</li> <li>3. Describe the clinical consequences of hypo and hyperadrenalism.</li> </ol>
<p>Pathology of the adrenal glands (Pathology)</p>	<ol style="list-style-type: none"> <li>1. Describe the pathological features of benign and malignant tumors of the adrenal gland.</li> <li>2. List causes of Addison's diseases and their pathological features.</li> <li>3. Classify the types of multiple endocrine neoplasia.</li> </ol>
<p>Pharmacology of mineralocorticoids (Pharmacology)</p>	<ol style="list-style-type: none"> <li>1. Characterize the pharmacology of mineralocorticoids in terms of pharmacokinetics, mechanisms of actions and adverse reactions.</li> <li>2. Describe the synthetic analogs and their routes of administrations.</li> <li>3. Understand the rationale of replacement therapy.</li> </ol>
<p>Pharmacology of glucocorticoids (Pharmacology)</p>	<ol style="list-style-type: none"> <li>1. Characterize the pharmacology of glucocorticoids in terms of pharmacokinetics, mechanism of action and adverse reactions.</li> <li>2. Describe the synthetic analogs and their routes of administration.</li> <li>3. Understand the rationale of replacement therapy.</li> </ol>
<p>Principles of laboratory techniques used for the measurement of hormones (Biochemistry)</p>	<ol style="list-style-type: none"> <li>1. List the most important lab methods used for laboratory measurement of hormones (Radio Immuno Assay (RIA) Enzyme-Linked Immunosorbent Assay (ELISA), Fluorescence Polarization Immuno Assay (FPIA), Chemiluminescence enzyme immunoassay (CLIA)).</li> <li>2. Understand the principles underlying the techniques used in hormone measurement.</li> </ol>

Epidemiology of obesity  (Community Medicine)	<ol style="list-style-type: none"><li>1. Describe factors influencing the frequency and severity of obesity in various populations.</li><li>2. Describe the pattern of obesity distribution among Jordanians.</li></ol>
---	---

**Classroom policies:**

1. The lectures will be held online using Zoom video conference service, in an interactive way and at the times listed in the timetable.
2. Zoom lectures are considered formal lectures, so appropriate behavior and lecture etiquettes are expected (be on time and do not interrupt the educational process).

**Make up exams**

Makeup exams should not be given unless there is a valid excuse according to the Yarmouk University policy. I expect documentary evidence regarding all missed exams. You must contact me within 24 hours if you are unable to take an exam at the scheduled time.

The modality of makeup exams will be determined later.

**Attendance**

Excellent attendance is expected. Attendance will be automatically recorded by Zoom software, so please use your university emails to access the lectures.

# Small group seminars

## Clinical case 1 - Thyrotoxicosis

### Case history

Mrs. A.B. was 25 years old when she became pregnant for the first time. The pregnancy was uneventful and no thyroid function disturbances were recognized.

At about ten weeks postpartum, she became increasingly fatigued and irritable with episodes of palpitations. She was seen by an internist because of these symptoms.

### Physical Examination

She appeared anxious and hyperkinetic. Her pulse was 120/min, BP 130/60. Her skin was warm, moist and smooth. She had lid lag and normal ocular motility. The thyroid was diffusely enlarged, with a prominent isthmus, and was estimated to weigh approximately 40 grams (2 times normal size). She had a bounding cardiac apical impulse, a pulmonic flow murmur, and a systolic bruit over the thyroid. She had a fine tremor and rose from a deep knee bend with difficulty. The rest of the examination was unremarkable.

### Laboratory data

Serum T4: 16 $\mu$ g/100ml (normal 4.5-10),  
Serum T3: 550ng/100ml (normal 75- 180).

### Objectives of the seminar

1. What is your differential diagnosis?
2. Are more tests required to define the thyroid status?
3. What additional physical signs would strengthen your preferred diagnosis?
4. Describe the expected clinical course for 2 of the possible diagnoses and what therapy would you recommend?
5. What is the cause of the a) pulmonic flow murmur?  
b) the thyroid bruit?  
c) lid lag?
6. Is there any contraindication to future pregnancy?

## Clinical case 2 - Diabetes Mellitus

### **Case history**

The patient is a 23-year-old woman who was referred in December for evaluation of suspected glucose intolerance.

The patient initially presented the previous April with onset of headache. Her blood glucose (BG) was 112 mg%. In September, a 2-hour OGTT was done: FBG = 125mg%

1/2-hour BG = 188 mg%

1 –hour BG = 243 mg%

1 1/2-hour BG = 251 mg%

2-hour BG = 223 mg%

The patient has experienced occasional thirst and hunger, with mild fluctuations in weight. In September, she was treated with a meal plane eliminating concentrated sweets.

The patient has no specific symptoms of hypoglycemia.

There is no history of DKA, diabetic retinopathy, nephropathy, neuropathy or hypertension.

**Family history:** Father, deceased age 58 due to myocardial infarct; history of diabetes mellitus 2 years prior to death. Mother, age 55, is alive and well. One brother and one step-brother is alive and well. There is a history in paternal grandmother and great-grandmother of diabetes mellitus.

### **Physical examination:**

Height 156 cm,

Weight 50kg. BP 130/70 right arm supine, 120/76 right arm sitting. Pulse 80/min and regular.

Respirations 16/min. Patient is a febrile. HEENT:

PERRLAEOM intact. Fundi normal. ENT clear.

Cardiovascular: Regular rate, with no murmurs or gallops. Peripheral pulses are 2+ and equal bilaterally, without bruits.

Neurological: Cranial nerves II-X11 are normal. Motor and sensory exam is intact. DTR 2+ and equal bilaterally.

### **Objectives of the seminar:**

1. Do the glucose tolerance tests results meet the criteria to establish the diagnosis of diabetes mellitus?
2. If this is diabetes mellitus, please indicate what type of diabetes that it is and the reasons that you would believe that it fits that classification?
3. What further diagnostic tests would help you in establishing the type of diabetes that is present?

4. What therapeutic intervention would you recommend at the current time?
5. Explain how normal or even elevated plasma insulin levels can be accompanied by hyperglycemia and discuss common mechanisms for this phenomenon.
6. In the absence of insulin treatment can Type2 diabetic patients eventually develop spontaneous DKA? Explain.

\*\*\*\*\*

### Summary of teaching activities in the E.S. module

Department	No. of lectures	No. of labs	No. of Small Group Seminars
Anatomy	3	1	0
Physiology	11	0	0
Biochemistry	6	0	0
Pathology	8	2	0
Pharmacology	7	0	0
Community Medicine	2	0	0
Small group discussion	0	0	2
<b>Total</b>	<b>37</b>	<b>3</b>	<b>2</b>

*Dr. Fatimah Almahasneh*

(ES module coordinator)