



Anatomical, Histological, Hormonal, And Ultrasonography Study Of Neonate Thyroid Gland

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ABSTRACT

Materials And Methods: The neonate thyroid gland collected and inspected grossly and taken all measurements. Then histologically preparation of the slides and stained with routine Haematoxylin and Eosin (H&E) and special stains for descriptive study. Alive healthy neonates was taken for assessment of thyroid stimulation hormone, in addition the volume by ultrasound and using ellipsoid formula 0.479 as correction factor.

Results:- Thyroid gland present in lower part of neck anteriorly. Consist from right and left lobes connected via isthmus from lower medial portion of gland. The gland appeared U shape, red brown in color. The mean $\pm$ SD Weight 1.35 ± 0.34 gram. Dimensions measurement as following, length 12.48 ± 1.76 , 12.21 ± 1.79 for right and left lobes respectively. Width 5.73 ± 0.82 , 5.88 ± 0.73 for right and left lobe. Under light microscope contain large number of follicles larger follicle present on periphery and small in central. The means of TSH in different age groups were had a tendency to decreased as following 10.70 ± 3.09 mU/L, 3.55 ± 1.81 mU/L, 3.30 ± 1.61 mU/L, and 2.85 ± 1.27 mU/L, in male. While in females were 10.90 ± 3.19 mU/L, 3.60 ± 1.98 mU/L, 3.41 ± 1.23 mU/L, and 3.48 ± 1.45 mU/L in groups A, B, C, and D, respectively. The total volume of neonates thyroid gland groups in present study in male that were 412.7 ± 62.2 mm³, 429.5 ± 60.7 mm³, And the total volume in female were 401.2 ± 83.9 mm³, 428.6 ± 57.8 mm³ for first two groups respectively. The present study aimed to describe normal neonate thyroid gland as Anatomical, Histological, Hormonal, and Sonographical study it can throw light to help clinicians deal better with the gland during neonatal period in addition provide local standard data.

Introduction

The thyroid gland is one of the ductless glands, brownish-red and highly vascular gland. It's largest endocrine gland in human body consists of two large lateral lobes right and left lobes connected united by a narrow thin isthmus to form butterfly shape structure.[1] The lobes of the thyroid approximately conical in shape, their ascending apices diverge laterally to the level of oblique lines on the lamina of thyroid cartilage, and their bases leveled with fourth or fifth tracheal rings. The lateral lobes have a broad lower segment and a slightly conical apex. Each lateral lobe has convex surface anteriorly and concave surface posteriorly. Thyroid gland from

posteromedial facet is attached to the side of the cricoid cartilage by a lateral thyroid ligament.[2] Isthmus connects the lobes lower parts, across the midline usually anterior to the second, third and fourth tracheal cartilages though often higher or sometimes lower, its site and size vary considerable it is about 1.25cm in both transversely and vertically.[3] As the pretracheal fascia firmly attaches the isthmus of thyroid gland with thyroid cartilage, its swelling shows a well-known clinical sign that the thyroid travels upwards on swallowing, by which thyroid swelling may be distinguished from any other neck swellings.[4] The weight of the thyroid gland further increases in postnatal life from approximately 2–4

gm. at birth to about 15–20 gm. in adulthood.[5] Tanriover O *et al.*[6] found the mean length, width, and thickness of the left lobe is 5.21, 2.90, and 2.33 cm, respectively, while the mean length, width, and thickness of the right lobe is 5.26, 2.97, and 2.39.

The thyroid gland has an abundant blood supply provided by four major arteries (two pairs). It is profuse blood supply. It receives 5% of the cardiac output, which is high in proportion to its weight and size. Normally it is supplied by two pairs of arteries include superior thyroid artery, inferior thyroid artery, and Occasionally present singular thyroid ima artery. The thyroid gland drainage by superior thyroid vein, middle thyroid vein, inferior thyroid vein on each side. All these vines end to internal jugular vein and the brachiocephalic veins.[7,8] The lymphatics from the thyroid gland mainly drain to deep cervical nodes. A few pass into prelaryngeal, pre and paratracheal nodes, and a few drain directly into the thoracic duct.[9] The thyroid gland receives its innervation from sympathetic and Parasympathetic.[10].

Histological structures of thyroid gland include thyroid follicles, follicular and parafollicular cells. Thyroid follicles are the functional and structural units of the thyroid gland. Thyroid tissue is composed of 20-30 million follicles, and each lobules consists of about 20-40 follicles bound together by a thin sheath of connective tissue and supplied by a lobular artery. When the gland is in a normal physiological status histo-morphologically, it is presented with round or oval follicles.[11] Each follicle is a cystic structure consisting of a single layer of epithelial cells, termed thyrocytes or follicular cells, that make up the wall structure of the follicle. Appear single layer of cells of endodermal origin, the shape of these cells, together with the size and shape of the follicles, vary in shape and size from squamous to low columnar, depends upon the activity of the thyroid gland, the activity that is controlled by a thyroid-stimulating hormone from the anterior pituitary.[12] Thyroid cells take up iodine and make thyroid hormones. The lumen of the follicles is occupied with colloid show as thick, sticky matter mostly consisting of thyroglobulin, which is a large glycoprotein that stores thyroid hormone until they needed by the body.[13] Thyroid gland conceder unique among the endocrine gland in that it stores large amount of hormone in an intact from within extracellular compartments in the center of follicles, in contrast with another endocrine gland store only small quantities of hormones in intracellular site.[14].

The thyroid gland is essential for normal human physiology. Last year's endocrine disorders are more common and considerable contributors to neonatal morbidity and mortality and, of these, congenital hypothyroidism is the most common. Early treatment with thyroxin (T4) with successive supplementation for life produces excellent results for both growth and development.[15] Hypothalamic thyroid releasing hormone stimulates TSH secretion from the anterior

pituitary TSH then initiates thyroid hormones synthesis and release from the thyroid gland The thyroid hormones are essential for adequate growth and development. Throughout fetal and extrauterine life. Thyroid hormones also play a key role in neonatal as well as adult normal physiology, affecting almost all tissues and maintaining healthy status of all human systems including central nervous system maturation, cardiovascular function, skeletal health, somatic growth, and balanced energy and metabolic status.[16].

Sonography The thyroid gland is the most commonly imaged glands using ultrasound due to the limitation of clinical examination. In recent decades, sonography has become the gold standard for assessment of the thyroid gland; thyroid size mainly been assessed by ultrasound. Size of thyroid gland precise determinant of volume.[17] Determining volume is important in evaluating the growth and involution of the thyroid gland. Sonographic evaluation of the thyroid size in neonates promising but remained relatively underused technique in for thyroid imaging neonates. Partly due to lack of normative data for thyroid volume in the neonatal period. The accurate estimation of the thyroid volume is very important for the evaluation and management of thyroid disorders.[18] Yousef M. *et al.*[19] Cited the correction factor of 0.479 resulted in a more precise assessment of thyroid volume compared with the previously accepted correction factor of $\pi/6$ based on these findings. The WHO has used 0.479 as the correction factor in the assessment of thyroid volume.

Materials and methods

Neonatal thyroid gland was collected from autopsied bodies from the mortuary room from institute of forensic medicine in Baghdad under legal permission. The cause of death for each cadaver was due to one of the following diseases: congenital heart disease, intrapartum asphyxia, aspiration pneumonia, sudden infant death syndrome, and urinary tract diseases. After make midline dissection of the neck thyroid gland inspected grossly and all measurements were taken include length, width, depth, weight, and volume (the later was by both sonography and replacement fluid). Then histologically preparation of the slides comprise; firstly, the samples were fixed and preserved in 10% buffer formalin saline solution in plastic labeled container. The tissue was washed in distil water; dehydrated with ascending grades of alcohol, cleared by xylene, and embedded in paraffin wax. Paraffin blocks were cut at 5 micrometer thickness and stained with routine Haematoxylin and Eosin (H&E) and periodic acid Schiff's, for descriptive study. TSH hormone levels were measured via (Cobas e 411 analyzer, Roche, German). Fully automated Electrochemiluminescence technology. Ultrasonography examination made by taking the maximum lengths of individually lobes were recorded by vertical imaging, and maximum width and depth were recorded by horizontal

imaging. The volume of each lobe calculated using World Health Organization (WHO) recommended formula: Craniocaudal dimension (mm)* Medirolateral dimension (mm)* Anteroposterior dimension (mm)* 0.479.[20] Total thyroid gland volume was taken using summing up volume of both lobes. Isthmus dimensions were not included in the formula as recommended by World Health Organization.[21] The subject divide in to 4 groups (1-7 A, 8-14 B, 15-21 C, 22-28 D) for both hormone and ultrasonography studies.

Results

Anatomically the thyroid gland is located anteriorly in lower part of the neck, in the muscular triangle. Corresponding to lamina of the thyroid cartilage the gland lie lateral to lower third of lamina of thyroid cartilage. Related to cricoid cartilage the thyroid present lateral and inferior to cricoid cartilage from lateral and anterior view respectively. Simultaneous anterior to superior tracheal rings. Thyroid gland appear as completely developed, U shape or "horseshoe shaped", reddish in color due to profused blood supply, without agenesis of any part. In the present study neonates weight of the thyroid gland was 1.35 ± 0.34 gram.

In the present study the thyroid gland consist of two lobes. These lobes lie on parasagittal plane. Both lateral lobes of neonates thyroid gland were found somewhat asymmetrical pyramidal in shape, have a broad base with direct contact to isthmus from the lower medial surface and slightly a tapering apex. According to lower third of thyroid cartilage and cricoid cartilage levels, the superior boundary of lateral lobes of the thyroid gland was observed reach at lower third lamina of the thyroid cartilage. The inferior border of the right and left lobes, related to tracheal rings was determined reach to fourth or may perhaps exceed to reach fifth tracheal rings (figure1). The measurement of thyroid lobes were as follows; Length 12.48 ± 1.76 mm, 12.12 ± 1.79 mm of right and left lobes respectively. Width of right and left lobes were 5.73 ± 0.82 mm, 5.88 ± 0.73 mm. Thickness right and left lobes were 3.95 ± 0.66 mm, and 4.0 ± 0.99 mm respectively.

Histologically the microscopic examination of thyroid gland of the present study showed that thyroid gland in neonate surrounded by a capsule of loose connective tissue, which formed from fibrous layer of elastic fibers and reticular fibers in addition to the blood vessels. The capsules extend to the gland tissue by the trabeculae which divided the gland parenchyma to several lobules. The interstitial connective tissue of the gland presented was with thin fibrous septa between the follicles. The thyroid gland is mainly formed from follicles these follicles consists of three components which are represented by follicular basement membrane, follicular cells and the colloid which filled the follicle cavity. The wall of follicular lining tissue presented with a cuboidal thyroid epithelium in one layer. The nuclei of

follicular cells were generally centrally or basally located and varied in shape, but oval-shaped forms were commonly found in the cuboidal cells. The cavity of the follicles is filled with colloid in different quantities. The colloid appeared as homogeneous mass with relatively slight optical density. The colloid margins seems lighter than the remainder. (figure 2&3).

Thyroid Stimulating Hormone (TSH) means $\pm$ SD of TSH in different age groups were had a tendency to decreased as following 10.70 ± 3.09 mU/L, 3.55 ± 1.81 mU/L, 3.30 ± 1.61 mU/L, and 2.85 ± 1.27 mU/L, in male. While in females were 10.90 ± 3.19 mU/L, 3.60 ± 1.98 mU/L, 3.41 ± 1.23 mU/L, and 3.48 ± 1.45 mU/L in groups A, B, C, and D respectively.

Ultrasonography neonates were examined in this study full-term, euthyroid neonates. The results showed thyroid tissue located in a normal position, uniform echo texture, limited interiorly by trachea, exteriorly by carotid artery and jugular vein, and anteriorly by the pretracheal muscles. In neonate, the thyroid lobes appeared as ovoid's, and their structure appeared more echogenic than the muscles and blood vessels (figure 4). Measuring of thyroid gland volume in both sex in different age groups by using Brunn's (ellipsoid) formula method (volume = length * width * depth * 0.479). The total volume of neonates thyroid gland groups in present study in male were 412.7 ± 62.2 mm³, 429.5 ± 60.7 mm³, 431.3 ± 68.7 mm³ and 452.9 ± 75.3 mm³ in groups according to age in days A(1-7), B(8-14), C(15-21), and D(22-28) respectively, and the total volume of female is same groups mention above were 401.2 ± 83.9 mm³, 428.6 ± 57.8 mm³, 426.9 ± 63.6 mm³, and 447.7 ± 72.6 mm³ respectively for the previous group.

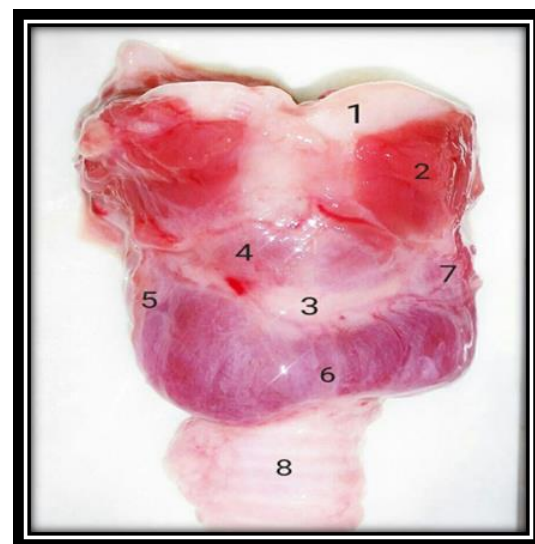


Fig. (1) Neonate thyroid gland

1- Thyroid cartilage 2- Thyrohyoid muscle 3- Cricothyroid muscle 4- Cricoid cartilage 5- Isthmus of thyroid gland 6- Right lobe of thyroid gland 7- Left lobe of thyroid gland 8- Trachea.

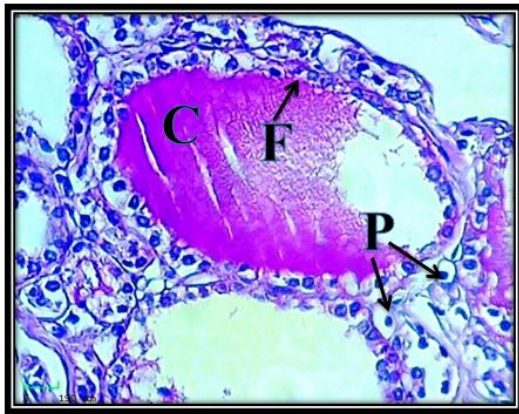


Fig (2) clear demonstration of structur and content of single follicle of thyroid gland. (C) colloid, (F) Follicular cell, (P) Parafollicular cells. PAS stain 40X.



Figure (3) thyroid gland explain (T) Trabeculae extend from capsules to the gland tissue which divided the gland to several (L) lobules. (BV) Blood Vessels within septa (HE stain 10X)

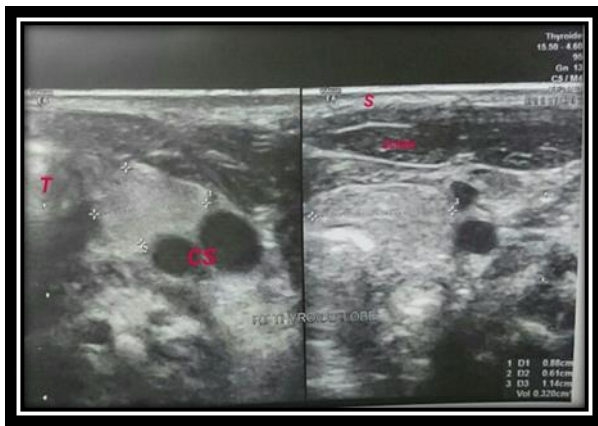


Fig. (4) Ultrasound of right lobe neonate thyroid gland, CS carotid sheath, SCMM sternocleidomastoid muscle, T trachea all these structures surround the gland.

Discussion

Anatomically Concerning to location of thyroid gland lies anterior lower part of neck deep to the sternothyroid and sternohyoid muscles, located anteriorly in the neck. Morphology of thyroid gland specimens appears U shape that agree with Grewal.[22] The weight increases in infancy and childhood. The weight of thyroid gland was $1.35 \pm$

0.34 gm. These values coincide with the study of Ratnakar.[23] how found the weight of thyroid gland was 1.25 gms. Griffin J.[24] Have mentioned the weight of thyroid gland 1 to 1.5 gm at term. Comparing this study with adult by Al-Samarrae AJ et al.[25] They found the weight of thyroid gland 21.81 gm. Which indicate the weight increase with age.

The present study showed the right and left lobe connected to intervening isthmus in the normal thyroid gland. No more difference between dimensions of right and left lobe but sizes increased with age advanced. That agree with Lokanadham.[26] Anomalies were not found in present study. Verahanumaiah.[27] That said agenesis of isthmus of thyroid gland is rare in human.

Histological examination of human thyroid gland sections revealed that the size of the follicles was not homogeneous, larger follicles are usually found in the periphery and smaller ones found centrally this agree with Brown RA.[28] According to Jyothi *et al.*[29] distinguish of follicles started from the periphery as vascularity was more in the periphery than the central part of gland. in our study the space between follicles not a common feature and more follicles appear as neighbor. In the present study, a colloid in the follicles appeared irregular and eroded indicating secretory activity. The follicles which consists of spheres formed by simple cuboidal epithelium having a lumen filled with gelatinous substance termed colloid this finding not consistent with Otoole K.[30] Any change in the size of the thyroid gland could therefore be due to alteration in the size of the existing follicles, or tissue between the follicles, not in number of follicles and amount of follicular epithelia. The secretory follicles constitute the functional and structural units of the thyroid gland. The size of a follicle depends on the size, number and activity of cells. correlate with finding of Ross MH.[31]

In this study distinguished methods have been used to estimate the thyroid status in the newborn. Measurements of serum (TSH) concentrations provided a certain amount of information on the thyroid function in the neonatal period as extrauterine life adaptation. Significant changes occur in thyroid physiology at the time of birth. A surge in the serum TSH is seen after delivery that harmony with Caylan N.[32] These arising in levels of hormones is due to cold-stimulated. Another interpretation At birth, cold-stimulated TSH surge is observed, followed by a TSH decrease until day 3 or 4 of life by T4 feedback inhibition. Or/and these elevation in hormones levels directly after birth possibly related to delivery stress.[33]

Ultrasonography, The thyroid volume in newborns found in this study was somewhat differ with the normative data that reported by several authors but lie within range. like Dan Yao *et al.*[34] That found thyroid gland value $640 \pm 270 \text{ mm}^3$ Tajtakova *et*

al.[35] $600 \pm 200 \text{ mm}^3$ (range 200-1600 mm^3). Traditionally Germany is iodine poor. So the science Liesenkoetter *et al.*[36] Did two different study between supplemented and iodine deficiency and find the neonatal thyroid volume higher in iodine deficient (mean 1500 mm^3) than the neonate iodine efficient (mean 700 mm^3). So this variation in calculated volume value between this study and previous mention studies appear normal because our country

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دراسة تشريحية، نسيجية، هرمونية، والموجات فوق صوتية للغدة الدرقية لأطفال حديثي الولادة

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الملخص

المواد والطرق:- تم جمع وفحص الغدة الدرقية لأطفال حديثي الولادة عينايا وأخذ جميع القياسات. ثم إعداد الشرائح النسيجية وصبغها بالصبغة المعتادة هيماتوكسيلين و ايويسين (H&E) واصباغ اخرى خاصة للدراسة الوصفية. تم أخذ عينات دم من اطفال اصحاء لتقييم هرمون المنبه للغدة الدرقية (TSH) بالإضافة الى الحجم عن طريق الموجات فوق الصوتية وباستخدام الصيغة الإهليجية 0.479 كعامل تصحيح.

النتائج:- تكمن الغدة الدرقية في الجزء الامامي السفلي من الرقبة، وتتكون من الفص الأيمن والأيسر ويتصلان عبر البرزخ من الجزء السفلي من الغدة. الغدة تظهر شكل حرف U باللغة الانكليزية وتكون حمراء-بنية اللون. المتوسط ومعيار الانحراف للوزن 0.34 ± 1.35 غرام. قياسات الأبعاد كما يلي، الطول 12.48 ± 1.76 ملم، العرض 12.21 ± 1.79 ملم، العرض 5.73 ± 0.82 ملم، 5.88 ± 0.73 ملم للفص الايمن والايسر تواليا. تحت المجهر الضوئي يحتوي على عدد كبير من بصيلات أكبر بصيلات موجودة على المحيطات وصغيرة في الوسط. كانت مستويات الهرمون المحفز للغدة الدرقية في المجموعات العمرية المختلفة لديها ميل إلى الانخفاض على النحو التالي:- 3.09 ± 10.70 mU/L ، 1.81 ± 3.55 mU/L ، 3.30 ± 1.61 mU/L ، 1.27 ± 2.85 mU/L ، في الذكور. بينما في الاناث كانت 3.19 ± 10.90 mU/L ، 1.98 ± 3.60 mU/L ، 3.4 ± 1.23 mU/L ، 1.45 ± 3.48 mU/L في المجموعات A و B و C و D على التوالي. باستخدام الموجات فوق الصوتية، اجمالي حجم الغدة الدرقية الاطفال حديثي الولادة في الدراسة الحالية للذكور كانت 412.7 ± 62.2 مم³ ، 429.5 ± 60.7 مم³ . للإناث كانت 401.2 ± 83.9 مم³ ، 428.6 ± 57.8 مم³ . للمجموعتين الاولى والثانية تواليا.

أجريت هذه الدراسة لغرض وصف الغدة الدرقية الطبيعية لأطفال حديثي الولادة كدراسة تشريحية ونسجية وهرمونية وموجات فوق. يمكنها أن تعطي ضوء لمساعدة الأطباء على التعامل بشكل مميز مع الغدة خلال فترة الوليد بالإضافة إلى توفير بيانات قياسية محلية.