STUDY COMPONENT

Clinical Anatomy of the Endocrine System

UNIT THEME 1: HYPOTHALAMUS; HYPOPHYSIS; PINEAL GLAND
UNIT THEME 2: THYROID AND PARATHYROID
UNIT THEME 3: PANCREAS; ADRENAL GLANDS
UNIT THEME 4: REPRODUCTIVE ORGANS

SUB-SPECIFIC OUTCOMES:

This component of block III is designed to enhance the development of multi-disciplinary knowledge and problem-orientated learning abilities in order to integrate anatomical concepts applicable to the endocrine glands.

SUB-UNITS:

1. Hypothalamus
   a. Position and relations of the hypothalamus.

2. Hypophysis
   a. Structure, position and relations of the hypophysis.
   b. Hypophyseoportal system of the hypophysis.

3. Pineal gland
   a. Position and relations of the pineal gland.

4. Thyroid
   a. Position, relations, structure and blood supply of the thyroid gland.
   b. Embryological development of the thyroid gland

5. Parathyroid glands
   a. Position of the parathyroid glands
   b. Anatomical variations.
   c. Embryological development of the parathyroid glands.

6. Pancreas
   a. Structure of the pancreas.
   b. Vertebral heights of the various parts of the pancreas.
   c. Arterial blood supply and venous drainage of the pancreas.
   d. Relations of the pancreas

7. Adrenal glands
   a. Structure and relations of the adrenal glands.
   b. Arterial blood supply and venous drainage of the adrenal glands.
   c. Relationship of the autonomic plexuses to the adrenal glands.

8. Testis
a. General structure of the testis  
b. Arterial supply, venous drainage, lymph drainage and nerve supply of the testis.  
c. Embryological development and descent of the testis.

9. **Ovaries**

a. Structure, relationships, arterial supply, venous drainage, lymph drainage and nerve supply of the ovaries.  
b. Embryological development and descent of the ovaries.

**EMBEDDED KNOWLEDGE:**

The student must know the names and understand the position of the endocrine glands as done in block 1.  
The student must be able to define the differences between endocrine and exocrine glands.  
Know the functions of the hypothalamus.

**ASSESSMENT CRITERIA:**

**Self assessment**
1. Sketch all the structures dealt with in these study unit themes.  
2. Sketch the hypophyseoportal system between the hypothalamus and the hypophysis.  
3. Describe the anatomical basis for the clinical syndrome that results from the secondary pressure effects from a hypophyseal tumour.  
4. List the clinical syndromes and their anatomical basis resulting from enlargement of the thyroid.  
5. Give the reason why the parathyroid bodies develop as they do.  
6. Discuss the anatomical basis of the pancreas as an endocrine organ.  
7. Sketch the arterial supply and the venous drainage of both adrenal glands.  
8. Discuss the route of descent of the testis. Explain the arterial supply and venous drainage.  
9. List the different structures that might be implicated during enlargement of the ovaries and explain the possible clinical picture that might develop.

**Peer assessment**
You must be able to discuss the subunits with your fellow students.

**Formative and summative evaluation**
One test on these unit themes is written during the block.

**ASSESSMENT PORTFOLIO:**

Identification of the various components of the endocrine system with an appreciation of the clinical conditions related to the relationships and embryology of these glands.

**CRITICAL SKILLS:**

The student must be able to:

1. **Hypothalamus**
   a. Name and identify the position, relations and nuclei of the hypothalamus.

2. **Hypophysis**
a. Name and identify the position, relations and parts of the hypophysis.
b. Name and identify the clinically important structures anatomically related to the hypophysis.
c. Explain the anatomical basis for bitemporal hemianopia that occurs in the presence of a hypophyseal tumour.
d. Identify the hypophyseal fossa on a lateral skull X-ray.
e. Identify the hypophysis on CT (computerized tomography) or MRI (magnetic resonance imaging).
f. Describe the hypophyseoportal system of the hypophysis.

3. Pineal gland

a. Name and identify the position, and relations of the pineal gland.
b. Identify the position of the pineal gland on a plain film X-ray, CT or MRI of the skull.

4. Thyroid

a. Discuss the position, relations, structure and blood supply of the thyroid gland.
b. Briefly discuss the embryological development of the thyroid gland and the clinical relevance thereof.
c. Name the structures affected by enlargement of the thyroid and list the effects thereof.
d. List the relationship of the thyroid to the following clinically important structures - trachea, carotid arteries, recurrent laryngeal nerve, external laryngeal nerve, thyroidal arteries and parathyroids.
e. Identify the thyroid on CT scans or MRI.

5. Parathyroid glands

a. Briefly describe the position of the parathyroid glands and indicate the importance of anatomical variation.
b. Explain embryologically the reasons for anatomical variation in the position of the parathyroids.

6. Pancreas

a. Discuss the macroscopic structure of the pancreas.
b. List the vertebral heights of the various parts of the pancreas.
g. Discuss the arterial blood supply and venous drainage of the pancreas.
d. Discuss the anatomical basis by which the pancreas is both an endo- and exocrine gland.
e. List the posterior relations of the head of the pancreas that may become involved in enlargement of the tumour of the head of the pancreas. List the signs and symptoms of obstruction that may result.
f. Identify the pancreas on CT scans or MRI.

7. Adrenal glands

a. Name the structure and list the relations of the adrenal glands.
b. List the arterial blood supply and venous drainage of the adrenal glands.
c. Name the relationship of the autonomic plexuses to the adrenal glands.
d. Identify the regions of the adrenals on a coronal section of the glands.
e. Identify the adrenals on CT scans or MRI.

8. Testis

a. Note the unexpected arterial supply, venous drainage, lymph drainage and nerve supply of the testis.
b. Discuss the embryological descent of the testes.
c. Describe the general structure of the testis.
d. Consider the function of the Leydig cells (interstitial cells).

9. **Ovaries and Uterus**
   a. Note the unexpected arterial supply, venous drainage, lymph drainage and nerve supply of the ovaries.
   b. Discuss the embryological descent of the ovaries.
   c. Identify the ovaries on CT scans or MRI.
   d. Describe the general structure of the ovary.

**REFERENCES:**


**Clinically oriented Anatomy: Moore and Dalley 6th edition:** 205-206; 209-210; 240; 265-268; 294-5; 382-383; 875; 878-879; 884; 961; 1039-1044.


**Gray’s Anatomy for Students: 2nd edition:** 188; 260-1; 320-22; 358-9; 448-450; 454; 825; 836; 838; 964-968


**Embryology for the Health Student: Jacobs, Greyling and Meiring** 63-67

**Neuroanatomy: Bosman 2nd edition:** 5, 53, 54, 58, 59, 96, 97

**TERMINOLOGY:**

Optic nerve, optic chiasma, optic tract, optic radiation, bitemporal hemianopia, infundibulum, hypophysis, thalamus, hypothalamic sulcus, hypothalamus, adenohypophysis, neurohypophysis, sella turcica, hypophyseal fossa, sphenoid bone and sinus, cavernous sinus, internal carotid artery, circle of Willis, cranial nerves: III, IV, V<sub>1</sub>, V<sub>2</sub>, VI, diaphragma sellae, pharyngeal pouches, thyroid, parathyroid, thymus, pancreas, suprarenal/adrenal gland, testis, ductus/vas deferens/spermatic cord, inguinal canal, superficial and deep inguinal ring, ovary, uterine tube/fallopian tube, CT scan, MRI.

**UNIT THEME 1:** HYPOTHALAMUS; HYPOPHYSIS; PINEAL GLAND

Optic chiasma

Pituitary gland
2. Describe the hypophyseoportal system of the hypophysis
Netter plate 148

Arteries and Veins of Hypothalamus and Hypophysis
3. Case study to demonstrate the relationships of the hypophysis

Mrs Erasmus is diagnosed with a tumour of the hypophysis. She suspects that her vision is deteriorating, as she could not see the car in the right lane when she was overtaking another car. Her doctor examines her visual fields and makes the concomitant diagnosis of bitemporal hemianopia.


3.2 Is there any relationship between the 2 diagnoses made? How can a tumour of the hypophysis cause visual disturbances? Meiring p 744, Moore and Dalley 5th edition: p. 912; Moore and Dalley 6th edition p. 875, 876 Superior extension of a pituitary tumour may cause visual symptoms owing to pressure on the optic chiasma found anterior-superior to it.

3.3 Explain bitemporal hemianopia in view of Netter plate 120, Neuroanatomy: 96, 97.
Head Scans: Axial CT Images

Optic nerve
Optic chiasma
Optic tract
Optic radiation
1. Explain the embryology of the thyroid and parathyroid gland. Meiring: 168, 169, 171, 190, 191; Embryology for the Health Student: Jacobs, Greyling and Meiring 63-67 The thyroid gland develops between 1st and 2nd pharyngeal arch from where it descends. The inferior parathyroid develops from the 3rd pharyngeal pouch and descends with the thymus to a more inferior position than the superior parathyroid. The superior parathyroid develops from the 4th pharyngeal pouch before it descends.
2. Identify the thyroid gland as well as its subdivisions, relationships and blood supply. (Meiring: 168-170, 172 and 745; Netter: 74, 75, 76; Moore 5th edition: 1046, 1081-1087, 1115-1116, 1119; Moore 6th edition: 1040-1043; Gray’s 2nd ed. 964-968)
Superior laryngeal nerve

Inferior thyroid vein

Superior thyroid vein

Middle thyroid vein

Inferior thyroid vein

Pyramidal lobe

Regional nodes: Paratracheal

Central deep nodes: Jugulo-omohyoideus

Lymph Vessels and Nodes of Head and Neck

Parathyroid Glands
Right Lateral View

Superior laryngeal nerve

Inferior laryngeal nerve
3. Identify the parathyroid gland as well as its relationships.
(Meiring: 171, 172 and 745; Netter: 76; Moore 5th edition: 1087, 1088; Moore 6th edition: 1043, 1044; Gray's 2nd ed.964-968)

On examination of Mrs Jordan a swelling in the neck of 2 cm by 4 cm is felt to the left of the trachea and larynx. The mass moves superiorly when the patient swallows. Fine needle aspiration indicates the presence of a papillary carcinoma. The left lobe and isthmus of the thyroid gland are removed but the left parathyroid gland is spared. Following the surgery, Mrs Jordan complained of hoarseness for 2 weeks.

Give the anatomical basis for the following -
4.1 The location of the thyroid.
Left lobe is anterolateral to the larynx and trachea

4.2 The relationship between the thyroid and parathyroid glands.
External to the thyroid capsule on the medial half of the posterior surface of each lobe of the thyroid inside its sheath: the superior usually 1cm superior to the inferior thyroid arteries, the inferior usually more than 1cm inferior to this artery.

4.3 The post-operative hoarseness.
Hoarseness results from unilateral recurrent nerve injury: bruising or pressure of accumulated blood or serous exudates. The right and left recurrent nerves are related to the inferior pole of the thyroid gland. The right recurrent laryngeal nerve is further related to the inferior thyroid artery and its branches.

4.4 The embryological reasons for the variations in the position of the parathyroid glands.
The superior parathyroid glands may be as far superior as the thyroid cartilage, and the inferior ones as far inferior as the superior mediastinum. The inferior parathyroid has a variable descent along with the thymus that also originates from the third pharyngeal cleft. The superior parathyroid originating from the fourth pharyngeal cleft descents with the thyroid not as far down as the inferior parathyroid.
UNIT THEME 3: PANCREAS AND ADRENAL GLANDS


1. Identify the pancreas and adrenal glands

- Tail of pancreas
- Inferior vena cava
- Right suprarenal gland
- Right kidney
- Neck of pancreas
- Superior mesenteric artery
- Body of pancreas
- Head of pancreas
- Uncinate process of pancreas
- Abdominal aorta
2. Identify the pancreas and adrenal glands on the MRI scans
UNIT THEME 4: REPRODUCTIVE ORGANS

1. Identification of the structures of the male genital system.

2.3 Descent of testes through inguinal canal by relative growth:

Descent of Testis
8 Weeks

Descent of Testis
11 Weeks

Descent of Testis
4 Lunar Months

Descent of Testis
8 Lunar Months
4. Case study to demonstrate the descent of the testis:

A 12-year-old boy, has only one testis in his scrotum. No testis is detected in either the inguinal opening or the canal. After an MRI-scan the testis is demonstrated in the abdomen. Due to the 35-45 times increased risk of cancer in an undescended testis, especially in children older than ten years of age; it is decided to remove the testis.

Meiring: 378-380; Netter: 386; Moore: 217, 218, 220

Give the anatomical basis for the route followed during descent of the testis and the different positions where the testis might be located.

By the 12th week of development, the testis is in the pelvis, and by 28 weeks it lies close to the developing deep ring. The testis begins to pass through the inguinal canal during the 28th week and takes approximately 3 days to traverse it. Approximately 4 weeks later, the testis enters the scrotum. The undescended testis usually lies somewhere along the normal path of its prenatal descent, commonly in the inguinal canal.

As for the male gonads the ovaries also develop in the abdomen before descending to the pelvis

6. Identification of the structures of the female genital system on MRI: Moore 5th ed.: 471, 474, 475; Moore 6th ed. 437

Transverse MRI of pelvis