

VARIATIONS IN THE HISTOMORPHOMETRY OF ADULT THYROID GLAND CADAVERS IN KOSI REGION OF BIHAR

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Abstract

Background: The thyroid gland occupies the inferior region of neck. It is described as a reddish-brown endocrine gland with rich blood supply. Sub Himalayan plains are said to be world's biggest goitre region. But no state to be entirely free from goitre. Goitre is characterised as compensatory hypertrophy of thyroid gland. **Materials and Methods:** King (1836) termed the thyroid follicles cells in 1909. Antonelli A, Fallahi P, Ferrari SM et al (2012 Jul.) reported high incidence ($P < .05$) of new cases of hypothyroidism, thyroid dysfunction, anti - thyroperoxidase and a hypoechoic pattern in control. Tan YH, Du GN, Xiao YG, Guo SQ, (2013) done a prospective study involving 151 and reported that thyroid mesentery is a distinctive structure for guiding surgical dissection. Cibas ES, Baloch ZW, Fellegara G et al (2013.) reported accuracy and precision of light microscopic diagnosis is very poor. **Result:** The follicular cells in humans in the present study ranged from simple squamous to simple columnar. In human the follicular cells were mainly low cuboidal (Ham, 1979), but squamous, cuboidal and columnar according to (Bloom and Fawcett 1975). In the present work undertaken the parafollicular cells (C-cells) were found widely dispersed throughout thyroid gland of all mammals. These cells were slightly larger than the follicular cells had central spherical nucleus and were lightly stained which was in accordance with David H Cormack (1993). **Conclusion:** In the present study the shape of follicular cells observed normal according to previous references. But size was different with average diameter of 106.84 microns. The 'C' cells were seemed to be larger than follicular cells which are in groups with spherical nucleus.

INTRODUCTION

The thyroid gland occupies the inferior region of neck. It is described as a reddish-brown endocrine gland with rich blood supply. Characteristic of all mammals. Human thyroid shows two lobes connected by isthmus, which differs among animals like dogs and cats with no isthmus. Galen (130-200 AD), first portrayed thyroid in his "De Voice". Detailed precise description was given by Andreas Vesalius in his "De Fabrica Corporis Humani (1543 AD).^[1] Gland was noted as a vascular shunt cushioning the brain against blood flow. Further, advancements of thyroid knowledge took the course of time. Baumann (1895), linked iodine with thyroid. Morphometry of thyroid is 5cm x 2.5 cm x 2.5 cm with isthmus of 1.2 cm x 1.2 cm. weight of thyroid is more in females with 20-25 grams, even more during menstruation and pregnancy. Gland is situated against C5, C6, C7, T1. Trachea's superior

part is embraced by thyroid gland. Thin layer of connective tissue covers the gland. Actual functional units of gland are follicles which are spherical. External carotid artery gives off superior thyroid artery and inferior thyroid artery is given off by thyrocervical trunk, acts as sources of blood supply, while superior, middle and inferior thyroid veins drain the same.

Sub Himalayan plains are said to be world's biggest goitre region. But no state to be entirely free from goitre. Goitre is characterised as compensatory hypertrophy of thyroid gland. Dates back to the time of Ebers Papyrus (1500 BC). Also, goitre references are found in Atharva Veda (2000 BC).^[2,3]

Review of literature

King (1836) termed the thyroid follicles cells in 1909, Major studied the vasculature of thyroid gland.^[4] In 1916 Bensely first observed the colloid globules within the acinar cells. Nadler et al used labelled leucine an amino acid which was

incorporated into glycoprotein and used this to show that thyroglobulin is formed in follicular cells and secreted in the lumina of follicles.^[2] Cramer and Ludford in 1926 first time showed that thyroid cells do not store their products.^[3] Classic description of hyperthyroidism or exophthalmic goitre were presented by Parry (1825), Graves (1835),^[5] Von Basedow (1840) first noted hyperthyroidism in 1800 and the condition was recognized as a disease entity by Parry in 1825. Baumann suggested the association of iodine with the functioning of thyroid gland in 1895. Kendall in 1914 first isolated the thyroid hormone thyroxine (T₄) by crystallization of L-thyroxine from alkaline hydrolysates of thyroid tissues.

Salter (1940) recognized thyroglobulin to be a free biochemical complex activity. Harington and Barger determined the composition of (T₄) and accomplished its synthesis.^[5] In 1951 Gross and Zabland discovered a new iodine containing compound in the plasma with biological properties similar to those of thyroxine but much more potent. Pitt-Rivers and Gross (1952) later identified this substance to be tri-iodothyroxine (T₃). Curling (1850) and Gull (1875) described the condition hypothyroidism or myxoedema.^[6] Murray (1891) claimed first of all to treat myxoedema with thyroid extract. Moorish physician Albacasis conducted first thyroidectomy in Spain's Arab city of Zahra.

Coninx-Girardet (1927) described changes occurring with season in the thyroid gland belonging to European marmot and observed that there was quantity variation of the amount of colloid, height of epithelial cells in different seasons.^[7] Nonidez (1932) observed that in mammalian thyroid that parafollicular cells were smaller in population and situated both in follicular epithelium and in the inter follicular spaces and referred it to as mitochondria rich cells or C-cells. He also found the parafollicular cells were larger than principal cells and less deeply stained in routine histological preparation.^[8] Wollman and Breitman (1970) noted that the involution occurs in hyperplastic thyroid gland. Procedure differs radically from that in prostate and mammary gland. There is modest decrease of thyroid weight and DNA content and some flattening of the columnar epithelium in hyperplastic gland.

Bloom and Fawcett (1975) stated that the thyroid gland is situated in the anterior region of the neck weight 25 – 40 gm. It consists of two lateral lobes connected by an isthmus. McMillan et al (1974) found that C-cells in human thyroid were mostly in follicular epithelium, both singly and in groups. They are confined to central region of lateral lobes. The cell population decreases to zero at the periphery of the gland and in poles of the isthmus. Robert Getty (1975) observed that in bovine the thyroid gland consists of two flattened triangular lobes connected by a distinct glandular isthmus across the ventral surface of trachea. Colour of the

gland is pale and measures about 15 gm in weight, 8 cm in length, 5 cm in height.

Sinna EA, Ezzat N. (2012) done a retrospective study of 296 cases of nodular thyroid. They started that papillary carcinoma was the frequent (72.4%) lesion. They concluded that FNA cytology has to be considered as an initial test for evaluation.

Bergmann P, Cannie M. (2012) determined that TSH can be considered as first line analysis of thyroid dysfunction.

Liu H, Xie YJ, Xu YQ, Li C, Liu XG. (2012) reported that transtracheal assisted sublingual approach to totally endoscopic thyroidectomy is safe and feasible.^[11]

Jomaa B, Aarts JM, de Haan LH et al (2013) conducted a study on in vitro effect of eleven thyroid-active compounds on pituitary and/or thyroid weights in vivo, using the proliferation of GH3 rat pituitary cells in the so-called "T-screen," and of FRTL-5 rat thyroid cells in a newly developed test denoted "TSH-screen" to gain insight into the relative value of these in vitro proliferation tests for an integrated testing strategy (ITS) for thyroid activity. They concluded that T-screen may directly predict this THR-mediated in vivo adverse effect.

Antonelli A, Fallahi P, Ferrari SM et al (2012 Jul.) reported high incidence (P < .05) of new cases of hypothyroidism, thyroid dysfunction, anti - thyroperoxidase and a hypoechoic pattern in control.

Tan YH, Du GN, Xiao YG, Guo SQ, (2013) done a prospective study involving 151 and reported that thyroid mesentery is a distinctive structure for guiding surgical dissection.

Cibas ES, Baloch ZW, Fellegara G et al (2013.) reported accuracy and precision of light microscopic diagnosis is very poor.^[12]

MATERIALS AND METHODS

Study on the thyroid gland was done in the Department of Anatomy, Katihar Medical College, Katihar. Intact thyroid glands were obtained from adult cadavers as early as possible from the dissection hall and this study was done on 40 cadavers. The thyroid glands were obtained from cadavers following all legal formalities and when taken out whole, were immersed in 10% formalin solution. Each was weighed separately using electronic weighing scale. Immediately after dissection of the thyroid gland, following morphometrical parameters were recorded by means of vernier callipers as follows:

1. Length-Cranio-caudal distance of the thyroid gland.
2. Breadth-Anterior-posterior diameter at the middle of the gland.
3. Thickness-Medio-lateral distance at the middle of thyroid gland.
4. Weight of the gland was taken in a precision balance.

Statistical analysis of biometrical values were done as Snedecor and Cochran. Significant difference of parameters was noted if $t > 2.447$.

Histological preparation

Immediately after biometry the thyroid gland was cut by a sharp razor blade into smaller pieces of size 3-4 mm and fixed in 10% formalin and labelled separately. They were left in fixative solution for 24-28 hrs. The fixed tissues were processed for embedding in paraffin and sectioned at 5 micrometre thickness in a Rotary Microtome and sections of the tissues were stained by routine haematoxylin and eosin, according to standard methods laid down by Carleton (1957). The stained section was examined under both low and high-power microscope to see the thyroid follicles, follicular cells, parafollicular cells, colloid and other structures. The location of parafollicular cells was noted in the different mammals. The character of the colloid was noted. The staining character of all the above structure was noted. From each group of cadavers' slides were taken randomly. From each slide about 10 follicles were observed. The diameter of these 10 follicles taken with the help of micrometer slides used with the light microscope.

Histological calculation

1. We placed the stage micrometre on the stage and inserted a micrometre eyepiece into the eyepiece.
2. We focus the objective on the stage micrometre scale (the same objective is used when measuring the object).
3. Now we determine the number of divisions of the scale of the eyepiece micrometre that exactly equals any number of divisions of the stage micrometre.

4. Then we remove the stage micrometre and focus on the object to be measured and determine the number of eyepiece divisions exactly covering the image of the object measured.

1 division of ocular micrometre = $\frac{5}{22}$ divisions of objective micrometre scale as 1 division of objective micrometre measures 0.01 mm.

$$\begin{aligned} \text{So, } \frac{5}{22} \text{ division of objective micrometre measures} &= \frac{5}{22} \times 0.01 \text{ mm} \\ &= 0.00227 \text{ mm} \\ &= 2.27 \times 10^{-3} \\ &= 2.27 \mu\text{m} \end{aligned}$$

1 division of objective micrometre scale = 2.27 μm

RESULTS

The microanatomical features of the thyroid gland were as follows:

The thyroid gland in human consists of closely arranged and are of different size. The follicles of human were found to contain a homogenous colloid which stained pink with Haematoxylin and Eosin stain. In some epithelial lined follicles, there existed some vacuoles within the substance of the colloid. The epithelial cells lining the follicles ranged from simple squamous to simple cuboidal and columnar. Between the follicles scattered throughout the thyroid gland were some lighter staining cells, these were the parafollicular or the C-cells. Cell size was seemed to be larger than the follicular cells. These cells were seen mainly in groups. Mainly grouped appearance of cells and also a scattered appearance between basement membrane and follicular cells was seen.

Table 1: Average diameter of follicles in the thyroid gland

Name of mammal	Diameter of follicles (In micrometres)
Human	106.84

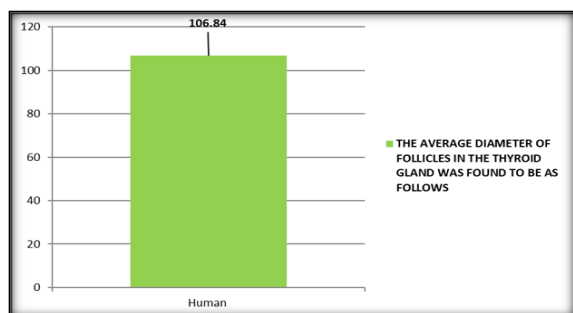


Figure 1: Normal Histology of Thyroid Gland (Courtesy from Wikipedia)



Figure 2: Thyroid gland histology (present study)

DISCUSSION

Histological structure of thyroid gland has been seen under light microscope with due importance on follicles, follicular cells, follicular diameter, para follicular cells.

Follicles

The description on histological characteristic of thyroid gland have been detailed by many authors Bloom and Fawcett (1975),^[13] Ham (1979), Dellman and Brown 1976, Banks (1981), Leeson and Leeson (1981), Turner and Bagnara (1976), David H Cormack (1993), Leslie P.Gartner (2007). The glandular parenchyma possessed numerous follicles of different sizes. In the current study, we observed human thyroid to contain differently sized follicles.

The shape of the follicles was found to be spherical to ovoid (Bloom and Fawcett 1975). Marine (1908) has reported that the thyroid follicles of human are irregularly rounded to tubular in shape.

Das et al (1965) observed thyroid follicles to be oval in shape in general.^[14] Leeson Leeson Paparo (1981) stated the follicles vary greatly in size depending upon the degree of distension of secretion. In our study the shape and size of follicles in humans were variable.^[15] Such a finding was also observed by Victor P. Eroschenko (2005) and Bloom and Fawcett (1968).

The follicles are filled with acidophilic colloid which stained pink with H & E stain according to Di Fiore's (2005), Gartner (2007), Leeson and Leeson (1985) and Inderbir Singh (2007). In the present work undertaken also showed follicles filled with pink coloured colloid. Towards periphery the follicles were small & towards their centre follicles were large. (Das et al 1965, Turner & Bagnara 1976).

Follicular cells

The follicular cells in humans in the present study ranged from simple squamous to simple columnar. In human the follicular cells were mainly low cuboidal (Ham, 1979), but squamous, cuboidal and columnar according to (Bloom and Fawcett 1975).

The findings of present study were similar to that noted by Bloom & Fawcett (1975), Roy et al (1975) and Dellman & Brown (1981). The type of follicular cells depends on the activity of gland being squamous in under active gland and cuboidal to columnar in active gland (Bloom and Fawcett 1975, Dellman and Brown 1981, Inderbir Singh 2007,^[16] Dukes' 1996). The size of follicles also varies with season as observed in Marmotamonax where the summer follicles were found smaller and winter follicles large (P.P. Krup, R.A. Young and R. Frink 1977).^[17] R. Bowen (2008 Mar.) – The follicles were neighboured by a thyroid epithelial cell, single layer of thyroid epithelial cells, which secrete T3 and T4.

Parafollicular Cells

In the present work undertaken the parafollicular cells (C-cells) were found widely dispersed

throughout thyroid gland of all mammals. These cells were slightly larger than the follicular cells had central spherical nucleus and were lightly stained which was in accordance with David H Cormack (1993).^[18]

The population of para follicular cells was smaller than the principal (follicular) cells as stated by Bloom and Fawcett (1975). Similar finding was seen in the present study. According to Tice (1977) para follicular cells may be found single or in group. In the present study cells were found in groups. Wolfe et al (1974) observed that major distribution of C-cells in normal adult human thyroid was in middle of lateral lobe their distribution was intra follicular and in between the follicular cells. Such a finding was also seen in the present study in all mammals.^[19] R. Bowen (2008) reported that parafollicular cells were scattered among follicular cells and in spaces between the spherical follicles, parafollicular cells which secrete calcitonin.

Follicular Diameter

Follicular Diameters were measured from 20 clearly seen sections of thyroid tissue in each species of mammals which were almost round and selected randomly. The average diameter of thyroid follicles in this study was noted as 106.84 microns. According to Garner (2007) the follicular diameter was 0.2 – 0.9 mm. Larsen, Kronenberg et al (1975),^[20] noted them to be 200 mm; Bloom and Fawcett (1975) stated them to be 0.2 – 0.9 mm. Roy et al (1975) observed the diameter to increase in older objects. Edwin L Kaplan (1994) noted them to be 30 mm. The diameter of thyroid follicles increases with age as evidence by Al-Baghadi (1964) in camel. The diameter findings of the present study almost fall in the range of the works of Dellman & Brown (1981), Larsen, Kronenberg et al, Bloom and Fawcett (1975)

CONCLUSION

In the present study the shape of follicular cells observed normal according to previous references. But size was different with average diameter of 106.84 microns. The 'C' cells were seemed to be larger than follicular cells which are in groups with spherical nucleus.

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