Morphological and Histochemical Study of Parathyroid Gland in Squirrel Caucasian (*Sciurus Anomalus*)

Original Article

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ABSTRACT

Introduction: The parathyroid glands have great importance in the human physiology and anatomy due to that produce hormones necessary for growth and body functions.

Materials and Methods: the parathyroid gland samples were collected from S. anomalus from 5 adult animals (males) from Baghdad Governorate's local markets, The specimens were fixed using formalin (10%), and the samples were washed well using ethyl alcohol (70%) for the removal of the fixative solution, and then specimens were dehydrated in ascending grades of ethyl alcohol (70%, 80%, 90%, 100%). Xylene was used to clear the samples which were placed in paraffin wax in an oven at 58-60° C . The prepared sections were stained using Haris Haematoxlin and Eosin (H&E) stains & Masson trichrome (MTC).

Results: This study has proven the presence of two pairs of parathyroid glands in S. anomalus, which is located in contact with the thyroid gland and occupies two sites within its tissue, an apical site as well as embedded within the thyroid tissue. The gland appears as an oval or irregularly shaped lobe which thin connective tissue capsule surrounds and is an extension of the thyroid capsule, and septa extend from it to the internal tissue, dividing it into incomplete lobules. In addition, the capsule consists of collagen fibers, elastic fibers, a few reticular fibers, and nuclei of smooth muscle fibers. Histologically, the parathyroid gland consists of three types of cells: chief cells, which are the most common, oxphill cells, and water clear cells. These two types of cells are arranged in the form of columns or cell cords In this study, While the third type of cells are water clear cells, which is the few cell in comparison to the other types.

Conclusion: The parathyroid glands are located on both sides of the thyroid glands in adult males of the S. anomalus. A connective tissue capsule surrounds parathyroid glands, and their internal histological structure consists of three cell kinds: chief, Oxphill, and water clear cells.

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Key Words: Histochemical study, morphological study, *sciurus anomalus*.

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INTRODUCTION

The parathyroid glands have great importance in the human physiology and anatomy due to that are the last organ discovered in humans in 1880[1,2]. They are endocrine glands that produce hormones necessary for growth and body functions. Furthermore, they have small, round bodies found within the connective tissue that consist up the thyroid capsule, and sometimes it is embedded in the tissue of the thyroid gland itself[3,4,5]. These glands are called parathyroid or parathyroid due to their close proximity to the thyroid gland, on both trachea sides of the below the larynx[6,7,8,9,10,11]. The parathyroid glands appear as two pairs of glands in humans, but their number and location change in other vertebrates[12].

A thin capsule surrounds each parathyroid separating it from the thyroid gland, and a thin septa extend from the capsule that penetrate the gland carrying with them blood vessels and nerves. and vessels[6]. Histologically, the gland is composed of tissue arranged in the form of thick and branching columns containing large cells called Eosinophils (oxyphil cells) and smaller cells that are more widespread cells called chief cells. These cells secrete parathyroid hormone (PTH), consisting of 84 amino acids, which has an important role in controlling calcium and phosphate ions in the blood and has 84 amino acids[2]. Previous studies have shown that there is insufficient researches related to the histological structure of the parathyroid glands in S. anomalus, and this pay the attention to detect the parathyroid glands histologically.

MATERIAL AND METHODS

Samples collections

In this study, the parathyroid gland samples were collected from S. anomalus from 5 adult animals (males)

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from Baghdad Governorate's local markets. The animals were divided on the basis of the taxonomy of the Natural History Museum.

The Histological preparations

The histological sections were prepared according to the method of Bancroft and Stephen[13]. The specimens were fixed using formalin (10%), and after the fixation, the samples were washed well using ethyl alcohol (70%) for the removal of the fixative solution, and then specimens were dehydrated in ascending grades of ethyl alcohol (70%, 80%, 90%, 100%). Xylene was used to clear the samples which were placed in paraffin wax in an oven at 58-60° C, and then embedded with paraffin wax in plastic cubes. Paraffin-embedded blocks were cut into thin section as a ribbon using a rotary microtome at a thickness of 5 um. The prepared sections were stained using Haris Haematoxlin and Eosin (H&E) stains & Masson trichrome (MTC).

RESULTS

Anatomical Description of Parathyroid Gland

This work has proven the presence of two pairs of parathyroid glands in S. anomalus. The detected glands are located in contact with the thyroid gland and occupies two locations within its tissue, an apical location (Figure 1), in addition to another location embedded within the thyroid tissue (Figure 2). The gland appears in the form of an oval or irregularly shaped lobe which a thin connective tissue capsule surrounds and the septa are extended from it into the internal tissue of the gland which divides it into incomplete lobules (Figure 3).

The location of the parathyroid glands was determined through histological study due to the difficulty of distinguishing and separating them, and their small size, as well as the small size of the thyroid gland in the animal subject under consideration.

The Histological features of Parathyroid Gland

The microscopic investigation of the parathyroid gland in S. anomalus revealed that a thin connective tissue capsule surrounds the gland, whith septa are extended from it. The capsule has elastic fibers, smooth muscle fiber nuclei, collagen fibers, a few reticular fibers, nerves and vessels blood (Figure 4). The septa extend from the capsule into the gland tissues, forming incomplete lobules. In addition, the colloidal fibers in the capsule and the septa extending from it are colored blue using MTC (Figure 5).

The tissue of the parathyroid gland has three cell types. The first type is chief cells, which are more widespread than other cells and appear oval to polygonal in shape, small in size, nuclei are oval to circular in shape, and the cytoplasm is light in color and stain with the dyes that used in this study. The second type of cells are called Oxphill cells, which are polygonal cells that are larger in size than the main cells. The nuclei are vesicular in shape and their cytoplasm is granular. These two types of cells are arranged in the form of columns or cell cords (Figure 6). While the third type of cells are water clear cells, which is the few cell in comparison to the other types. They appear polygonal in shape and are larger in size than the previous two cells. Their nuclei are oval in shape and the cytoplasm is transparent and does not contain granules and that appear scattered in the tissue of the gland (Figure 7).

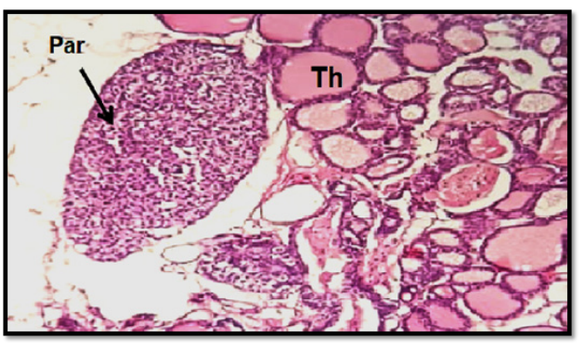

Fig. 1: Thyroid gland cross-sectional image, (Par) parathyroid gland , (Th) thyroid gland , (H&E stain, 100X).

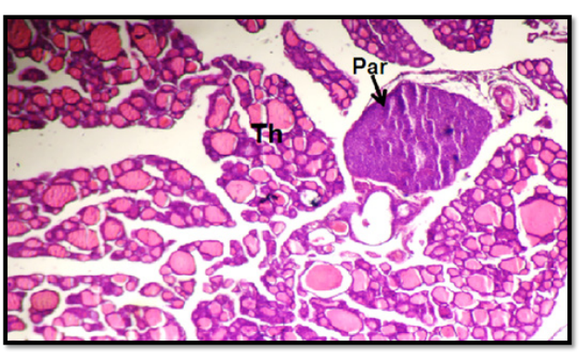

Fig. 2: Thyroid gland cross-sectional image (Par) parathyroid gland, (Th) thyroid gland, (H&E stain, 100X).

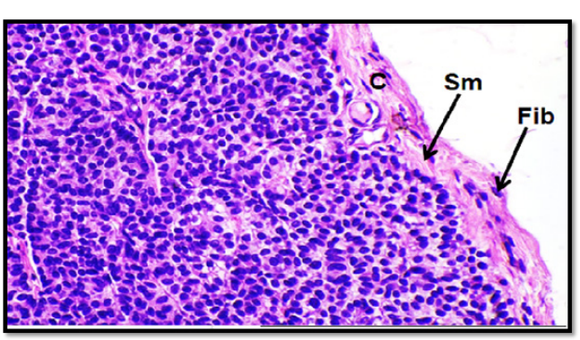

Fig. 3: Parathyroid gland cross-sectional image (C) Capsule, (Sm) smooth muscale fibers, (Fib) fibroblast (H&E stain, 400X).

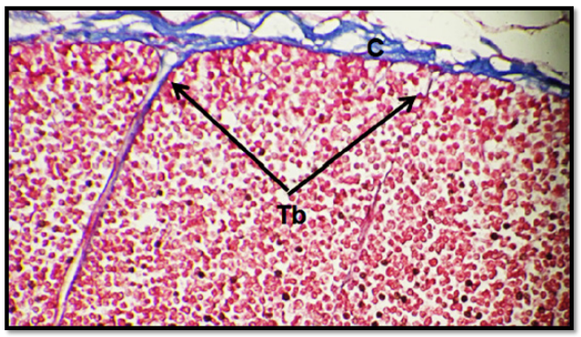

Fig. 4: Parathyroid gland cross-sectional image (c) Capsule, (Tb) Trabeculae extending from the capsule, (MTC stain, 400X).

Fig. 5: Parathyroid gland cross-sectional image (Ch-c) Chief cells, (Bv) Blood vessel, (MTC stain, 400X)

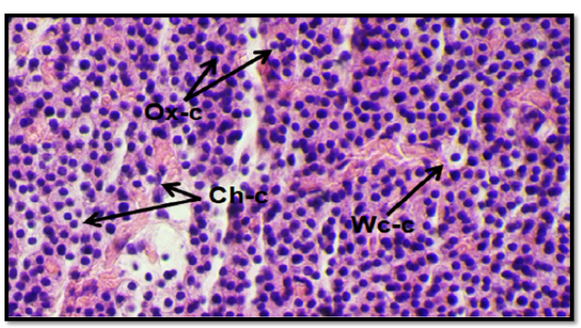

Fig. 6: Cross-sectional image of Parathyroid gland, (Ch-c) Chief cells, (Ox-c) oxphill cells, (Wc-c) clear water cells, (H&E stain, 400X).

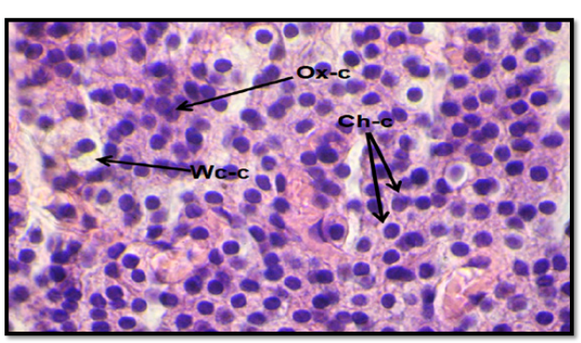

Fig. 7: Parathyroid gland cross-sectional image (Ch-c) Chief cells, (Ox-c) oxphill cells, (Wc-c) clear water cells, (H&E stain, 1000X).

DISCUSSION

The work has indicated two pairs of parathyroid glands in S. anomalus, and it is located in contact with the thyroid gland and occupies two sites within its tissue, an apical site and another site embedded within the thyroid tissue. This result contradicts the study of the parathyroid glands in mice[2] and female gray ferrets[14], where the gland exists in the form of one pair of the parathyroid gland and its shape is oval to circular, while the result is in agreement with the studies in weasel and long-eared hedgehog, in which the glands are located within the internal tissue of the parathyroid gland[15]. It appears in the long-eared hedgehog in the form of lobes of[2-4] oval in shape surrounded by a thin capsule of connective tissue extending from the capsule of the thyroid gland. This variation may be due to the activity of the animal and the nature of the function.

Histologically, the findings of this study in male Caucasian squirrels revealed that a connective tissue capsule surrounds the parathyroid glands. The tissue is considered an extension of the thyroid capsule is made of collagen fibers, smooth muscle fiber nuclei, elastic fibers, few reticular fibers, nerves and vessels of blood. Furthermore, septa are extended from the gland capsules into the glands, which are divided it into incomplete lobules. These confirm the findings of previous studies of the parathyroid glands in Iraqi buffaloes[16] and golden hamsters[17]. The current study found that the tissue of the parathyroid glands consists of three cell kinds, represented by chief cells, which are the most common cells, oxphill cells, and water clear cells. This is in agreement with the observations of the parathyroid glands in the weasel and the long-eared hedgehog[15] Iraqi buffalo[16]. On the hand, the results are different with the findings in the golden hamster, which contains one type of cells represented by the chief cells[17], and the moorhen, which also contains one type of cells[18], as well as with the brown bat, in which the gland contains two cell kinds, chief and water clear[19], and also in the one-humped camel in which the tissue of the parathyroid glands contains two types of cells[20]. The agreement may be due to the fact that parathyroid glands of mammals are analogous structure, while the differences in the names of cells perhaps related with the concentration of the secretion.

CONCLUSIONS

This study concluded that the parathyroid glands are located on both sides of the thyroid glands in adult males of the Caucasian squirrel (*Sciurus anomalus*), within the connective tissue of the thyroid capsule. A connective tissue capsule surrounds parathyroid glands, and their internal histological structure consists of three cell kinds: chief, Oxphill, and water clear cells.

CONFLICT OF INTERESTS

There are no conflicts of interest.

REFERENCES

1. Al- Mahdawi FKI, Hassan AS and Alsiadi WAW: Parathyroid gland, anatomy, histology, and physiology (a short review). Bas. J. Vet. Res. (2020) 19(1): 81-87.
2. Chen H, Senda T, Emura S and Kubo K: An Update on the Structure of the Parathyroid Gland. Open Anat. J. (2013) 5: 1-9.
3. Ali KH and Mirhish SM: Anatomical and Histological Study of Thyroid, Parathyroid and Ultimobranchial Glands in Iraqi Local Breed Turkey (Meleagris gallopavo). The Iraqi J. Vet. Med. (2015) 39(1): 40-48. DOI: 10.30539/ijvm
4. Lkalawy S A M, Abo-Elnour R K, El Deeb DF and Yousry M M : Histological and immunohistochemical study of the effect of experimentally induced hypothyroidism on the thyroid gland and bone of male albino rats.The Egyptian Journal of Histology.(2013) 36(1) :92-102. DOI: 10.1097/01.EHX.0000424169.63765.ac
5. Selim A OA, Abd El-Haleem MRA, Ibrahim and Iman H B : Effect of sodium fluoride on the thyroid gland of growing male albino rats histological and biochemical study.The Egyptian Journal of Histology.(2012) 35(3): 470-482. DOI: 10.1097/01.EHX.0000418503.12452.9a
6. AI-Mukhtar K and AL-Rawi AA: Histology, 2nd ed. Dar Al-Kutub for printing and publishing, Baghdad, (2000): 419.
7. Al-Aamery RA and Dauod HAM: Anatomical and Histological Study of Thyroid Gland in Weasel (Herpestes javanicus) (E.Geoffroy saint. Hilaire. 1818). IH.J.P.A.S. (2016) 29(1):13.
8. Batah AL, Mirhish SM: Comparative Histomorphlogical Study of Thyroid Gland in Adult Males of Guinea Pigs (Cavia porcellus) and Albino Rats (Rattus norvegicus). Indian J. O. Sci. (2019) 9(52): 16560-16569.
9. Hammodi NMJ and Al Aamery RA: Histological and immunohistochemical study of thyroid gland in Caucasian squirrel (Sciurus anamalus) (Gmelin, 1778) by using marker (Anti-Thyroglobulin, Code IR5090). Periodicals Eng. Nat. Sci. (2022) 10(6) PP104-112.
10. Hussin AM and Khudhayer YYA: Comparative histological study of Thyroid tissue in Carp fish Cyprinus carpsio and Mice Swiss albicans. Bull. Iraq nat. Hist. Mus. (2016) 14(2): 109-116.
11. Hammodi, NMJ and Al Aamery RA: Morphological and Histological Study of Thyroid Gland in Felis Catus (Linnaeus, 1758). IH.J.P.A.S. (2023) 36 (3): 51-59 . Doi.org/10.30526/36.3.3114
12. Kardong KV: Vertebrates comparative anatomy, function, evolution. (4th Ed.). Washington state University (2006): 817.
13. Bancroft JD and Stevens A: Theory and practice of histological techniques, 2nd ed. Churchill Livingstone, London, (1986) :XIV+662.
14. Tadjalli MM and Faramarzi, A: Gross Anatomy of The Thyroid and Parathyroid Glands in Indian Gray Mongoose (Herpestes edwardsii). Cibtech J. Zoo. (2016) 5(1): 1-5.
15. Dauod HAM. and Al-Aamery, RA: Comparative histomorphological and immunohistochemical study of parathyroid gland in two Iraqi mammals (Weasel, Herpestes javanicus and long-ear hedgehog, Hemiechinus auritus). Journal of Genetic and Environmental Resources Conservation, (2023) 11(1): 53-59.
16. Hussin AM, Al-Taay MM: Histological study of the thyroid and parathyroid glands in Iraqi Buffalo (Bubalus bubalus) with referring to the seasonal changes. Bas. J. Vet. Res. (2009) 8(1): 26-38. DOI: 10.33762/BVETR.2009.55206
17. Shoumura S, Emura S, Ishizaki N, Yamahira T, Chen H, Ito M. and Isono H: Effects of hyperrgravity environment on the parathyroid gland of the propranol-treated golden hamster. Acta. Anat. (1990) 3: 93-95. DOI: 10.1159/000146780
18. Kadhim KK, Al-Samarrae NS and Al-Fayas JY: Some topographical and histological studies of thyroid and parathyroid glands of moorhen (Gallinula c. chliropus). The Iraqi J. Vet. Med. (1998) 22(1&2): 85-96.
19. Kwiecinski GG, Wimsatt WA and Krook L: Morphology of thyroid C-cells and parathyroid glands in summer - active little brown bats Myotis lucifugus lusifugus , with particular reference to pregnancy and lactation. Am. J. Anat. (1987) 178(4): 421-7. DOI: 10.1002/aja.1001780411
20. Metwally MAM. and Attia HFA: Anatomical and Histological Studies on the Parathyroid gland of the camel (Camelus dromadrius). The International Scientific Conference on Camels, Saudia Arabia, (2006): 1484- 1494.

الملخص العربى

دراسة مظهرية وكيمونسجية للغدة جار الدرقية في السنجاب القوقازي Sciurus Anomalus

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المقدمة: تحتل الغدد الجار الدرقية اهمية كبيرة في علم وظائف الاعضاء والتشريح البشري وذلك لانتاجها هرمونات ضرورية للنمو ووظائف الجسم

مواد وطرائق العمل: تم جمع عينات الغدة جار الدرقية لحيوان S. anomalus وبواقع ٥ حيوانات بالغة (ذكور) والتي تم الحصول عليها من الاسواق المحلية في محافظة بغداد , تم تثبيت العينات باستعمال فورمالين (١٠٪) , تم غسل العينات جيدا بالكحول الاثيلي بتركيز ٧٠٪ ليتم التخلص من المادة المثبتة ، ومن ثم تمرر بسلسلة من الكحول الاثيلي ابتداءا من (٧٠٪-٨٠٪-٩٠٪-١٠٠٪) ، تروق العينات بأستعمال الزايلين ومن ثم توضع بشمع البرافين داخل فرن درجة حرارته (٥٨٪-٦٠٪). تلون العينات بأستعمال الملونات الروتينية الهيماتوكسلين والايوسين (H&E) وملون والماسون ثلاثي الكروم (MTC) .

النتائج : اثبتت الدراسة الحالية الى وجود زوجين من الغدد الجار الدرقية في حيوان S. anomalus تقع بتماس مع الغدة الدرقية وتحتل موقعين ضمن نسيجها , موقع طرفي قمي وموقع اخر منغرس ضمن نسيج الغدة الدرقية تظهر الغدة بشكل فص بيضوي او غير منتظم الشكل محاط بمحفظة رقيقية من نسيج ضام تعتبر امتداد لمحفظة الغدة الدرقية وتمتد منها حويجزات الى النسيج الداخلي تقسمها الى فصيصات غير كاملة , فضلا عن ان المحفظة تتالف من اليافة كولاجينية واليافة مرنة والقليل من اليافة شبكية وانوية لالياف عضلية ملساء ، نسجيا تتالف الغدة جار الدرقية من ثلاث انواع من الخلايا وهي الخلايا الرئيسية chief cells وهي الاكثر انتشارا والخلايا الحمضة Oxphill cells وخلايا الماء الشفافة Water clear cells, يترتب النوعين من الخلايا بشكل اعمدة او حبال ضمن نسيج الغدة , بينما النوع الثالث من الخلايا هي خلايا الماء الشفافة وهي الاقل مقارنة بالأنواع الأخرى.

الاستنتاج: الغدد جار الدرقية تقع على جانبي الغدة الدرقية في الذكور البالغة للسنجاب القوقازي S. anomalus ضمن النسيج الضام لمحفظة الغدة الدرقية ، تحاط الغدد الجار الدرقية بمحفظة من نسيج ضام ، والتركيب النسجي الداخلي لها مكون من ثلاث انواع من الخلايا وهي الخلايا الرئيسية والخلايا الحمضة وخلايا الماء الشفافة