

Anatomical and cytohistological study of the pituitary gland in adult turkey

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Article Info	Abstract
<p>Article history:</p> <p>Received: 28 January 2018 Accepted: 22 May 2018 Available online: 15 June 2019</p> <p>Key words:</p> <p>Anatomy Histology Pituitary gland Turkey</p>	<p>In order to conduct this study, eight adult turkey heads were obtained. Pituitary glands were harvested following cranial bones removal and examined morphologically and anatomically as well as topographically. Then, tissue sections were prepared and stained using Hematoxylin and Eosin, Alcian blue, orange G and periodic acid-Schiff staining techniques. The results showed that turkey pituitary gland as a pea-sized structure is located in the ventral part of the cerebrum and composed of adenohypophysis and neurohypophysis parts. Moreover, histological analyses revealed that sinusoids are well-developed at the distal part of the adenohypophysis and irregular masses of endocrine cells exist among them. Distributions of basophilic cells in the distal part of adenohypophysis were significantly higher than those of other endocrine cells, while the acidophilic cells had the lowest distribution. Lower and higher numbers of chromophobe cells were also found compared to those of basophilic and acidophilic cells, respectively. These findings were mostly similar to the other birds' pituitary gland anatomical and histological features, but there were also differences in cellular elements distributions along with infundibular cavity topography.</p> <p style="text-align: right;">© 2019 Urmia University. All rights reserved.</p>

مطالعه آناتومیکی و سیتوهیستولوژیکی غده هیپوفیز در بوقلمون بالغ**چکیده**

به منظور انجام این مطالعه، هشت عدد سر بوقلمون بالغ تهیه گردید. غده هیپوفیز متعاقب برداشت استخوان‌های کاسه سر جدا شدند و از نظر ریخت‌شناسی، آناتومی و نیز مکان‌نگاری مورد ارزیابی قرار گرفتند. سپس، مقاطع بافتی تهیه و توسط روش‌های هماتوکسیلین-ئوزین، آلتیان بلو، اورنج جی و پرودیوک اسید-شیف رنگ‌آمیزی شدند. نتایج نشان دادند که غده هیپوفیز بوقلمون به صورت ساختاری به اندازه نخود در قسمت شکمی مخ واقع شده است و شامل بخش‌های آدنوهیپوفیز و نوروهیپوفیز می‌باشد. همچنین، ارزیابی‌های بافت‌شناسی آشکار ساختند که سینوزوئیدها در بخش انتهایی آدنوهیپوفیز توسعه یافته می‌باشند و توده‌های نامنظم سلول‌های اندوکراین در حد فاصل آن‌ها وجود دارند. پراکندگی‌های سلول‌های بازوفیلی در بخش انتهایی آدنوهیپوفیز به شکل قابل ملاحظه‌ای بیشتر از پراکندگی‌های سایر سلول‌های اندوکراین بودند، در حالی که سلول‌های اسیدوفیلی کمترین میزان پراکندگی را دارا بودند. در مقایسه با سلول‌های بازوفیلی و اسیدوفیلی، سلول‌های رنگ‌گریز نیز به ترتیب دارای فراوانی کمتر و بیشتری بودند. این یافته‌ها به‌طور عمده مشابه ویژگی‌های آناتومیکی و بافت‌شناسی غده هیپوفیز سایر پرندگان بود ولی اختلافاتی نیز در پراکندگی‌های اجزای سلولی همراه با موقعیت مکانی حفره قیفی شکل وجود داشت.

واژه‌های کلیدی: آناتومی، بافت‌شناسی، بوقلمون، غده هیپوفیز

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Introduction

The pituitary gland, hypophysis cerebri, as a major endocrine gland is associated with hypothalamus through infundibular stalk and plays critical roles in other endocrine glands activities via several hormones secretion.¹ This small gland is located in sella turcica of the basisphenoid bone body and composed of adenohypophysis and neurohypophysis.² In mammals, the adenohypophysis is composed of pars distalis, pars intermedia and pars tuberalis; however, pars intermedia does not exist in birds and adenohypophysis is mostly made of pars distalis.³ The avian pars distalis is divided into cephalic and caudal regions containing acidophilic, basophilic and chromophobe cells as well as extracellular colloid and fibrous materials.^{4,6} Reportedly, presence of folliculo-stellate agranular cells containing immuno-reactive S-100 protein has also been described in avian pars distalis. It has been suggested that these cells may play roles in autocrine-paracrine regulation of hormone secretion along with immune-endocrine interactions.⁷ The neurohypophysis includes infundibular stalk, median eminence and pars nervosa consisting of neurosecretory terminals.¹

Recently, turkey has been suggested as an animal model to mimic human diseases and to promote pharmacotherapies.⁸ Further, it has been suggested that poultry productions will increase remarkably than those of ruminant meat in the coming three decades⁹ and efficient veterinary services can lead to poultry diseases control and their economic losses reduction.^{10,11}

Based on this concept, the present study was carried out to disclose anatomical and cytohistological features of the pituitary gland in adult turkeys and to provide a clear understanding of the avian endocrinology resulting in veterinary diagnostics promotions.

Materials and Methods

In this study, eight adult turkey heads were provided randomly from slaughterhouses of Urmia, West Azerbaijan province, Iran. Pituitary glands were harvested following cranial bones removal, examined anatomically using stereomicroscope (SZX-ILLB200; Olympus Co., Tokyo, Japan) and fixed in 10% neutral buffered formalin for 72 hr. Then, the samples were embedded in paraffin, serially cut using a rotary microtome (Leitz Wetzlar GmbH, Wetzlar, Germany), stained using Hematoxylin and Eosin (H & E; Merck, Darmstadt, Germany), Alcian blue (AB; Merck), orange G (OG; Merck) and periodic acid-Schiff (PAS; Asian Chemical Company, Amol, Iran) staining techniques and analyzed via light microscopy (Eclipse E200-LED; Nikon, Tokyo, Japan). Cell distribution per unit area was determined using the unbiased counting frame¹² and photomicrographs were taken using SONY onboard camera (Zeiss, Tokyo, Japan).

Statistical analysis. All quantitative data were expressed as mean \pm SEM. Statistical analyses were conducted using SPSS (version 20.0, IBM Company, Chicago, USA) and one-way analysis of variance (ANOVA) followed by Tukey multiple comparison. The *p* values less than 0.05 were considered as statistically significant.

Results

Anatomical findings. Anatomical examinations revealed that turkey pituitary gland as a pea-sized structure is located in the ventral part of cerebrum and associated with an optic nerve as a second pair of the cerebral nerve in the frontal part of cerebrum as well as hypothalamus via infundibular stalk (Fig. 1A). The gland was observed in sella turcica fossa of the basisphenoid bone body and attached to the periosteum via meninges. The large and dark anterior part of the gland, adenohypophysis, was separated from the pale and small dorsal part of the gland, neurohypophysis, by a narrow and dark line known as Rathke's cleft.

Furthermore, the optic lobes were found at lateral sides of the gland and pons and medulla oblongata were observed dorsally (Fig. 1B).



Fig. 1. A) Dorso-lateral view of the pituitary gland in adult turkey. 1: Pituitary gland; 2: Optic nerve. **B)** Ventral view of the pituitary gland in adult turkey. 1: Pituitary gland; 2: Optic lobes; 3: Medulla oblongata; 4: Eyeball.

Histological findings. The present study revealed that turkey has a well-developed adenohypophysis and the neural part is located at the vicinity of third ventricle near diencephalon. The distal part was composed of cephalic and caudal lobes. Although these two lobes were not different from each other, distinct different cell diversity was found. Pituitocytes with round to oval nuclei and pale cytoplasm were observed in neural part. The unmyelinated axons terminal regions with Herring bodies were also located in neural part.

The histological evaluations showed that pars intermedia doesn't exist in turkey adenohypophysis, but there is a connective tissue containing a few cells between adenohypophysis and neurohypophysis and a wide infundibular cavity is present inside pars nervosa of turkey pituitary gland (Figs. 2A and 3A).

The connective tissue was evident along the capsule surrounding the pituitary gland and the Rathke's cleft was seen between the distal part and connective tissue. Numerous blood vessels were also observed in the connective tissue around adenohypophysis and neurohypophysis. Additionally, the neural part contained infundibular stalk and median eminence with similar histoarchitectures.

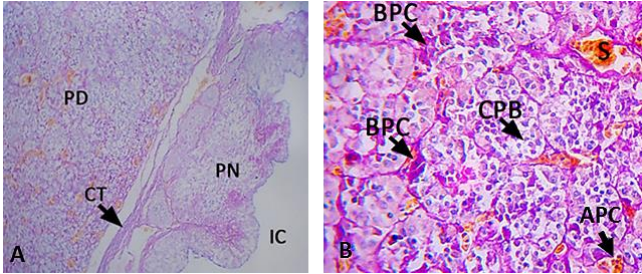


Fig. 2. Photomicrograph of the pituitary gland in adult turkey. PD: Pars distalis; PN: Pars nervosa; CT: Connective tissue; IC: Infundibular cavity; APC: Acidophilic cells; BPC: Basophilic cells; CPB: Chromophobe cells; S: Sinusoid (Orange G staining; A: 100× and B: 400×).

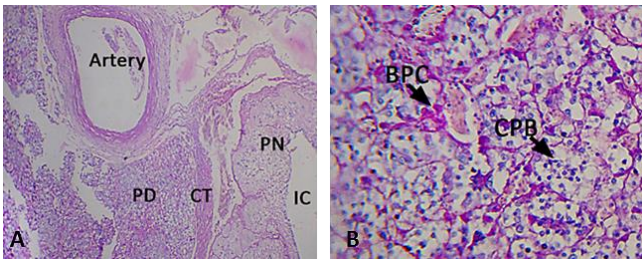


Fig. 3. Photomicrograph of the pituitary gland in adult turkey. PD: Pars distalis; PN: Pars nervosa; CT: Connective tissue; IC: Infundibular cavity; BPC: Basophilic cells; CPB: Chromophobe cells (Periodic acid-Schiff staining; A: 100× and B: 400×).

Moreover, histological analyses via OG and PAS stainings indicated that sinusoids are well-developed at the distal part of the adenohypophysis and irregular masses of endocrine cells exist among them. The growth hormone-secreting acidophilic cells (APCs), somatotrophs, with cytoplasm filled with acidophilic secretory granules and poorly stained chromophobe cells (CPCs) were also evident in pars distalis following OG and PAS stainings (Figs. 2B and 3B). The AB staining exhibited that basophilic cells (BPCs) with basophilic secretory granules are a major cellular constituent of turkey pars distalis (Fig. 4).

Stereological analyses following H&E staining revealed that distribution of BPCs with deep purple-colored cytoplasm in the distal part of adenohypophysis is significantly higher than that of other endocrine cells, while APCs have the lowest distribution. Lower and higher numbers of CPCs with pale-colored cytoplasm were also found compared to those of BPCs and APCs, respectively (Fig. 5).

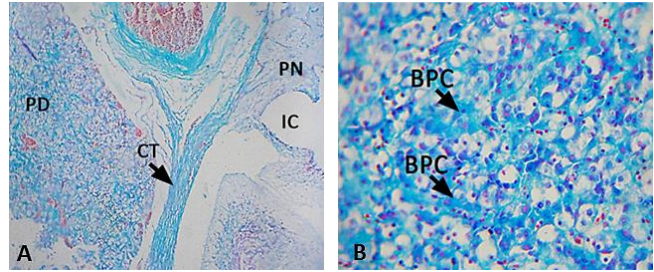


Fig. 4. Photomicrograph of the pituitary gland in adult turkey. PD: Pars distalis; PN: Pars nervosa; CT: Connective tissue; IC: Infundibular cavity; BPC: Basophilic cells (Alcian blue staining; A: 100× and B: 400×).

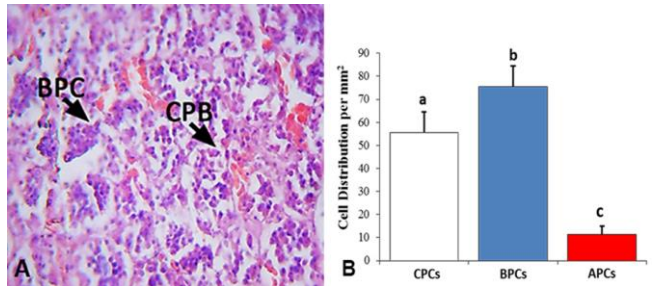


Fig. 5. A) Photomicrograph of the pituitary gland in adult turkey. BPC: Basophilic cells; CPB: Chromophobe cells (Hematoxylin and Eosin staining; 400×). **B)** Distribution of acidophilic, basophilic and chromophobe cells in pars distalis of adult turkey pituitary gland. CPCs: Chromophobe cells; BPCs: Basophilic cells; APCs: Acidophilic cells. abc Different letters indicate significant differences ($p < 0.05$).

Discussion

Although birds and mammals share general biological characteristics, they also bear major differences due to different metabolic demands and genetic features as well as biochemical adaptations.^{13,14} Moreover, it has been shown that ecophysiological factors and food habits can lead to various anatomical, cytohistochemical and histophysiological characteristics of the same tissue among bird species.^{15,16}

Since thorough understanding of tissues normal histology is pivotal in a diagnostic pathology,¹⁷ the current study was undertaken to shed further lights on morphological and cytohistological appearances of the pituitary gland in adult turkey.

Confirming previous reports, anatomical findings in this study showed that pea-sized pituitary gland in turkey is located in the ventral part of cerebrum and observed in sella turcica fossa of the basisphenoid bone body.¹⁸ Its well-developed adenohypophysis was also separated from small neurohypophysis via narrow Rathke's cleft as described previously.^{2,4}

Our histological observations revealed that the pars intermedia doesn't exist in turkey adenohypophysis, but there is a connective tissue containing a few cells between adenohypophysis and neurohypophysis. Similarly, the

absence of pars intermedia in the pituitary gland has been reported in birds and cetaceans including bottlenose dolphin (*Tursiops truncatus*), sperm whale (*Physeter macrocephalus*) and striped dolphin (*Stenella coeruleoalba*).^{3,19,20} Accordingly, it was found that adenohypophysis and neurohypophysis are separated by a thick layer of connective tissue in a bottlenose dolphin¹⁹ and a thin fibrous membrane in melon-headed whale (*Peponocephala electra*), spinner dolphin (*Stenella longirostris*), striped dolphin (*Stenella coeruleoalba*), pantropical spotted dolphin (*Stenella attenuata*), pygmy sperm whale (*Kogia breviceps*), dwarf sperm whale (*Kogia sima*), Risso's dolphin (*Grampus griseus*), short-finned pilot whale (*Globicephala macrorhyncha*), false killer whale (*Pseudorca crassidens*), Fraser's dolphin (*Lagenorhynchus hosei*), rough-tooth dolphin (*Steno bredanensis*), Gervais's beaked whale (*Mesoplodon europaeus*) and infant sperm whale (*Physeter catodon*).²¹ Conversely, it has been demonstrated that teleosts adenohypophysis is divided into pars distalis and pars intermedia regions.²² Additionally, histological analysis in this study indicated that no follicle was found in the pars distalis of turkey adenohypophysis, which stands in contrast to previous findings.^{19,21}

Stereological evidence in current study exhibited that distribution of BPCs in pars distalis of turkey adenohypophysis is noticeably higher than that of other endocrine cells, while APCs have the lowest distribution. Contrarily, it has been reported that APCs are the most predominant cell type within the rat²³ and Egyptian insectivorous bat (*Rhinopomahardwickei*) adenohypophysis.²⁴

On the whole, anatomical and cytohistological characteristics of turkey pituitary gland were mostly similar to those of other birds, but there were also differences in cellular components distribution in adenohypophysis providing novel cytological insights into the avian endocrinology.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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