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M.SC. IIIRD SEMESTER CC-12
VERTEBRATE ENDOCRINOLOGY
TOPIC- AIM AND SCOPE OF ENDOCRINOLOGY

ENDOCRINOLOGY

- Endocrinology is the study of endocrine system(system of glands which secrete Hormones) and the hormones which they secrete.

ENDOCRINE SYSTEM

- Group of specialized organs and tissues that produce, store, and secrete substances called as hormones.

- Hormone is a chemical messenger that are released in one part of the body, travel in the blood stream and have an effect on other part of the body. This helps different parts of the human body to communicate with each other and regulate physiologic processes through feedback mechanisms.

HISTORICAL SUMMARY (20th CENTURY)

YEAR	ORGAN, ACTION, HORMONE	DISCOVERER
1902	Discovery of secretin	W. Bayliss and E.H. Starling
1903-1906	Discovery of gastrin	J.S. Edkins
1905	First use of the term “hormone”	E.H. Starling, proposed by W.B. Hardy
1906	Transphenoidal surgery of pituitary tumors	H. Schloffer
1906	Oxytocin action from pituitary extracts	H. Dale
1912	Relationship between the posterior pituitary and diabetes insipidus	A.E. Frank

YEAR	ORGAN, ACTION, HORMONE	DISCOVERER
1914	Thyroxine crystals	E.C. Kendall
1926	Insulin crystals	J.J. Abel
1935	Testosterone isolated from testes	E. Laqueur
1940-1949	Isolation of LH, ACTH, GH, and FSH	Choh Hao Li and Evans
1951	Oxytocin and vasopressin released by the pituitary	W. Bargmann and E. Scharrer
1956	Autoantibodies in Hashimoto thyroiditis	I.M. Roitt and D. Doniach
1966-1971	GH structure and synthesis	Choh Hao Li and colleagues
1971	Elucidation of the structure of TSH	J.G. Pierce and colleagues

AIM OF ENDOCRINOLOGY

TO STUDY ENDOCRINOLOGY

- KNOW ABOUT ENDOCRINE GLANDS AND HORMONE SECRETIONS
- CHEMICAL NATURE AND BIOSYNTHESIS OF HORMONES
- DIFFERENT TYPES OF HORMONE RECEPTORS AND PRINCIPLES OF HORMONE ACTION
- FUNCTIONS OF ENDOCRINE GLANDS AND THEIR DISORDERS
- TO KNOW HOW HORMONES REGULATES METABOLISM, RESPIRATION GROWTH, REPRODUCTION, SENSORY PERCEPTION AND MOVEMENT ETC.

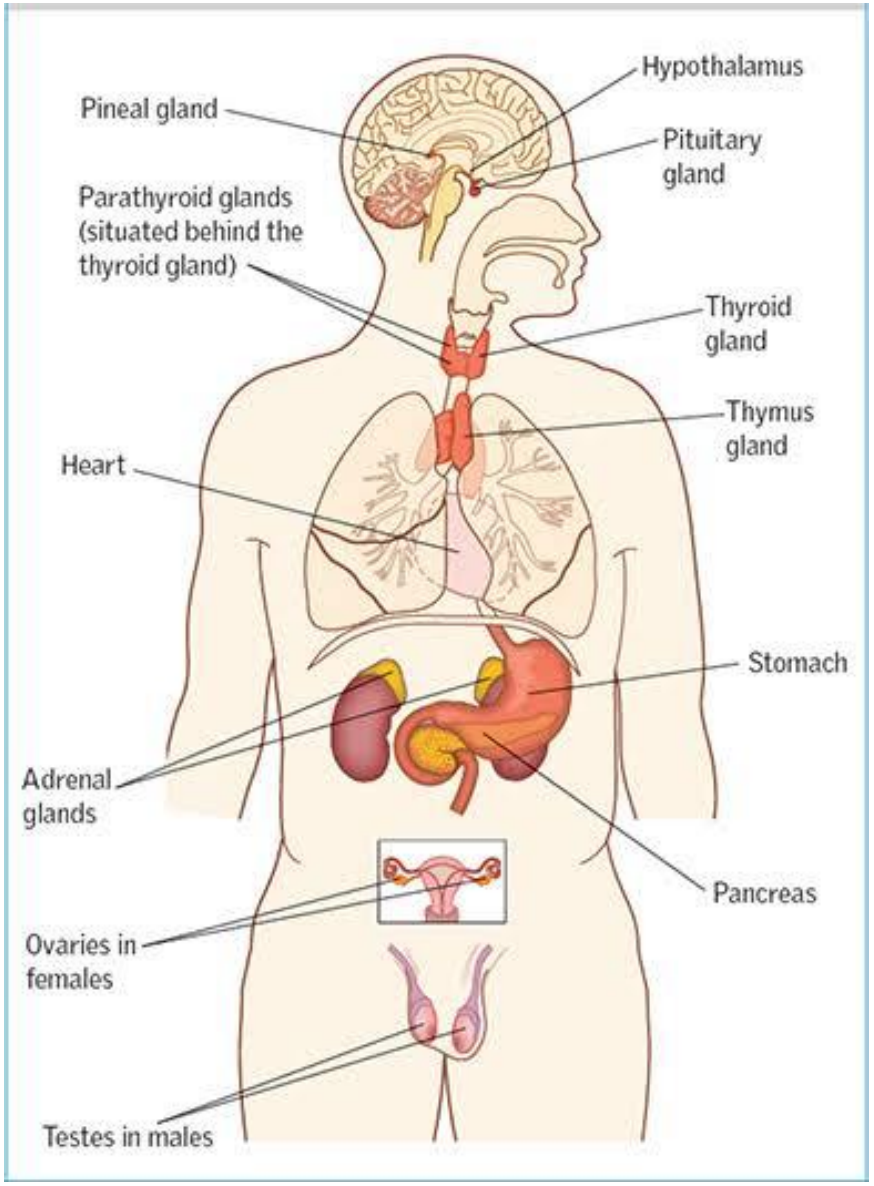

Fig 1. Various endocrine organs in human

Hormone	Structure	Functions
Pituitary Hormones		
Oxytocin	polypeptide of 9 amino acids **CYIQNCPLG** (C's are disulfide bonded)	uterine contraction, causes milk ejection in lactating females, responds to suckling reflex and estradiol, lowers steroid synthesis in testes
Vasopressin	polypeptide of 9 amino acids **CYFQNCPRG** (C's are disulfide bonded)	responds to osmoreceptor which senses extracellular [Na^+], blood pressure regulation, increases H_2O readsorption from distal tubules in kidney
Melanocyte-stimu-lating hormone (MSH)	α polypeptide = 13 amino acids β polypeptide = 18 amino acids γ polypeptide = 12 amino acids	pigmentation
Corticotropin (ACTH)	polypeptide = 39 amino acids	stimulates cells of adrenal gland to increase steroid synthesis and secretion
Thyrotropin (TSH)	2 proteins: α is 96 amino acids; β is 112	acts on thyroid follicle cells to stimulate throid hormone synthesis
Growth hormone (GH)	protein of 191 amino acids	general anabolic stimulant, increases release of insulin-like growth factor-I (IGF-I), cell growth and bone sulfation

Prolactin	protein of 197 amino acids	protein of 197 amino acids
Luteinizing hormone (LH)	2 proteins: α is 96 amino acids; β is 121	increases ovarian progesterone synthesis, luteinization; acts on Leydig cells of testes to increase testosterone synthesis and release and increases interstitial cell development
Follicle-stimulating Hormone (FSH)	2 proteins: α is 96 amino acids; β is 120	ovarian follicle development and ovulation, increases estrogen production; acts on Sertoli cells of semiferous tubule to increase spermatogenesis
Hypothalamic Hormones		
Corticotropin-releasing factor (CRF)	protein of 41 amino acids	acts on corticotrope to release ACTH and β-endorphin (lipotropin)
Gonadotropin-releasing factor (GnRF)	polypeptide of 10 amino acids	acts on gonadotrope to release LH and FSH
Prolactin-releasing factor (PRF)	this may be TRH	acts on lactotrope to release prolactin
Prolactin-releasing inhibiting factor (PIF)	may be derived from GnRH precursor, 56 amino acids	acts on lactotrope to inhibit prolactin release

Growth hormone releasing factor (GRF)	protein of 40 and 44 amino acids	stimulates GH secretion
Somatostatin	polypeptide of 14 and 28 amino acids	inhibits GH and TSH secretion
Thyrotropin-releasing factor (TRF)	polypeptide of 3 amino acids	stimulates TSH and prolactin secretion
Thyroid Hormones		
Thyroxine and triiodothyronine	iodinated dityrosin derivatives	responds to TSH and stimulates oxidations in many cells
Calcitonin	protein of 32 amino acids	produced in parafollicular C cells of the thyroid, regulation of Ca^{2+} and P_i metabolism
Calcitonin gene-related peptide (CGRP)	protein of 37 amino acids, product of the calcitonin gene derived by alternative splicing of the precursor mRNA in the brain	acts as a vasodilator

Parathyroid Hormone		
Parathyroid hormone (PTH)	protein of 84 amino acids	regulation of Ca^{2+} and P_i metabolism, stimulates bone resorption thus increasing serum [Ca^{2+}], stimulates P_i secretion by kidneys
Hormones and Peptides of the Gut		
Glucagon-like peptide 1 (GLP-1) formerly called enteroglucagon	Two forms: 31 amino acids, GLP-1(7-37) and 30 amino acids, GLP-1(7-36)amide	potentiates glucose-dependent insulin secretion, inhibits glucagon secretion, inhibits gastric emptying
Glucose-dependent insulinotropic polypeptide (GIP) originally called gastric inhibitory polypeptide	polypeptide of 42 amino acids	inhibits secretion of gastric acid, enhances insulin secretion
Gastrin	17 amino acids	produced by stomach antrum, stimulates acid and pepsin secretion, also stimulates pancreatic secretions
Secretin	27 amino acids	secreted from duodenum at pH values below 4.5, stimulates pancreatic acinar cells to release bicarbonate and H_2O

Cholecystokinin, CCK	33 amino acids	stimulates gallbladder contraction and bile flow, increases secretion of digestive enzymes from pancreas
Motilin	22 amino acids	controls gastrointestinal muscles
Vasoactive intestinal peptide (VIP)	28 amino acids	produced by hypothalamus and GI tract, relaxes the GI, inhibits acid and pepsin secretion, acts as a neurotransmitter in peripheral autonomic nervous system, increases secretion of H_2O and electrolytes from pancreas and gut
Somatostatin	14 amino acid version	inhibits release and action of numerous gut peptides, e.g. CKK, gastrin, secretin, motilin, GIP; also inhibits insulin and glucagon secretion from pancreas
Substance P a member of the tachykinin family that includes neurokinin A (NKA) and neurokinin B (NKB)	11 amino acids	CNS function in pain (nociception), involved in vomit reflex, stimulates salivary secretions, induces vasodilation antagonists have anti-depressant properties
Pancreatic Polypeptide, PP	36 amino acids	suppresses glucose-induced insulin secretion, inhibits bicarbonate and protein secretion from pancreas

Peptide Tyrosine Tyrosine, PYY	36 amino acids	inhibits gastric motility by inhibiting cholinergic neurotransmission, inhibits gastric acid secretion
Neuropeptide Tyrosine, NPY	36 amino acids 6 receptors	effects on hypothalamic function in appetite, controls feeding behavior and energy homeostasis, levels increase during starvation to induce food intake
Amphiregulin	2 peptides: 78 amino acid truncated form and 84 amino acid form with 6 additional N-terminal amino acids	homology to EGF and binds to the EGF receptor (EGFR)
Pancreatic Hormones		
Insulin	disulfide bonded dipeptide of 21 and 30 amino acids	produced by β-cells of the pancreas, increases glucose uptake and utilization, increases lipogenesis, general anabolic effects
Glucagon	polypeptide of 29 amino acids	produced by α-cells of the pancreas, increases lipid mobilization and glycogenolysis in order to increase blood glucose levels
Pancreatic polypeptide	polypeptide of 36 amino acids	increases glycogenolysis, regulation of gastrointestinal activity
Somatostatin	14 amino acid version	inhibition of glucagon and somatotropin release

Placental Hormones		
Estrogens	steroids	maintenance of pregnancy
Progestins	steroids	mimic action of progesterone
Chorionic gonadotropin	2 proteins: α is 96 amino acids; β is 147	activity similar to LH
Placental lactogen	protein of 191 amino acids	acts like prolactin and GH
Relaxin	2 proteins of 22 and 32 amino acids	produced in ovarian corpus luteum, inhibits myometrial contractions, secretion increases during gestation
Gonad Hormones		
Estrogens (ovarian)	steroids; estradiol and estrone	maturation and function of female secondary sex organs
Progestins (ovarian)	steroid; progesterone	implantation of ovum and maintenance of pregnancy
Androgens (testicular)	steroid; testosterone	maturation and function of male secondary sex organs
Inhibins A and B	1 protein (α is 134 amino acids; β is 115 and 116 amino acids	inhibition of FSH secretion

Adrenal Cortical Hormones		
Glucocorticoids	steroids; cortisol and corticosterone	diverse effects on inflammation and protei synthesis
Mineralocorticoids	steroids; aldosterone	maintenance of salt balance
Adrenal Medullary Hormones		
Epinephrine (adrenalin)	derived from tyrosine	glycogenolysis, lipid mobilization, smooth muscle contraction, cardiac function
Norepinephrine (noradrenalin)	tyrosine derivative	lipid mobilization, arteriole contraction
Liver Hormones		
Angiotensin II	polypeptide of 8 amino acids derived from angiotensinogen (present in the α_2-globin fraction of plasma) which is cleaved by the kidney enzyme **renin** to give the decapeptide, angiotensin I, the C-terminal 2 amino acids are then released (by action of angiotensin-converting enzyme, ACE) to yield angiotensin II	responsible for essential hypertension through stimulated synthesis and release aldosterone from adrenal cells

Kidney Hormones

Calcitriol [1,25-$(OH)_2$-vitamin D_3]	derived from 7-dehydrocholesterol	responsible for maintenance of calcium ar phosphorous hoemostasis, increases intestinal Ca^{2+} uptake, regulates bone mineralization

Cardiac Hormones

Atrial natriuretic peptide (ANP)	several active peptides cleaved from a 126 amino acid precursor	released from heart atria in response to hypovolemia, acts on outer adrenal cells t decrease aldosterone production; smooth muscle relaxation

Pineal Hormones

Melatonin	*N*-acetyl-5-methoxytryptamine	regulation of circadian rhythms

- **The endocrine disorders are a varied group of diseases that usually occur due to hypo-functioning or hyper-functioning of these glands.**

➢ **COMMON ENDOCRINE DISORDERS**

A. DIABETES

B. THYROID DISORDERS- HYPERTHYROIDISM
- HYPOTHYROIDISM
- THYROD TUMORS

C. PITUITARY DISORDERS- PITUITARY TUMORS
- DEFICIENCY OF PITUITARY HORMONES
- INCREASED LEVEL OF PITUITARY HORMONES
- DIABETES INSIPIDUS

D. ADRENAL DISORDERS- ADRENAL TUMORS
- CUSHING'S SYNDROME
- ADRENAL FAILURE

- **COMMON ENDOCRINE DISORDERS**

E. POLYCYSTIC OVARY SYNDROME

F. MALE REPRODUCTIVE DISORDERS

- MALE INFERTILITY
- HYPOGONADISM

G. DISORDERS OF GROWTH

- DEFICIENCY OF GROWTH HORMONES
- INCREASED LEVEL OF GROWTH HORMONES

H. DISORDERS OF PUBERTY

- DELAYED PUBERTY
- PREMATURE PUBERTY

I. DISORDERS OF SEXUAL DEVELOPMENT

- TURNER'S SYNDROME
- KLINEFELTER'S SYNDROME

- **COMMON ENDOCRINE DISORDERS**

J. METABOLIC BONE DISORDRES

- **OSTEOPOROSIS**
- **RICKET'S**
- **OSTEOMALACIA**
- **VITAMIN D DEFICIENCY**

K. OBESITY AND OVERWEIGHT

L. DYSLIPIDEMIA

- **DISORDERS RELATED TO CHOLESTEROL**

M. OTHER HORMONAL DISORDERS

- **NRUROENDOCRINE DOSORDERS**
- **MEN SYNDROME**

SCOPES OF ENDOCRINOLOGY

- Scope in the field of Endocrinology is beyond anticipation.

- There is incomplete understanding of numerous endocrine interactions, biosynthetic regulations, and hormone release with respect to influences by other hormones or intracellular regulators. This is the subject of very ambitious research in animal models and with tumor cells.

- Animal models provide new findings. Whether these models can be applied in humans has to be investigated for each new substance or method.

SCOPES OF ENDOCRINOLOGY

- The boundaries between endocrinology and other fields of modern biology are both artificial and imprecisely drawn.

- Endocrinology has benefitted enormously and has even contributed from recent advancements in other fields particularly Immunology, biochemistry, cell biology, and molecular biology.

- Progress in biochemistry made it possible to study pure hormones, and application of immunological techniques allowed identification and measurement of various molecular species.

SCOPES OF ENDOCRINOLOGY

- The introduction of techniques of molecular biology brought breakthroughs in the understanding of hormone actions, and curiously brought us full circle back to the early approaches of studying the consequences of eliminating the source of a signaling molecule or administering an excess to gain insight into function.

- With the perfusion of pure-science techniques and concept into all phases of the subject, Endocrinology has become a respected Science and a dignified field of research specialization.

THANKS