Histological study of the thyroid tissue in carp fish (*Cyprinus Carpio)* in Summer and Winter

Amer M Hussin and Yahia Yass Khudher
Department of Anatomy, Embryology and Histology, College of Veterinary Medicine, Baghdad University, Iraq.
E-mail: yah_vet_85@yahoo.com
Accepted: 22/7/2015

Summary

This study is designed to investigate the effect of temperature on thyroid gland of 24 adult healthy female carp fish (12/ season). Neutral buffered formalin solution10% was used for fixation and routine histological techniques. Hemotoxline and Eosine and PAS stains were, also used. The results revealed that the thyroid tissue in carp fish was closely associated with the renal and sub pharyngeal tissue. Spleen and liver did not show any thyroid follicles. The thyroid tissue of carp fish consisted of disseminate thyroid follicles not surrounded by apparent capsule. Different sizes and shapes of thyroid follicles were observed. The follicular cells form tight epithelium. Para follicular cells were distributed among the follicles. The seasonal thyroid follicles were often filled with colloid summer and winter. In conclusion the study was classified glands units of the thyroid tissue into two states: The first stat of the low activity in winter its cells were epithelial flat to squamous and follicles almost filled with homogeneous, while the state of activity in the Summer, follicular homogenous colloid cells were cuboidal follicular and sessile to high contain homogeneous diluted colloid.

Keywords: Thyroid follicles, Carp fish, Summer, Winter.

Introduction

The thyroid tissue in the fishes is organized as diffuse follicles with a few exceptions rather than as an encapsulated gland as found in most other vertebrate species (1). Geven (2) Reported that the thyroid gland in teleost mostly found in subpharyngeal region. However, in some species it meight be found in heart, head of kidney and kidney (trunk). The follicles of thyroid gland migrate to distant unusual locations such as liver, kidney, eye, gut, spleen and gonad. The shape of thyroid was variable depending on various fish group; in cyclostomes it takes the form of follicles; in many teleost, it becomes like diffused structure as small masses of follicles; in elasmobranches and bony fishes, thyroid is a compact structure (3). The molecules components of the hypothalamic-pituitary-thyroid (HPT) axis in fish correspond closely to those of mammals (4). Power (5) Revealed that thyroid hormones are present in high quantities in fish eggs and presumably of maternal origin. The diverse actions of thyroid hormones in fishes are primarily due to the sensitivity of thyroid axis to many physical, chemical, and biological factors of both intrinsic and extrinsic origins despite possessing specific osmoregulatory and metabolic actions at cellular and whole-body levels (6). Evidences are presented that thyroid hormones could modify the pattern and magnitude of stress response in fishes as it modifies either its own actions or the action of stress hormones (7).

Materials and Methods

Twenty four (12 winter and 12 summer) adult females apparently healthy Carp fish were collected from Dijla river in Baghdad during 2014. Samples from sub-pharyngeal region, head of kidney, kidney, heart, liver, spleen, skeletal muscle, Gills and mesentery were prepared. All samples were fixed in 10% neutral buffered formalin fixatives for two days. Tissue samples were dehydrated in a graded series of ethanol, embedded in paraffin, sectioned at 7 µm thick and stained with H&E and PAS stains (8). Light microscope was used in inspection. All the Images were uploaded into a computer by means of a digital camera (MEM 1300) through the microscope. The measurements have been carried out with image J(Java-based image processing program developed at the National Institutes of Health) (9).

Results and Discussion

The present work revealed that the thyroid follicles were present only in the tissues of renal and sub pharyngeal region. In carp fish, the thyroid was not a localized compact structure. Thyroid follicles were scattered across the renal tissue and at the ventral aorta. They appeared as diffuse small masses rather than encapsulated localized gland (Fig. 1). The thyroid follicles are variable in size and shape and separate by a fine fibrovascular connective tissue. The shapes and sizes of thyroid follicles are spherical, ovoid and irregular in shapes; small and large sizes (Table, 1 and Fig. 2). The colloid was homogenous, amorphous in summer and granular thick in winter, (Fig. 3). The follicular cells form tight epithelium whose cells were either squamous in winter or cuboidal in summer. Para follicular cells were distributed among the thyroid follicles, they had clear wide cytoplasm and spherical dark nuclei (Fig. 4). In summer time, the height of the epithelium was more than that of winter (Table, 2). In winter time, the thyroid follicles were aggregated at the periphery of thyroid tissue., The study classifies the functional unit of thyroid gland to has only two hypoactive and active forms; the first form had flattened to squamous epithelial follicular cells whose follicles were nearly filled with colloid; the second form had low to high cuboidal epithelial follicular cells whose follicles were partly filled with colloid. Reabsorption vacuoles were seen on the luminal surfaces of follicular cells in summer time.

Table, 1: The diameter of thyroid follicles (µm) carp fish in the two seasons.

Diameter of follicle /µm	Head of kidney		kidney		Sub pharyngeal region	
Season	S	*L*	S	L	S	L
Summer	26.9±2.18*	69.7±8.7*	40.3±3.4*	86±6.1*	47.2±3.8*	98.7±11.8*
Winter	42.9±3.6	84.7±4.6	49±1.5	98.4±4.1	63.5±7.1	104.8±9.5

(*): there was a significant difference (P<0.05) of thyroid follicles between summer and winter. Values =mean± SE, S= small, L= large.

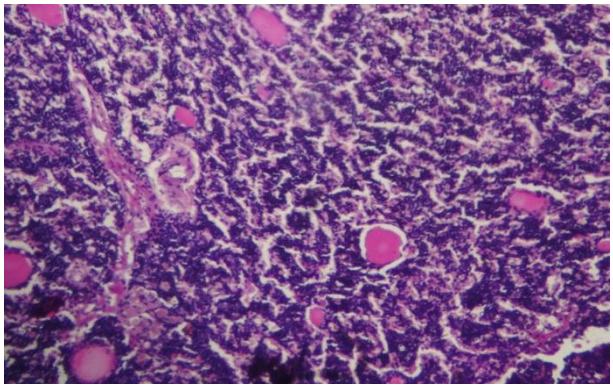
Table, 2: The height of follicular (µm) carp fish cells in both seasons.

Height of follicular cells/µm	Head of kidney	Tail of kidney	Sub pharyngeal region
Season			
Summer	5±0.14*	4.9±0.16*	3.5±0.12*
Winter	2.4±0.1	2.5±0.14	2.2±0.24

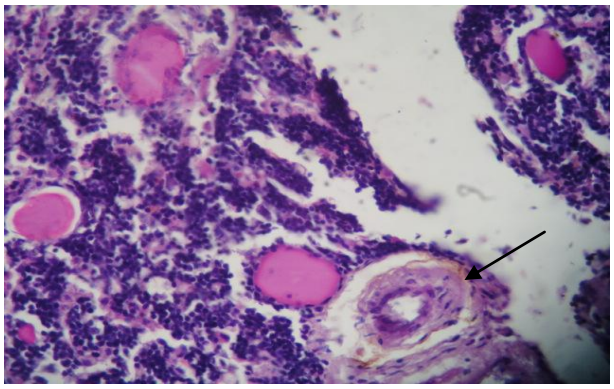
*** A significant difference (P<0.05) in the height of follicular cells between summer and winter. Values =mean± SE, S= small, L= large.**

The thyroid tissues in fish generally were more associated with the renal tissue as they mostly lay in the head of the kidney and kidney. Genten (1) stated that in elasmobranchs and a few species of bony fishes. The follicular structure of carp fish was remarkably similar to that found in mammals. These results were almost similar to the findings of (1 and 10) who reported that cells are active in colloid production and have greater height than those that remains metabolically inactive, but the results did not agree with these of (11) who regarded the increase in the size of thyroid gland as environmental adaptation to the cold in winter as when the size of thyroid increases, the basal metabolic rate will correspondingly increase and the body temperature will also elevated. The study gave that the simplicity of the circulatory system in carp fish might explain the unique distribution of the thyroid tissue in this way. This could be attributed to the fact that any ductless endocrine glands need abundant blood supply to transport their secretion far away from the site of release from the thyroid tissue to the different organs of the body. The heart of the fish is composed only of two chambers and the circulatory system includes only one circulation and the blood passes through the blood capillaries to the Gills and then to the tissues of the body, this is called the single circulation. The thyroid tissue possibly was scattered into different thyroid structures as an ecological adaptation to supply the hormone into different regions of the body. The result of the study explains the different sizes of thyroid follicles are depend on both the functional status and the section angle. This is in agreement with (1) who reported that the sizes of follicles appeared in

the section were largely depended on the section angle. The present study indicate that the activity of thyroid gland was divided into two forms; the first form was "the hypoactive form". This is the state when the thyroid gland starts to collect the thyroglobulin from the blood circulation in their follicles. The thyroid secreting activity in this state is expected to be limited. The type of follicular cells was mostly flattened to squamous due to the pressure of the large amount of colloid on the luminal surface of these cells. The colloid filled the follicles during this state appeared to be very dense. This type of activity was occur when the thyroid secreting activity was at its minimal state (during winter time).

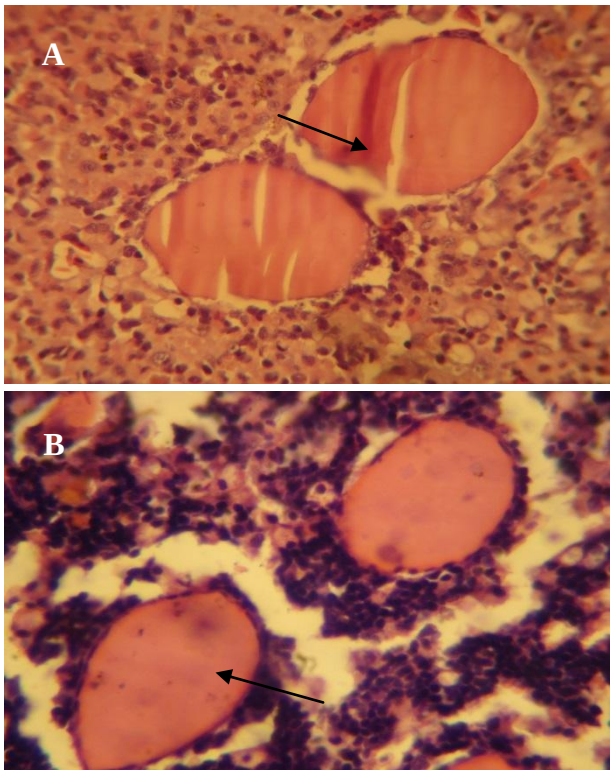


Figure, 1: Head of kidney in fish scattered follicles of thyroid gland filled with homogenous colloid. Notice the absence of connective tissue capsule (10X PAS).

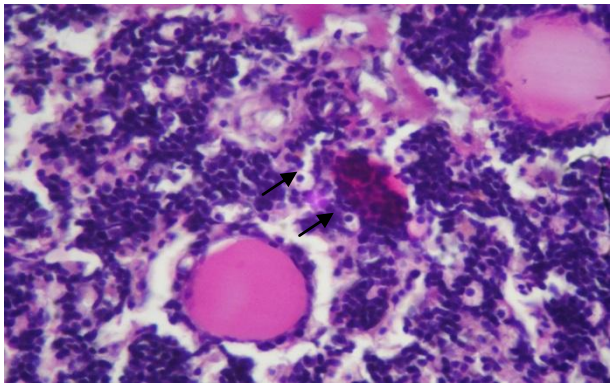


Figure, 2: Kidney in fish small and large thyroid follicles filled with homogenous colloid. Notice the large arteriole near one follicle (arrow) (40X. PAS stain)

The second state was "the active state", when the thyroid secreting activity was started and the follicular cells were started to absorb the thyroglobulin present in the follicle and transported mostly as required from squamous to cuboidal. The reabsorption vacuoles were formed due to cellular absorption of the colloid. On the other hand, (1 and 12) classified thyroid activity into two states, i.e., low-active state (resting) and active state, and reported that the epithelial cell height of the follicular cells were do not differ, and suggested that the activity of fish thyroid follicles was quiescent. This is in accordance with the finding of the present result.



Figure, 3: Kidney in fish thyroid follicles in Carp fish showing non- homogenous coagulated colloid in winter time (A), and diluted homogenous colloid in summer time (B) (arrows). 40X. H and E stain.



Figure, 4: Head of kidney in fish two large thyroid follicles of fish. Notice many clear cells lie near the follicles (arrows) (40X. PAS. Stain).

References

1. Genten, F.; Terwinghe, E. and Danguy, A. (2009). Atlas of fish histology. Science publishers. Jersy. Pp: 151-153.
2. Geven, E. J.; Nguyen, N.; Boogaart, M. U. D.; Tom –Spaning, F. A.; Flik, G. and

Klaren, P. H. M. (2007). Comparative thyroidology: Thyroid gland location and iodothyronine dynamics in mozambique tilapia (Oreochromicmozambicuc peters) and Common Carp (cyprinus Carpio). J. Experi. Biol. 210: 4005-4015.

3. Pandey, A. K. and Shukla, L. (1986). Impairment of thyroid activity inSarotherodon mossambicus due to DDT treatment. Bulletin of environmental contamination and toxicology, 36(1): 132-139.
4. Blanton, M. L. and Specker, J. L. (2007).The hypothalamic-pituitary- thyroid (HPT) axis in fish and its role in fish development and reproduction. Crit. Rev. Toxicol., 37(1-2): 97-115.
5. Power, D. M.; Liwellyn, L.; Faustino, M.; Nowell, M. A.; Bjonnsson, B. T.; Einarsdottir, I. E.; Canario, A. V. and Sweeney, G. E. (2001). Thyroid hormones in growth and development of fish. Comp Biochem. Physiol. Toxicol. Pharmacol., 130(4): 447-59.
6. Mesher, A. L. (2010). Junqueira's Basic Histology. McGraw Hill Medical. Toronto. Pp: 360-365.
7. Peter, M. C. (2011). The role of thyroid hormones in stress response of fish. Gen. Comp. Endoc., 172(2):198-210.
8. Suvarna, S. K.; Layton, C. and Banchroft, J. D. (2013). Banchroft's theory and practice of histological techniques. 7th ed. Churchill livingstone, Elsevier limited.
9. Ballesteros, R.; Bonsfills, N.; Chacón, N. García, J, and Gómez, E. (2012). Histo-morphometry of the Ligaments Using a Generic-Purpose Image Processing Software, a New Strategy for Semi-Automatized Measurements. J. Digit Imag., 25: 527–536.
10. Samuelson, D. A. (2007). Veterinary histology.Saunders an imprint 0f Elsevier Inc. China. Pp: 407-409.
11. Ganong, W. F. (2005). Medical physiology. 22th ed. McGraw Hill a Lange medical book. Toronto. Pp: 317-332.
12. Dellmann, H. D. and Brown, E. M. (1987).Text book of veterinary histology. Lea and Febiger. Philadelphia.

دراسة نسجية للنسيج الدرقي في أسماك الكارب (*Cyprinus carpio*) صيفا وشتاءً

عامر متعب حسين و يحيى ياس خضير

فرع التشريح والأنسجة والأجنة، كلية الطب البيطري، جامعة بغداد، العراق.

E-mail: yah_vet_85@yahoo.com

الخلاصة

أجريت الدراسة النسجية لتسليط الضوء على تأثيرتغير درجة حرارة الجو على نسيج الدرقية في أسماك الكارب. استعمل 24 من أناث أسماك الكارب البالغة الخالية من الأمراض. (12سمكة في كل من الصيف والشتاء). بعد التضحية بالحيوانات ثبتت في محلول الفورمالين المتعادل الدارئ 10%. أجريت التقنيات النسجية الروتينية المعتادة ثم صبغت العينات بصبغتي الهيماتوكسلين والآيوزين وصبغة كاشف شف الدوري. أظهرت النتائج النسجية أن وجود نسيج الدرقية في أسماك الكارب يرتبط بالنسيج الكلوي والنسيج تحت البلعومي (حول الابهر البطني) فقط، لم تسجل الدراسة وجود النسيج الدرقي في مناطق الجسم الأخرى. يكون النسيج الدرقي في أسماك الكارب غير مصمت وينتشر كجريبات متفرقة غير محاطة بمحفظة واضحة وبدلا منه تكون الجريبات محاطة بنسيج ضام رخو. تمتلك الجريبات أشكال وأحجام مختلفة. يتكون متن النسيج الدرقي من طبقة مفردة من الخلايا الجريبية المتراصة التي تبطن كل جريبة وتوجد بين الجريبيات الخلايا حول الجريبية (الخلايا الصافية). أظهرت النتائج الموسمية أن جريبات الدرقية تكون في الغالب مملوءة بالغروان صيفا وشتاءً. تستنتج الدراسة الحالية تصنيف الوحدات الافرازية للنسيج الدرقي الى حالتين: حالة النشاط الواطئ في الحالة الاولى (الشتاء) والذي تكون خلاياه الجريبية الظهارية مسطحة الى حرشفية والجريبيات تقريبا مملوءة بغروان متجلط غير متجانس، وحالة النشاط في الحالة الثانية (الصيف) والذي تكون خلاياه الجريبية مكعبة واطئة الى مرتفعة والغروان مخفف متجانس.

الكلمات المفتاحية : جريبات الدرقية، أسماك الكارب، صيف، شتاء.