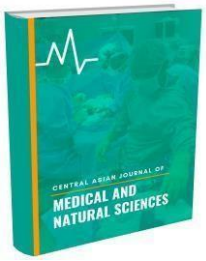

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Article

Review of Pituitary Gland Dysfunction and Diseases

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Abstract: One of the most significant endocrine glands in the human body, the pituitary secretes hormones that affect the functioning of other glands, helping to regulate a wide range of physiological processes. The infundibulum connects the pituitary gland to the hypothalamus, and it is situated in the sella turcica, a bony chamber near the base of the brain. The anterior lobe, or adenohypophysis, is the largest portion of the pituitary gland and is made up of secretory cells that produce hormones like growth hormone (GH), adrenocorticotropic hormone (ACTH), milk-stimulating hormone (prolactin), thyroid-stimulating hormone (TSH), and the reproductive hormones (FSH and LH). Two hormones are secreted by the posterior lobe (posterior pituitary-neurohypophysis): oxytocin, which is involved in childbirth and milk production, and antidiuretic hormone (ADH), which maintains water balance. These hormones affect water and salt balance, growth, metabolism, reproduction, and stress management. Health issues like dwarfism, gigantism, hyperprolactinemia, and syndromes like Cushing's and Sheehan syndrome can result from any disruption in pituitary function.

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Introduction

The pituitary gland stays a tiny organ sited close the brain base, straight beneath the nasal bridge, in a bony pouch known as the "sella turcica." It is located directly below the optic chiasm, which connects the nerves to the eyes. The larger anterior pituitary (located at the front) and the smaller posterior pituitary (located at the rear) are the two primary portions of the pituitary gland. These sections each produce distinct kinds of hormones and serve distinct purposes [1]. The pituitary is referred to as the "master gland" since it aids in regulating the release of different hormones from the thyroid, adrenal glands, testes, and ovaries, among other glands. Numerous hormones are liberated into the bloodstream via the pituitary gland, and these hormones subsequently affect other glands and organs. The hypothalamus, located directly above the pituitary gland, regulates the pituitary gland itself. Depending on the body's needs, the hypothalamus functions as a thermostat to tell the pituitary gland to release more or fewer hormones [2]. It is situated beneath the hypothalamus and pineal gland at the base of the brain. The pituitary gland is in charge of regulating the body's hormone secretion overall. This gland, which is around half a gram in weight (about the size of a small bean), secretes a lot of important hormones into the blood. These hormones provide direct commands to all of the body's hormonal glands, telling them to release their hormones into the blood right away [3]. The frontal lobe creates up over 75% of the pituitary gland's total weight. The profusion of capillary blood capillaries encircling the front lobe is another characteristic that defines it. The cells of the anterior lobe are fed by unique arteries that release a variety of hormones that control various bodily processes, including growth[4].

Pituitary Anatomy

The pars tuberalis, an imperfect layer of epithelial cells with an unknown function, covers the ventral aspect of the pituitary stalk, which is mostly composed of neuronal and vascular components. Neural tissue, which makes up the bulk of the stalk, contains the numerous coiled capillary capillaries that terminate the nerve fibers that originate from cells in the hypophysiotrophic region[5]. Coming neurohormones From the fiber ends, these nerve fibers are transported into the bloodstream via the coiled capillaries and, ultimately, into the portal veins.There are two types of portal vessels: long and short. A crucial distinction is made by the provenance of the vessels that supply them[6]. The lower hypophysial arteries, which emerge from the interior carotid arteries, are the source of those that resource the coiled capillaries that comprise the small Entry vessels, while the long portal veins originate from the afferent arterioles to the coiled capillaries, which are provided through the longer hypophysial arteries (which emerge as of the interior carotid arteries beyond the diaphragma sellae). In the sinus cavern. Whereas the long portal vessels supply the majority of the pars distalis by running down the pituitary stalk, the short portal arteries serve a small area of the lobe nearby to the portion of the minor infundibular stem that is repressed in the pars distalis [7]. In one motivating case of head wound, the pituitary trunk had been torn across beyond the flat of the arterial ring formed as of the higher hypophysial arteries. Because the nerve fibers that carry neuro-hormones depressed the trunk have been cut, the cells are efficiently "denervated," meaning that the blood providing them lacks liberating or inhibitory features. This means that there was no infarct in the pars distalis and that the afferent artery resource to the coiled capillaries in the stalk, which provides rise to the extensive portal arteries, stayed maintained. Because of this, cells don't release a lot of hormones. It should be noted that there isn't a substantial direct artery supply to the pars distalis [8].

The pituitary's anterior part

The adenohypophysis, another name for the anterior pituitary, is a key endocrine system organ. The anterior lobe of the pituitary, which, along with the posterior pituitary, forms the pituitary gland (hypophysis), is situated at the human brain base and protrudes from the hypothalamus. The pars distalis, pars tuberalis, and pars intermedia are the three sections that make up the anterior pituitary, The majority of pituitary hormone synthesis takes place in the pars distalis, or distal part, which makes up the majority of the anterior pituitary. There are two different kinds of cells in the pars distalis : chromophil cells and chromophobe cells. Acidophils (alpha cells) and basophils (beta cells) are two more subtypes of chromophils. Together, these cells create anterior pituitary hormones, which are then released into the bloodstream [9].

The pars tuberalis, or tubular part, is a portion of a highly vascularized sheath which runs from the parietal stalk of the pars distalis to the pituitary stalk, likewise called the infundibulum or infundibular stalk, little is known about the function of the parietal stalk of the pars tuberalis. This has however been shown to be critical in the reception of the endocrine signal advising the pars tuberalis of the photoperiod (day of the week) by TSHB (TSH subunit beta). The release of melatonin in reaction to light signals transferred to the pineal gland regulates the expression of this subset of the regulative secretagogue [10]. Previous research has demonstrated that melatonin receptors are located in this area [11].

Pituitary hormones in the anterior region

1. Growth hormone (GH)

This hormone promotes the growth of muscles and bones in particular by speeding up the production of protein until puberty. However, if this hormone is secreted in excess during childhood, the height of the child increases to about 2.5 meters, which causes gigantism because long bones continue to grow. However, dwarfism results if this hormone is secreted in less than the necessary quantity.

Aggressive conduct is a characteristic of the person with dwarfism, which is a form of compensation for the physical inferiority he perceives [12].

2. Adrenal Corticotrophin Hormone (ACTH)

This hormone controls the activity of the cortex of adrenal and triggers the release of hormones from the outer part of the adrenal gland. The cortex shrinks if this hormone is absent or secreted insufficiently, although it still secretes hormones, albeit in trace amounts. The hormone facilitates the conversion of lipids into fatty acids via influencing adipose tissue as well. The release of adrenocorticotropic hormone (ACTH) is influenced by two factors: blood levels of hormones from the adrenal cortex and the neurosecretory material known as hormone-releasing factor, which is released by the hypothalamus [13].

3. Thyroid-Stimulating Hormone (TSH)

TSH, stays a glycoprotein hormone that is created through the frontal pituitary gland. It is the prime inducer of thyroid hormone manufacture through the thyroid gland. The thyroid also enlarges as a outcome of the proliferation of thyroid follicular cells. The axis of hypothalamus and pituitary regulates the release of TSH. Specifically, neurons in the hypothalamus produce thyroid-releasing hormone (TRH), which motivates thyrotrophs of the frontal pituitary to produce TSH. Triiodothyronine (T3) or tetraiodothyronine (T4) are thyroid hormones that are released when TSH stimulates thyroid follicular cells [14].

4. Follicle-Stimulating Hormone (FSH)

A glycoprotein polypeptide hormone, (FSH) is a gonadotropin. FSH stays formed and liberated through the frontal pituitary gland's gonadotropic cells, which also control the body's growth, pubertal maturation, progress, and reproductive processes regulates the development and growth of the reproductive system and the reproductive mechanism. A normal balance of FSH levels in the blood is essential for normal fertility in both men and women. Any increase or decrease in FSH levels may be an important indicator of a fertility disorder, which may hinder pregnancy and childbirth. FSH production an essential character in the growth of ovarian follicles[15].

5. Luteinizing Hormone (LH)

Luteinizing hormone, or lutropin, is produced by the gonadotropic cells of the anterior pituitary gland. The hypothalamus' gonadotropin-releasing hormone (GnRH) controls the production of LH. An abrupt rise in LH, referred to as an LH surge, causes ovulation and the enlargement of the corpus luteum in females. In males, LH, likewise named interstitial cell-stimulating hormone (ICSH), motivates Leydig cells to produce testosterone. LH and FSH complement each other. LH deficiency often occurs concurrently with FSH deficiency due to their common origin secretion, by the pituitary gonadotroph cells. Luteinizing hormone contributes to the maturation of primordial germ cells in both sexes. It is essential for ovulation and boosts the ovary's and testes' construction of steroid hormones in females and testosterone in males, respectively [16].

6. Prolactin Hormone

Prolactin, a protein best recognized for facilitating the production of milk by mammals, is also referred to as lactotropin and mammotropin. It affects more than 300 distinct processes in humans and other mammals [17]. The pituitary gland secretes prolactin in reaction to ovulation, feeding, estrogen treatment, and breastfeeding. Between these occurrences, it is abundantly secreted in pulses. Prolactin is crucial for immune system modulation, metabolism, and pancreatic development [18].

The pituitary gland's posterior lobe

The back of the pituitary is not glandular as the front of the pituitary; It is mostly made up of magnocellular neurosecretory cells' neuronal projections (axons) that emerge from the hypothalamic paraventricular and supraoptic nuclei. The neurohypophysial chemicals vasopressin and oxytocin are stored and released by these axons into the neurohypophyseal capillaries, where they enter the systemic circulation and partially return to the hypophyseal portal system. The posterior pituitary contains axons as well as pituicytes, which are specialized glial cells that resemble astrocytes and help store and release hormones[19].

The posterior pituitary gland's hormones

1. Antidiuretic Hormone (ADH)

The kidneys are impacted by this hormone, which increases their capacity to absorb water from the renal tubules and decreases the production of urine. On the other hand, when blood water content rises due to increased water intake, blood levels of the particular hormone fall, which causes the kidneys to absorb less water and increase urine production. Water absorption in the kidneys is significantly impacted if the release or secretion of the hormone (ADH) in the blood ceases for any reason, such as the death of the pituitary cells that release it or their infection with the disease, As a result, some water is eliminated in the urine rather than absorbed. We refer to this situation as non-diabetic diabetes. It was called thus to differentiate it from diabetes mellitus [20].

2. Oxytocin Hormone

This hormone causes the uterine smooth muscles to contract during birthing. Additionally, during lactation, it promotes the smooth muscles of the mammary glands to contract. The uterine muscles are strongly contracted by this hormone, which is known as the fast labor hormone. This helps to release the fetus from the uterus during labor, Oxytocin is transported by the blood to the mammary gland, where it induces the muscle fibers around its ducts to contract, allowing the nipple to produce more milk [21].

Pituitary dysfunction

Tumors of the pituitary gland

Pituitary tumors begin as a single aberrant cell that grows into numerous more aberrant cells before becoming a tumor. We still don't fully understand the cause. Almost invariably benign (not cancer), pituitary tumors can be treated with medication or surgery, depending on the kind of tumor, Although it is possible, pituitary cancer is extremely uncommon [22]. Most pituitary tumors are called "pituitary adenomas"; "adeno" refers to a gland, and "oma" to a tumor. Additional prevalent forms of pituitary tumors are Rathke's cleft cysts and craniopharyngiomas. In actuality, abnormal cells and little pituitary tumors are rather frequent. Approximately 20 to 25 percent of the general population may have tiny pituitary tumors that are benign and do not require treatment[23]. Tumors of the pituitary gland are often benign, but they put pressure on the gland and other parts of the brain, resulting in headaches, vision issues, and other health concerns. Secretory and non-secretory pituitary tumors are the two types of pituitary gland tumors[24].

Acromegaly

In adults, a rare disorder called acromegaly causes certain bones, organs, and other tissue to enlarge. The pituitary gland, a tiny gland in the brain, produces excessive amounts of growth hormone, which causes these alterations. This typically occurs because of a pituitary tumor. It isn't cancerous. An excess of growth hormone causes bones to enlarge, During childhood, this results in gigantism, a condition that causes a rise in

height. Adult acromegaly patients do not see a change in height. As an alternative, the hands, feet, and face get larger [25].

Cushing's Syndrome

Since elevated adrenocorticotropic hormone secretion or elevated blood cortisol causes this disease, which results in high blood pressure, weight gain, weakness and exhaustion, and easy bruising, it frequently arises from a tumor in the pituitary gland or close to it [26].

Diabetes insipidus

This condition is caused by a lack of the antidiuretic hormone vasopressin, and its symptoms include excessive urination that lasts all day and all night. Diabetes insipidus in children can also affect growth, weight gain, appetite, and eating habits. They could show up with diarrhea, vomiting and fever, Adults with untreated diabetes insipidus may live healthy lives for decades as long as they drink enough water to compensate for their urine losses. But there is always a chance of being dehydrated and losing potassium, which might result in hypokalemia [27].

Hyperprolactinemia

Excessive pituitary gland production of prolactin hormone due to a tumor causes the natural amounts of sex hormones, testosterone in men and estrogen in women, to drop, which can result in the following issues: reduced sexual desire and infertility in both sexes [28].

Sheehan Syndrome

Sheehan syndrome is brought on by severe blood loss that damages the anterior pituitary gland. This typically occurs after birth, when the mother loses a substantial amount of blood. This lack of blood prevents the pituitary gland from producing hormones. It is not always possible to diagnose Sheehan syndrome right after giving birth. Sometimes, Sheehan syndrome symptoms could not appear for months following childbirth or a major traumatic event. Agalactorrhea, or the lack of lactation, is the primary and most prevalent sign of Sheehan syndrome. Hot flashes, amenorrhea or oligomenorrhea, and diminished sex drive are other symptoms linked to a decrease in pituitary gland hormone production [29],[30].

Empty sella syndrome

The disorder, known as empty sella syndrome, occurs once the pituitary gland becomes trodden or narrow, filling the solda turcica with cerebrospinal liquid instead of the typical pituitary gland. It may be found as a by-product of brain imaging or as part of the diagnostic process for pituitary diseases [31]. Individuals who suffer from empty sella syndrome may have headaches and visual loss. Other symptoms that are linked to hypopituitarism include middle ear ossicle abnormalities, cryptorchidism, dolichocephaly, meningocele, muscular hypotonia, and platybasia [32].

Conclusion

The pituitary gland is the main hormonal regulator, releasing hormones that influence the activity of numerous other endocrine glands, including the testes, thyroid, adrenal, and ovaries. Diseases including gigantism or dwarfism, Cushing's syndrome, diabetes insipidus, and Sheehan syndrome can result from any pituitary gland abnormality.

REFERENCES

[1] O. Mete, R. Y. Osamura, and S. L. Asa, "Pituitary Gland: Introduction," in *WHO Classification of Tumours of Endocrine Organs*, 5th ed., Lyon, France: IARC Press, 2022.

[2] G. Aguilera, S. Subburaju, S. Young, and J. Chen, "The parvocellular vasopressinergic system and responsiveness of the hypothalamic-pituitary-adrenal axis during chronic stress," *Prog. Brain Res.*, vol. 170, pp. 29–39, 2008. [Online]. Available: https://doi.org/10.1016/S0079-6123(08)00403-2

[3] H. Corin, "The pituitary – 5th edition," *Acta Endocrinol. (Bucharest)*, vol. 17, no. 4, p. 565, 2021. [Online]. Available: https://doi.org/10.4183/aeb.2021.565

[4] R. J. Nelson, *An Introduction to Behavioral Endocrinology*, 4th ed. Sunderland, MA, USA: Sinauer Associates, 2011.

[5] G. J. Tortora and B. H. Derrickson, *Principles of Anatomy and Physiology*, 15th ed. Hoboken, NJ, USA: Wiley, 2017.

[6] E. Thompson and F. Wilson, *Pituitary Gland Anatomy and Physiology: A Textbook for Medical Students*. Oxford, UK: Oxford University Press, 2014.

[7] S. K. Malhotra, K. Sharma, and V. Saini, "Pituitary surgery and anaesthetic management: an update," *World J. Endocr. Surg.*, vol. 5, no. 1, pp. 1–5, 2013. [Online]. Available: https://doi.org/10.5005/jp-journals-10002-1114

[8] B. M. Chin, R. R. Orlandi, and R. H. Wiggins, "Evaluation of the sellar and parasellar regions," *Magn. Reson. Imaging Clin. N. Am.*, vol. 20, no. 3, pp. 515–543, 2012. [Online]. Available: PubMed.

[9] V. P. Eroschenko and M. S. H. di Fiore, *DiFiore's Atlas of Histology with Functional Correlations*. Philadelphia, PA, USA: Lippincott Williams & Wilkins, 2013.

[10] H. Dardente, "Melatonin-dependent timing of seasonal reproduction by the pars tuberalis: pivotal roles for long daylengths and thyroid hormones," *J. Neuroendocrinol.*, vol. 24, no. 2, pp. 249–266, 2012.

[11] P. J. Morgan and L. M. Williams, "The pars tuberalis of the pituitary: a gateway for neuroendocrine output," *Rev. Reprod.*, vol. 1, no. 3, pp. 153–161, 1996.

[12] J. B. Allard and C. Duan, "IGF-binding proteins: why do they exist and why are there so many?" *Front. Endocrinol.*, vol. 9, p. 117, 2018. [Online]. Available: https://doi.org/10.3389/fendo.2018.00117

[13] S. R. Bornstein et al., "Diagnosis and treatment of primary adrenal insufficiency: an Endocrine Society clinical practice guideline," *J. Clin. Endocrinol. Metab.*, vol. 101, pp. 364–389, 2016. [Online]. Available: https://doi.org/10.1210/jc.2015-17103

[14] B. Eghtedari and R. Correa, "Levothyroxine," StatPearls [Internet], Treasure Island, FL: StatPearls Publishing, Aug. 28, 2023. [Online]. Available: PubMed.

[15] C. Cahoreau, D. Klett, and Y. Combarnous, "Structure-function relationships of glycoprotein hormones and their subunits' ancestors," *Front. Endocrinol.*, vol. 6, p. 26, 2015. [Online]. Available: https://doi.org/10.3389/fendo.2015.00026

[16] D. Nedresky and G. Singh, "Physiology, Luteinizing Hormone," StatPearls Publishing.

[17] C. Bole-Feysot et al., "Prolactin (PRL) and its receptor: actions, signal transduction pathways and phenotypes observed in PRL receptor knockout mice," *Endocr. Rev.*, vol. 19, no. 3, pp. 225–268, 1998. [Online]. Available: https://doi.org/10.1210/edrv.19.3.0334

[18] N. Ben-Jonathan, E. R. Hugo, T. D. Brandebourg, and C. R. LaPensee, "Focus on prolactin as a metabolic hormone," *Trends Endocrinol. Metab.*, vol. 17, no. 3, pp. 110–116, 2006.

[19] R. C. Malenka, E. J. Nestler, and S. E. Hyman, "Neural and neuroendocrine control of the internal milieu," in *Molecular Neuropharmacology: A Foundation for Clinical Neuroscience*, 2nd ed., A. Sydor and R. Y. Brown, Eds. New York, NY, USA: McGraw-Hill Medical, 2009, pp. 246–259.

[20] B. A. Laway and S. A. Mir, "Pregnancy and pituitary disorders: challenges in diagnosis and management," *Indian J. Endocrinol. Metab.*, vol. 17, no. 6, pp. 996–100

[21] H. K. Caldwell and W. S. Young III, "Oxytocin and Vasopressin: Genetics and Behavioral Implications," in *Handbook of Neurochemistry and Molecular Neurobiology: Neuroactive Proteins and Peptides*, Lajtha A., Ed., Springer, 2006.

[22] M. B. S. Lopes, A. J. Gill, P. Wesseling, and D. J. Brat, "Tumours of the Sellar Region: Introduction," in *WHO Classification of Tumours of the Central Nervous System*, 5th ed., Lyon, France: IARC Press, 2022.

[23] G. Rindi, D. S. Klimstra, B. Abedi-Ardekani, et al., "A common classification framework for neuroendocrine neoplasms: an International Agency for Research on Cancer (IARC) and World Health Organization (WHO) expert consensus proposal," *Modern Pathology*, vol. 31, no. 12, pp. 1770-1786, 2018.

[24] O. Mete and M. B. Lopes, "Overview of the 2017 WHO classification of pituitary tumors," *Endocrine Pathology*, vol. 28, no. 3, pp. 228-243, 2017.

[25] A. M. Drewes, M. C. Arlien-Søborg, J. O. Lunde Jørgensen, and M. P. Jensen, "Acromegaly and symptoms of the motor apparatus," *Ugeskr Laeger*, vol. 180, no. 46, 2018.

[26] W. Yuan, "Management of the patient with transsphenoidal pituitary tumor resection," *Journal of Neuroscience Nursing*, vol. 45, no. 2, pp. 101-107, 2013.

[27] T. M. Fujiwara and D. G. Bichet, "Molecular Biology of Hereditary Diabetes Insipidus," *Journal of the American Society of Nephrology*, vol. 16, no. 10, pp. 2836–2846, 2005.

[28] B. Pi, "Benign brain tumors: Sellar/parasellar tumors," *Neurologic Clinics*, vol. 25, no. 4, pp. 1231-1249, 2007.

[29] Z. Karaca, A. Hacioglu, and F. Kelestimur, "Neuroendocrine changes after aneurysmal subarachnoid haemorrhage," *Pituitary*, vol. 22, no. 3, pp. 305-321, 2019.

[30] C. J. Thompson, R. W. Costello, and R. K. Crowley, "Management of hypothalamic disease in patients with craniopharyngioma," *Clinical Endocrinology*, vol. 90, no. 4, pp. 506-516, 2019.

[31] J. González-Tortosa, "Primary empty sella: Symptoms, physiopathology, diagnosis and treatment," *Neurocirugia*, vol. 20, no. 2, pp. 132–151, 2009.

[32] L. Goldman and A. I. Schafer, *Goldman's Cecil Medicine*, 24th ed., Elsevier Health Sciences, 2012.