Latest Classification and Such Functions of Human Hormones

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Research Article

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Abstract

Abstract: Based on the classification of human hormones, there is no solid idea in most books. In this view, this article could exemplify a concrete solution, especially for medical and university students. Hormones have many life-saving roles in the human body. With the deficiency of hormones, our body might fall into lots of problems. Data analyses of much information from books, articles, online supplements gave different ideas on total hormones. The result suggested that some hormones were secret from the same glands. Out of 110 hormones (when the same hormone came from different sources), exact different types of hormones were 88. Analyzed hormones consisted of four major groups- amine (4 hormones), eicosanoid (4), steroid (15), and peptide were (65) out of 88 endocrine chemicals. The endocrine and reproductive system (56) jointly secreted most of the hormones, and secondly gastrointestinal tract (26 hormones). Besides the organ system or glands, some are come out from the cell, tissue, tissue system, and placenta. This paper also mentions, phenotypically males and females exhibit many differences, hence hormonal analyses; they are more or less the same. For instance, many sex hormones are also present both in males and females. In the future, it needs to enhance more research on the classification of the hormones in the human body.

Introduction

Secretin, gastrin, and cholecystokinin were the first gastrointestinal hormones (Bayliss & Starling, 1902; Edkins, 1905; Ivy & Oldberg, 1928) and also the first structurally identified and are the largest endocrine organ in the body. Knowledge about the physiology and anatomy of the gut endocrine system is most helpful for the clinician to understand the pathophysiology of certain diseases (excess hormone production from gut endocrine tumours) (Rindi et al., 1999). Neuronal sensitivity may be involved in common gastrointestinal diseases like irritable bowel syndrome (Furness et al., 1999). The latest research will relate to gut peptides associated with deficiency diseases as potential growth factors in malignancies (Ahlman & Nilsson, 2001). The posterior pituitary gland is not a true gland (www.ncbi.nlm.nih.gov/books/NBK 551529/), but a collection of axons extending from the hypothalamus supraoptic and paraventricular nuclei terminating behind the APG (Pasternak, 2010; Kohler, 1983). The phylogenetic story of the gastrin family reveals that gastrointestinal hormones indeed are very old, and has evolved from a single ancestor (Rehfeld, 1998b). Secretin was believed to exist only as a carboxamidated peptide of 27 amino acid residues for many years (Mutt et al., 1970; Mutt et al., 1965). Hair follicles and sebaceous glands are the targets for androgens secreted by the gonads and adrenal cortex (Ebling, 1990; Fritsch et al., 2001) and melanocytes are directly influenced by polypeptide hormones of the pituitary gland (Suzuki et al., 1996). Glucocorticoid receptor expressed in basal keratinocytes, Langerhans cells, and dermal fibroblasts (Serres et al., 1996; Leiferman et al., 1983); androgen receptor (Fritsch et al., 2001; Liang et al., 1993; Tadokoro et al., 1997; Lachgar et al., 1999), and progesterone receptor is expressed in basal epidermal keratinocytes only (Im et al., 2000); thyroid hormone receptor (Tomma et al., 1993; Zonefrati et al., 1983), and estrogen receptor (Lachgar et al., 1999; Thorton et al., 2003; Crandall et al., 1998; Jee et al., 1994; Haczynski et al., 2002). It has been recognized that estrogens are important in the maintenance of human skin (Thomton, 2002) because the skin is also a source of corticosteroids (Gyster et al., 1997). Circulatory testosterone is a co-produced chemical in the skin and other peripheral organs (Orfanos et al., 2000). There is no doubt that human skin is the largest peripheral endocrine organ (Zouboulis, 2004). The objective of this article is to mention the latest
number of hormones depending on the chemical composition, same hormones from the different organs/glands, as well as organ systems of the human body.

**Materials And Methods**

In the college intermediate course of Bangladesh, there are some ideas on human hormones in the Zoology book, but those are not adequate. As a Biology teacher, there was a lacking of clarification about the hormones to the students. Textbook of Medical Physiology by Guyton and Hall (2015), most of the hormones were elaborated there with proper classification and functions. On the internet, a list of human hormones exhibited eighty plus hormones. In addition, all of the hormones mainly have their name/alternative names, secreted parts, chemical composition, and functions. Research articles and books were helpful for the qualitative analyses of chemicals. A quantitative method was applicable for ensuring the exact number of such hormones (Appendix 1).

**Results And Discussion**

Out of 88 hormones, 65 were in the peptide group, steroid 15 and others (amine and eicosanoid) 4 each (Table 1; Figure 1). Androstenedione is a steroid hormone available in the kidney, testis, and ovary. Dehydroepiandrosterone was second in their position secreted from the same organs (Table 2). Since the 'endocrine system' and 'reproductive system' are different in the human body but based on secreted hormones, these two systems secrete hormones jointly. From here, 56 types of hormones were secreted from these and showed their highest position. The digestive system from which 26 hormones (Table 3; Figure 2) secrete covers many biological activities through supplying the nutrients within the cell.

**Table 1.** Chemical composition of the hormones
| Chemical composition | Name of hormones                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Number |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Peptide              | Brain Natriuretic Peptide, endothelin, thrombopoietin, adiponectin, lepsin, Galanin, Cortistatin, Orexin, Pituitary adenylate cyclase-activating peptide, Prolactin-releasing hormone, Vasoactive intestinal peptide, Somatostatin, Thyrotropin-releasing hormone, gastrin, Ghrelin, Oxyntomodulin, Cholecystokinin, Enterocrinin, Gastric inhibitory polypeptide, Glucagon-like peptide I, Enteroglucagon, Secretin, Motilin, Guanylin, Angiotensinogen, Angiotensin I, Hepcidin, Insulin-like growth factor I, Lipasin, Amylin, Pancreatic polypeptide, Glucagon, Insulin, Incretin, somatotropin, Thyroid stimulating hormone, Adrenocorticotrophic hormone, Follicle stimulating hormone, Prolactin, Luteinizing hormone, Lipotropin, Endorphin, Melanocyte stimulating hormone, Oxytocin, Vasopressin, Melatonin, Triiodothyronine, Calcitonin, Parathormone, Atrial Natriuretic Peptide (ANP), Thymosin, Thymulin, Thymopoietin, Thymic humoral factor, Enkephalin, Erythropoietin, Uroguanylin, Renin, Anti-Mullerian hormone, Inhibin, relaxin, human placental lactogen, human chorionic gonadotropin hormone, angiotensinogen II, osteocalcin | 65     |
| Steroid              | calcidiol, calcitriol, dehydroepiandrosterone, dihydrocholecalciferol, androstenedione, cortisol, aldosterone, testosterone, dihydrotestosterone, estrogen, estradiol, gonadocorticoid, estrone, estriol, progesterone                                                                                                                                                                                                                       | 15     |
| Amine                | dopamine, thyroxine, adrenaline, nonadranaline                                                                                                                                                                                                                                                                                                                                                                                                               | 4      |
| Eisosanoid           | thromboxane, leukotrienes, prostaglandin, prostacyclin                                                                                                                                                                                                                                                                                                                                                                                                      | 4      |

**Table 2.** Same hormones from the different portions
| Hormones               | Glands/Organs                                                                 | Found in places |
|------------------------|-------------------------------------------------------------------------------|-----------------|
| Androstenedione        | kidney, adrenal cortex, adrenal medulla, testis, ovary                        | 5               |
| Dehydroepiandrosterone | testis, ovary, kidney                                                         | 3               |
| Estradiol              | testis, ovary                                                                 | 2               |
| Estriol                | ovary, placenta                                                               | 2               |
| Estrogen               | testis, ovary, placenta                                                       | 3               |
| Gastrin                | stomach, pancreas                                                             | 2               |
| Gonadocorticoid        | testis, ovary                                                                 | 2               |
| Inhibin                | testis, ovary, fetus                                                          | 3               |
| Progesterone           | ovary, placenta                                                               | 2               |
| Ralaxin                | decidual cell, prostate gland                                                 | 2               |
| Somatostatin           | hypothalamus, pancreas                                                        | 2               |
| Thrombopoietin         | striated muscle, liver, kidney                                                | 3               |
| Vasoactive intestinal peptide | hypothalamus, from duodenum to rectum (gut), pancreas | 3               |

Table 3. Organ system-wise secreted hormones
| Organ system/Others                                                                 | Secreted hormones |
|-----------------------------------------------------------------------------------|-------------------|
| Integumentary system                                                               | 1                 |
| Circulatory system                                                                 | 4                 |
| Muscular system                                                                    | 2                 |
| Nervous system                                                                     | 9                 |
| Digestive system                                                                   | 26                |
| Endocrine system + Reproductive system                                             | 56                |
| Respiratory system                                                                 | 1                 |
| Skeletal system                                                                    | 1                 |
| Others (nucleated cells, adipocytes, decidual cells, placenta, fetus)               | 10                |

Above 30 peptide hormone genes express more than 100 bioactive peptides, and monoamines and eicosanoids hormonal messenger (Rehfeld, 1998a). The gut or digestive system is the largest hormone-producing organ in the body (number of endocrine cells and number of hormones) (Schultz et al., 1989; Walsh & Dockray, 1994). A study of the 1960s showed that gastrointestinal hormones could be peptides of 20-30 amino acid residues (Rehfeld, 1998b). Hormonal differences between males and females, their body muscles differ (Guyton & Hall, 2015).

**Conclusions**

Our body is composed of many chemicals, and all have a remarkable impact on the body. Identified 88 hormones are not an easy task to know their all functions shortly. Studied hormones have unbelievable acts in our 12 organ systems. Moreover, all nucleated cells, tissue, and tissue system play a significant role as a whole. Hormonal deficiencies have a very negative role in our life. Through the proper classification of these hormones make us more curious to discover their unseen functions. In the future, it needs to enhance more research on the division of hormones in the human body.

**Declarations**

Conflict of Interest: There is no conflict of interest

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**Appendix**

**Appendix 1.** Total hormones and their functions
| Name                              | Status               | Secreted hormone(s)                      | Chemical composition | Functions                                                                 |
|----------------------------------|----------------------|------------------------------------------|----------------------|---------------------------------------------------------------------------|
| **Skin**                         | **Organ system**     | Calcidiol                                | Steroid              | Inactive form of vitamin D₃                                               |
| **Heart**                        | **Organ**            | Brain Natriuretic Peptide (BNP)          | Peptide              | Reducing bile production                                                  |
| **Blood**                        | **Tissue**           | Thromboxane                              | Eicosanoid           | Vasoconstriction, platelet aggregation                                    |
| **Blood**                        | **Tissue**           | Leukotrienes                             | Eicosanoid           | Increase vascular permeability                                            |
| **Endothelial cell**             | **Cell**             | Endothelin                               | Peptide              | Smooth muscle contraction                                                |
| **All nucleated cells**          | **Cell**             | Prostaglandin                            | Eicosanoid           | Vasodilation                                                              |
| **Striated muscle**              | **Organ**            | Thrombopoietin                           | Peptide              | Produce platelets                                                         |
| **Vascular muscle cells**        | **Cell**             | Prostacyclin                             | Eicosanoid           | Vasodilation; Platelet activation inhibitor                               |
| **Adipocytes**                   | **Cell**             | Adiponectin                              | Peptide              | Regulating glucose levels                                                 |
|                                  | **Cell**             | Leptin                                   | Peptide              | Inhibits appetite, stimulates thermogenesis                               |
| **Central Nervous System (CNS)** | **Organ system**     | Galanin                                  | Peptide              | Action potentials in neurone                                              |
| **Cerebral cortex**              | **Tissue system**    | Cortistatin                              | Peptide              | Neural activity (slow wave sleep)                                        |
| **Organ**                        | **Organ**            | Orexin                                   | Peptide              | Increased appetite                                                        |
| **Organ**                        | **Organ**            | Pituitary adenylate cyclase-activating peptide | Peptide          | Stimulates enterochromaffin-like cells                                   |
| **Organ**                        | **Organ**            | Prolactin-releasing hormone              | Peptide              | Release prolactin                                                         |
| **Organ**                        | **Organ**            | Prolactin-inhibitory factor/Dopamine     | Amine                | Inhibits release of prolactin                                             |
| **Organ**                        | **Organ**            | Vasoactive intestinal peptide            | Peptide              | Blood pressure; Relax smooth muscle of                                    |
| Organ | Peptide | Function |
|-------|---------|----------|
| Hypothalamus | Somatostatin (growth hormone-inhibiting hormone/growth hormone release-inhibiting hormone/somatotropin release-inhibiting factor/somatotropin release-inhibiting hormone) | Prevent the production of other hormones (may occur in tumors); Act as neurotransmitter; Role in gastrointestinal tract |
| Thyrotropin-releasing hormone | Peptide | Release thyroid stimulating hormone; Stimulates prolactin release |
| Gastrin | Peptide | Stimulates HCl secretion by parietal cells |
| Ghrelin | Peptide | Stimulate appetite |
| Oxyntomodulin | Peptide | Suppress appetite |
| Cholecystokinin | Peptide | Release digestive enzyme and bile juice |
| Enterocrinin | Peptide | Increase the secretion of alkaline mucous |
| Gastric inhibitory polypeptide | Peptide | Induce insulin secretion |
| Glucagon-like peptide I | Peptide | Release of insulin |
| Enteroglucagon | Peptide | Intestinal growth and dilation; Reduce the chance of apoptosis |
| Secretin | Peptide | Stimulates pancreatic acinar cells to release bicarbonate and water |
| Motilin | Peptide | Stimulates gastric activity |
| Vasoactive intestinal peptide | Peptide | Blood pressure; Relax smooth muscle of |
| Organ                          | Peptide                                      | Function                                                                 |
|-------------------------------|----------------------------------------------|--------------------------------------------------------------------------|
| Intestine (from duodenum to rectum (gut)) |                               |                                                                         |
| Intestine                      | Guanylin                                     | Regulates electrolytes                                                   |
| Intestine                      | Angiotensinogen                              | Vasoconstriction                                                         |
| Intestine                      | Angiotensin I                                | Vasoconstriction                                                         |
| Intestine                      | Hepcidin                                     | Inhibits iron export from cells                                          |
| Intestine                      | Insulin-like growth factor I                  | Insulin-like effects                                                     |
| Intestine                      | Thrombopoietin                               | Produce platelets                                                        |
| Intestine                      | Lipasin/Betatrophin                          | Stimulates the insulin-secreting beta cells                              |
| Liver                         | Amylin (Islet amyloid polypeptide)           | Inhibits digestive secretion                                             |
| Liver                         | Pancreatic polypeptide                       | Pancreatic secretions                                                    |
| Liver                         | Vasoactive intestinal peptide                | Blood pressure; Relax smooth muscle of trachea; Stomach; Gall bladder   |
| Liver                         | Somatostatin (growth hormone-inhibiting hormone/growth hormone release-inhibiting hormone/somatotropin release-inhibiting factor/somatotropin release-inhibiting hormone) | Prevent the production of other hormones (may occur in tumours); Act as neurotransmitter; Role in gastrointestinal tract |
| Pancreas                      | Glucagon                                     | Increase glucose                                                         |
| Pancreas                      | Insulin                                      | Decrease glucose                                                         |
| Pancreas                      | Incretin                                     | Stimulates pancreas including insulin release                           |
| Pancreas                      | Gastrin                                      | Stimulates HCl secretion by parietal cells                              |
| Gland                  | Hormone/Peptide                                                                 | Type       | Function                                                                 |
|-----------------------|--------------------------------------------------------------------------------|------------|--------------------------------------------------------------------------|
| Anterior pituitary    | Growth hormone/Somatotropin                                                     | Peptide    | Maintain growth                                                          |
| Gland                 | Thyroid stimulating hormone                                                     | Peptide    | Stimulates thyroid gland                                                 |
| Gland                 | Adrenocorticotropic hormone                                                     | Peptide    | Stimulates adrenal glands                                                |
| Gland                 | Follicle stimulating hormone                                                    | Peptide    | Stimulates follicle cells                                                |
| Gland                 | Luteotrophic/Lactogenic/Prolactin                                               | Peptide    |                                                                          |
| Gland                 | Luteinizing hormone/Lutropin/Gonadotrophic hormone/Interstitial cell-stimulating hormone in male | Peptide    | Stimulates gonads                                                         |
| Gland                 | Lipotropin                                                                      | Peptide    | Lipolysis; Stimulates melanocytes                                         |
| Gland                 | Endorphin                                                                       | Peptide    | Act as analgesics (diminish the perception of pain)                      |
| Mid pituitary         | Melanocyte stimulating hormone/Melanotropin/Intermedin                          | Peptide    | Stimulates melanocytes                                                    |
| Gland                 | Oxytocin                                                                        | Peptide    | Uterine contraction in birth                                              |
| Gland                 | Vasopressin/Anti-diuretic hormone                                               | Peptide    | Water absorption                                                          |
| Pineal gland          | Melatonin                                                                       | Peptide    | Sleep patterns (circadian rhythms)                                       |
| Thyroid               | Thyroxine                                                                       | Amine      | Maintains metabolic rate                                                 |
| Gland                 | Triiodothyronine                                                                | Peptide    | Maintains metabolic rate                                                 |
| Gland                 | Calcitonin                                                                      | Peptide    | Regulate levels of calcium and phosphate                                  |
| Parathyroid           | Parathyroid hormone/Parathormone/Parathyrin                                    | Peptide    | Absorption of calcium                                                     |
| Gland                 | Atrial Natriuretic Peptide (ANP)                                                | Peptide    | Powerful vasodilator                                                      |
| Gland                 | Thymosin                                                                        | Peptide    | Stimulate the production of T cell, which are important for immune system |
| Gland       | Peptide                                       | Steroid/Protein | Function                                                                 |
|------------|-----------------------------------------------|-----------------|--------------------------------------------------------------------------|
| Thymus     | Thymulin/Thymic factor                        | Peptide         | Circadian rhythm                                                         |
|            | Thymopoietin                                  | Peptide         | Process of T cells differentiation                                        |
|            | Thymic humoral factor                         | Peptide         | It increases immune response to particular virus                          |
| Kidney     | Calcitriol                                    | Steroid         | Increase absorption of vitamin D3 and calcium                             |
|            | Enkephalin                                    | Peptide         | Regulate pain                                                             |
|            | Thrombopoietin                                | Peptide         | Produce platelets                                                         |
|            | Erythropoietin                                | Peptide         | Erythrocyte production                                                   |
|            | Uroguanylin                                   | Peptide         | Regulate electrolytes                                                     |
|            | Dehydroepiandrosterone                        | Steroid         | Virilization, anabolic                                                   |
|            | Renin                                         | Peptide         | Conversion of angiotensinogen to angiotensin I                           |
|            | Dihydroxycholecalciferol                      | Steroid         | Bone mineralization                                                       |
|            | Androstenedione                               | Steroid         | Substrate for estrogen                                                    |
| Adrenal cortex | Androstenedione                               | Steroid         | Substrate for estrogen                                                    |
|            | Cortisol/Hydrocortisone/Glucocorticoid        | Steroid         | Immune response                                                           |
|            | Aldosterone/Mineralocorticoid                 | Steroid         | Control blood pressure                                                    |
| Adrenal medulla | Androstenedione                               | Steroid         | Substrate for estrogen                                                    |
|            | Epinephrine/Adrenaline                        | Amine           | Solve any unwanted situation                                              |
|            | Nor-epinephrine/Nor-adrenaline                | Amine           | Make people calm                                                           |
|            | Anti-Mullerian hormone                        | Peptide         | Inhibit release of prolactin and                                           |
| Gland               | Inhibin          | Peptide               | Inhibit production of FSH |
|---------------------|------------------|-----------------------|--------------------------|
| Gland               | Testosterone     | Steroid               | Male sexual characteristics |
| Gland               | Dehydroepiandrosterone | Steroid             | Virilization; Anabolic   |
| Gland               | Dihydrotestosterone | Steroid             | Male puberty and adult characteristics |
| Gland               | Androstenedione  | Steroid               | Substrate for estrogen   |
| Gland               | Estrogen         | Steroid               | Male physical feature and reproduction; Need to produce testosterone |
| Gland               | Estradiol        | Steroid               | Essential for the production of sperm |
| Gland               | Sex steroid/Gonadocorticoid | Steroid   | Stimulates sexual organs |
| Prostate gland      | Relaxin          | Peptide               | It relaxes pelvic ligaments |
| Gland               | Estradiol        | Steroid               | Female physical feature and reproduction; Need to produce testosterone |
| Gland               | Estrone          | Steroid               | Female sexual development |
| Gland               | Estradiol        | Steroid               | Ovulation; Thickening of the uterine wall; Implantation |
| Gland               | Estriol          | Steroid               | Female physical feature and reproduction; Need to produce testosterone |
| Gland               | Progesterone     | Steroid               | Menstrual cycle; Menopause; |
| Ovary          | Gland         | Inhibin   | Peptide | Inhibit production of FSH |
|----------------|---------------|-----------|---------|--------------------------|
|                | Gland         | Testosterone | Steroid | Male-like sexual characteristics in female |
|                | Gland         | Dehydroepiandrosterone | Steroid | Virilization; Anabolic |
|                | Gland         | Androstenedione | Steroid | Substrate for estrogen |
|                | Gland         | Sex steroid/Gonadocorticoid | Steroid | Stimulates sexual organs |
| Decidual cells | Cell          | Relaxin   | Peptide | Relaxes pelvic ligaments |
| Placenta       | Organ         | Human placental lactogen/Human somatomammotropin hormone | Peptide | Increase production of insulin; Metabolism of pregnant woman; Probably development of fetal tissue and mother's breast |
|                | Organ         | Human chorionic gonadotropin hormone | Peptide | Growth of corpus luteum |
|                | Organ         | Estrogen  | Steroid | Female physical feature and reproduction; Need to produce testosterone |
|                | Organ         | Estriol   | Steroid | Uterine growth |
|                | Organ         | Progesterone | Steroid | Menstrual cycle; Menopause; Pregnancy; Need to produce testosterone |
| Fetus          | Organ         | Inhibin   | Peptide | Inhibit production of FSH |
| Lung           | Organ         | Angiotensin II | Peptide | Regulates haemodynamic profile |
**Skeleton**  
**Organ system**  
**Osteocalcin**  
**Peptide**  
**Muscle function; Testosterone synthesis and energy expenditure**

**Source:** Guyton and Hall (2015); [https://en.wikipedia.org/wiki/List_of_human_hormones](https://en.wikipedia.org/wiki/List_of_human_hormones)  
N.B. Total secreted hormones (same hormones from the different organs/glands) 110; but the different types of hormones are 88.

**Figures**

**Figure 1**

Number of hormones corresponding with their chemical composition
Figure 2

Number of hormones depending on the organ systems