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SUDAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLAGE OF GRADUATE STUDIES

Evaluation of Normative Tonsils Size in Sudanese Children by Using Ultrasound

تقويم الحجم المعياري للوزتين للأطفال السودانيين بإستخدام الموجات فوق الصوتية

A thesis submitted in a partial fulfillment for the requirement of M.Sc. Degree in Diagnostic Medical Ultrasound

By:

Zohida Abdel Algabar Abdel Wahhab

Supervisor:

Dr: El-Safi Ahmed Abdulla

Associate Professor

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الأية

قال تعالي

صدق الله العظيم

الأية 5 من صورة الضحي

DEDICATION

To the four pillars of my life: God, my parents, and my sister.

Without you, my life would fall apart. I might not know where the life's road will take me, but walking with You, God, through this journey has given me Strength.

Sister

You are everything for me, without your love and

Understanding I would not be able to make it.

Daddy

You have given me so much thanks for your faith me, and

For teaching me that I shall never surrenders.

Mom

You always told me to "reach the stars." I think I

Get my first one. Thanks for inspiring my love for transportation.

We made it…

ACKNOWLEDGEMENTS

*I would thanks **Allah** for giving me strong well throughout my life to look always for the best.*

*I wish to express my warmest gratitude to my supervisors, **Professor EL-SAFI AHMED ABDALLA** and **Dr Mohammad EL FADEL** for their encouraging guidance and the patience they have generously shown during these years. I appreciate both my supervisors for the valuable time they have spent on research and scientific experience.*

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*I want to express my thanks to **Dr Mohammad EL FADEL** for his valuable assistance in conducting the statistical analyses.*

Finally, I want to thank the most important people of my life: my family and friends. I am deeply grateful to my parents for their lifelong encouragement and support.

ABSTRACT

Defining the normal value of the palatine tonsil size among the young Sudanese population is essential for a reliable evaluation of children with enlargement or signs and symptoms of tonsil disease. An ultrasound measurement was therefore under taken to determine the normal range of the tonsil diameter among Sudanese children.

The purpose of this study was to investigate a large ultrasound imaging study to evaluate the normal size of the tonsil during development of children using height and transverse diameters in which it's diameter in centimeter was assumed to equal the age of child in years, also to show the effect of the increase size of inflamed tonsil in the vascularity of it.

A total of 100 normal children and 50 patients with tonsillar diseases acute/chronic tonsillitis, recurrent tonsillitis and peritonsillar abscess were recruited in this study. On ultrasound scan the height, transverse diameters and Doppler blood flow of the tonsils where obtained from each subject and the data were analyzed with excel and specific package of social statistics version 14 (SPSS).

The study showed correlation between measured height diameter in centimeter and the age of child in years in which the correlation (R^2= 0.788). The ANOVA-test for significant showed a significant difference between the normal height diameter in centimeter and corresponding age in years at p=0.05 which was differ from the right to the left tonsil, moreover within the same age group, moreover the paired t-test for significance showed difference which was statically significant at (p>0.0001) and (R^2= 0.788) this means that it can't be practically used to estimation of the tonsils size throughout childhood.

The study showed strong correlation between measured transverse diameter in centimeter and the age of child in years in which the correlation R^2= 0.803. The ANOVA-test for significant showed a significant difference between the measured transverse diameter in centimeter and corresponding age in years at p=0.05, but however the paired t-test for significance showed

no difference which was statically significant at ($p<0.003$) and ($R^2= 0.803$) thus it can be used as a predictor for estimation of the tonsils size during childhood.

The study also showed a strong correlation between the measured height and transverse diameters of inflamed tonsil and the Doppler blood flow in it in which the correlation $R^2=0.300$ and 0.839 respectively, but the ANOVA test for significance showed insignificant effect between the estimation of height diameter of the tonsil and Doppler blood flow at ($p=0.532$) and showed significant effect between the estimation of transverse diameter of the tonsil and Doppler blood flow at ($p< 0.022$) thus the transverse diameter can be used with confidence in evaluation of the vascularity of the tonsil.

ملخص الدراسة

تحديد القيم الطبيعية لأقطار اللوزتين بين الأطفال السودانين مهم لإجراء تقيم دقيق وسريع للأطفال الذين يعانون من تضخم في اللوزتين او يعانون من وجود علامات او اعراض امراض اللوز.

الموجات فوق الصوتية التشخيصية هي الوسيلة التي استخدمت من اجل قياس اقطار اللوزتين وكانت نتائجها اكثر دقة من النتاتج المتحصل عليها بواسطة الفحص السريري للمرضي .
أجريت هذه الدراسة لتحديد المدي الطبيعي لأقطار اللوزتين في الأطفال السودانين وذلك بقياس القطر الطولي والعرضي لكل لوزة. اجريت هذه الدراسة في روضة سلسبيل الخاصة ومدرستي الثورة الحارة 14 بنين وبنات في عدد 150 من الأطفال (75 ذكورو 75 إناث) تروحت اعمارهم بين 1-15 سنة.

أظهرت الدراسة علاقة إرتباط قوية بين القطر العرضي للوز بالسنتميتر وبين عمر الأطفال حيث أن الإرتباط $R^2= 0.803$ وأظهر إختبار الإختلاف ANOVA وجود إختلاف بين قياس القطر العرضي و الطولي للوز بالسنتميتر وبين عمر الاطفال بالسنين بحيث انهما لا يتوافقان وقد أعتبرت هذه النتيجة هامة إحصائيآ عند $p=0.05$. إلا أن إختبار الإختلاف paired t-test وأظهر أن هذا الإختلاف غير موجود عند قياس القطر العرضي بالسنتميترومن النتائج ثبت أن القطر الطولي للوز يختلف الطبيعي يختلف بين اللوزتين واكثر من ذلك أنه يختلف بين مجموعة الاطفال في نفس العمر حيث أعتبرت هذه النتيجة هامة إحصائيآ ايضا ($p>0.0001$) و الإرتباط ($R^2=$ 0.788) وعليه فإنه بالإمكان تقدير مقاس اللوز عن طريق قياس القطر العرضي للوز.

وأظهرت الدراسة ايضا علاقة إرتباط قوية بين القطر العرضي و الطولي للوزالملتهبة وبين معدل تدفق الدم في اللوز،حيث أن الإرتباط $R^2=0.300, 0.839$ علي التوالي الإ أن إختبار الإختلاف ANOVAأظهر عدم وجود إختلاف ملحوظ بين القطر الطولي للوز الذي تم قياسه ومعدل تدفق الدم فيها عند ($p = 0.532$)في حين أظهر الإختبار وجود إختلاف ملحوظ بين مقاس القطر العرضي للوز ومعدل تدفق الدم فيهاعند ($p = 0.022$)وعليه وإعتماداً علي هذه النتائج فإنه يمكن إستخدام القطر العرضي لقياس الحجم الطبيعي للوز.

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List of abbreviations

US	ultrasound
MRI	Magnetic resonance imaging
CT	Computerize tomography
Rt	Right
Lt	Left
R	Correlation
yr	Years
SPSS	specific package of social statistics
ANOVA	Analysis of variance

CHAPTER ONE

Introduction

CHAPTER ONE

1-Introduction

1.1 Introduction

Tonsillar hypertrophy is a frequent source of anxiety for parents and doubt for general practitioners (Barr and Crombi, 1989, Brodsky et al., 1989, Crombie and Barr, 1990, Cinar, 2004, Ackay et al, 2006). In many patients with recurrent infections, tonsil hypertrophy present and tonsil size is one of the most important factors contributing to airway obstruction (Sdralis and Berkowitz, 1996). In both groups children and adults with hypertrophy of tonsils and symptoms of airway obstructions sometimes find that preoperative subjective tonsil sizes do not agree with real palatine tonsil mass, height, and width size (Cummings CW 2005).

Tonsillectomy is frequently used to eradicate airway obstruction in patients especially in children so tonsil size can help to predict success of rate of tonsillectomy in patients with tonsillar hypertrophy in children .Therefore, accurate evaluation of palatine tonsils is an important factor for the successful surgery of patients with airway obstruction (Wang JH, et al 2009).

The palatine tonsils reach their maximum normal size in early childhood, after puberty together with other lymphatic tissue in the body they gradually atrophy (Snell 2004).The palatine tonsils are usually easily seen in the orpharynx during oral examination. Clinical size assessment, however, is difficult since the posture of the tongue may significantly alter their appearance (Diamond 1980).

Some techniques for measurement of the tonsils have been developed, although the most frequently used techniques are the Clinical grading and lateral radiography. Clinical grading of tonsillar size is based on their transversal

extension the midline (Brodsky 1989). The depth or vertical aspects, however, are not regarded in the physical examination. The limited value of tonsillar grading in children has become evident when the real size of the surgically removed tonsillar tissue has been compared with the clinical grading (Wang et al. 2009). Nevertheless, controversies still exist about the value and/or significance of such measure methods. This way, Gray's anatomy states that ''the size of the projection of the medial border of the tonsil into the pharynx is not a true indication of the size of the organ'' (Warwick and Williams, 1973).

Moreover, the size of the tonsils cannot be confidently measured on the lateral radiograph, either. It only gives a two-dimensional (2D) view of the tonsils and does not reveal the transversal extensiveness of the tissue. Moreover, there is no longitudinal data available concerning the physiologic growth of the tonsils, which further increases the inaccuracy of whether tonsils should be interpreted as hypertrophic (Diamond1980).

On CT scanning, the tonsils are difficult to differentiate from anterior and posterior tonsillar pillars because of their similar attenuation coefficients. Similarly, on T1weighted MR Images, the tonsils are difficult to separate from muscle because the two are nearly isointense. On T2 weighted MR sequences, the tonsils have a high signal intensity than muscle because the lymphoid tissue and submucosal glands within the tonsils have a longer T2 relaxation time relative to the adjacent muscles (Minerva. Becker 2005).

Ultrasound is accurate, non invasive, inexpensive and bedside tool can use to study the tonsils size, shape and appearance, can assess blood flow of the tonsil and expected to be useful in the diagnosis and therapy of palatine tonsillar disease (Kaneak Haraguchi1989).

In this study we attempt to determine the mean value of the palatine tonsils diameters in young population from Sudan. Because by determining the

normal range of tonsils we can make early diagnosis in person who have tonsils hypertrophy. There are many studies (using different modalities) about measurement of the palatine tonsils diameters in foreign population. So this makes the diagnosis of tonsils disorders more easily for the children than taking blood for hematological investigation (ASO).

1-2 Problem of the study

The size of palatine tonsils differs with different age during childhood, and there is no standard measurement for normal tonsils size in Sudanese children which is important for early diagnosis of tonsils disorders.

1-3 Objectives

1-3-1 General objectives

The main objective of this study is to characterize the normative tonsils size in Sudanese children using ultrasound.

1-3-2 Specific objectives

- To find correlation between the gender, age, weight and size of the tonsils.
- To find a relation between ultrasound finding of palatine tonsil and clinical diagnosis.
- To evaluate the relation between the heights, transverses diameter, Doppler blood flow and the size of inflamed tonsil.
- To substantiate the use of Doppler ultrasound in diagnosis of tonsil enlargement.

1-4 Thesis outlines

Chapter one include introduction to the study , chapter two for medical review which include(anatomy, physiology and pathology) and the previous studies ,chapter three for method and material, chapter four include result ,chapter five for discussion, conclusion and recommendation of the thesis and presents suggestions future work, and finally references and appendices.

CHAPTER TWO

Literature review

CHAPTER TWO
2- Literature review

2-1 Anatomical revision

The palatine tonsil (usually refer to tonsil) is an oval mass of specialized sub epithelial lymphoid tissue situated in the triangular tonsillar fossa between the diverging palatopharyngeal and palatoglossal fold, the medial surface of the tonsil is free and project to a variable extend into the oropharynx depending partly on its size, but probably more importantly on the degree to which it is embedded into tonsilar fossa. In later fetal life a triangular fold of mucous membrane extends back from the lower part of the palatoglossal fols to cover the anteroinferior part of the tonsil in childhood ,however this fold is usually invaded by lymphoid tissue and becomes incorporated into the tonsil ,it is not usually possible to distinguish it clearly(Glesson1997).

The appearance of the tonsil, on the examination of the throat may give a miss leading estimate of its size, as indicated previously, some tonsils appear to lie very much on the surface of the throat with only a shallow tonsilar fossa, other are much more deeply buried in a deep tonsilar fossa, the upper pole of the tonsil may extend up into the soft palate and the lower pole may extend downwards beside the base of the tongue. The tonsil is larger in childhood when it is more active and gradually becomes smaller during

puberty (Glesson1997).

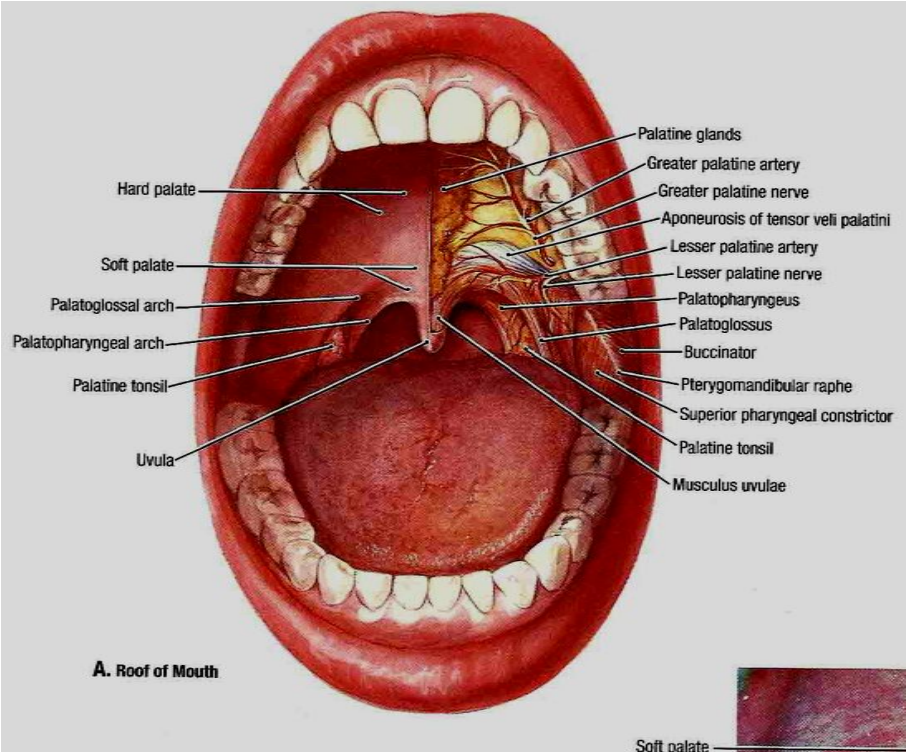

Figure 2-1: Isthmus of the fauces (oropharyngeal isthmus)

2-1-1 Embryology and Development

The tonsils begin developing early in the third month of fetal life. They arise from the endoderm lining, the second pharyngeal pouch, and the mesoderm of the second pharyngeal membrane and adjacent regions of the first and second arches. The epithelium of the second pouch proliferates to form solid endodermal buds, growing into the underlying mesoderm; these buds give rise to tonsillar stroma. Central cells of the buds later die and slough, converting the solid buds into hollow tonsillar crypts, which are infiltrated by lymphoid tissue (William 2001).

2-1-2 Surface anatomy

The palatine tonsil is too deeply placed to be felt externally, even when enlarged. When the mouth is closed the medial surface of the tonsil touches the dorsum of the tongue, in this position the surface making of the tonsil on the exterior of the face corresponds to an oval area over the lower part of the masseter muscle, a little above and in front of the angle of the mandible and behind the third lower molar teeth (Bannister 1995).

2-1-3 Blood supply of the tonsil

The main artery supply the tonsil is tonsillar branch of the facial artery which inters the tonsil near its lower pole by piercing the superior constrictor muscle just above the styloglossus muscle. A farther arteries supply reaches the tonsil from the lingual artery, by way of the dorsal lingual branches from the ascending palatine branch of the facial artery and ascending pharyngeal vessels, the upper pole received an additional supply from greater palatine vessel of the descending palatine branch of the maxillary artery.

Venous drainage of the tonsil to the paratonsillar vein, and vessels also pass to the pharyngeal plexus or facial vein after piercing the superior constrictor muscle. There is communication with the pterygoid plexus and drainage is eventually into the common facial and internal jugular veins (Glesson1997).

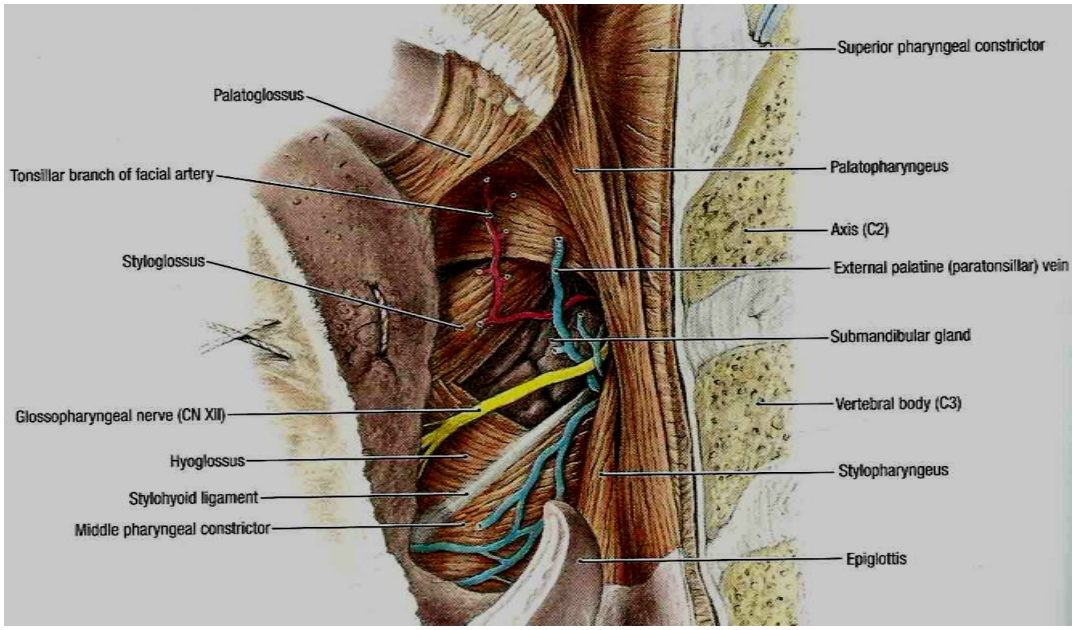

Figure 2-2: Isthmus of the fauces medial view

2-1-4 Nerve supply of the tonsil

The sensory nerve supply to the tonsillar region is mainly by the tonsillar branch of the glossopharyngeal nerve, the upper part of the tonsil nearest the soft palate supplied by the lesser palatine, branches of the maxillary division of the trigeminal nerve. Sympathetic fibers reach the tonsil on the arteries supplying it and are derived from the superior cervical ganglia (Glesson1997).

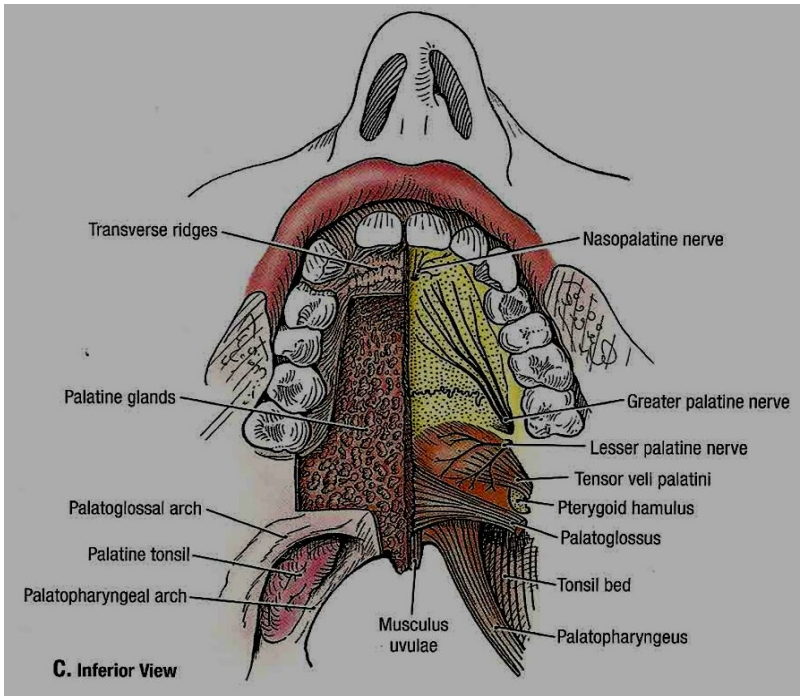

Figure 2-3: Palatine tonsil and tonsillar sinus (fossa or bed)

2-1-5 Lymphatic drainage of the tonsil

Lymphatic vessels from the tonsil pierce the buccopharyngeal fascia and pass to the upper deep cervical group of lymph nodes, in particular to the jugulodigastric group situated just below the posterior belly of the digastrics muscle. The tonsil has no afferent lymphatic vessels (Glesson (1997).

2-2 Functions of the tonsil

Like other mucosa- associated lymphoid masses the major functions of the palatine tonsil are as follow (Brandtzaeg 1988)

- To select clones of B and T cells relevant to the micro- organisms at the pharyngeal surface. To initiate this action it is envisaged that antigens cross the reticulated epithelium and are passed on to antigen –presented cell which carry out T- and thus B cell selection.

- To provide a site for proliferative expansion of selected B- and T-lymphocyte clones destined for immune functions in neighboring area of the pharyngeal mucosa.
- To produce IgA and IgG for local secretion (apparently a minor function which may be primarily concerned with the immediate protection of the tonsil itself).

2-3 Pathology of the tonsil

While the palatine tonsil is substantial part of the pharyngeal immune system, it may itself become infected in particular pathogenic bacteria, may invade the tonsillar crypts and proliferate within them causing an inflammatory reaction (Bannister 1995).

2-3-1 acute tonsillitis

This is a common disorder in children and it is unusual for a child not to have at least one or two episodes of tonsillitis, these attacks are particularly liable to occur when the child is exposed to large numbers of other children for the first time that is on entering nursery school or primary (David and Hibbert 1997).

2-3-1-1 *Complication of acute tonsillitis*

The systemic or general complication of acute tonsillitis almost confined to childhood, there are

- Septicemia
- Untreated acute tonsillitis can result in septicemia with septic abscesses, septic arthritis and meningitis.
- Acute rheumatic fever and glomerulonephritis

2-3-2 Peritonsillar abscess (quinsy)

Is a collection of pus between the fibrous capsules of the tonsil, usually at it is upper pole and the superior constrictor muscle of the pharynx it usually occur as complication of acute tonsillitis or it may apparently arise denovo with no preceding tonsillitis (David and Hibbert 1997).

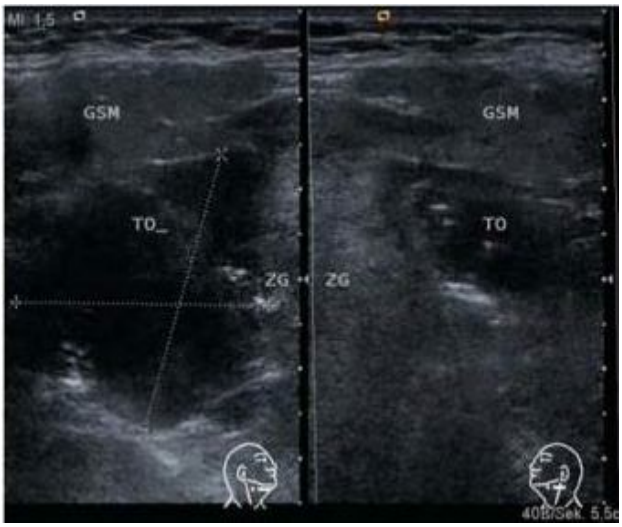

Figure2-4 Image from atlas of the head and neck ultrasound show right peritonsillar abscess compare to normal left tonsil.

2-4 Assessment of the size of the tonsil

The tonsil is more active in childhood and gradually becomes smaller during puberty. Its appearance may give a misleading estimate of its size. Some tonsils appear to lie mostly on the surface of the throat, with a shallow tonsillar fossa; others appear to be mostly buried in a deep tonsillar fossa (Beasley1997).

2-4-1 *Clinical assessment*

The proper way is to gently place the tongue depressor anterior to the circumvallate papillae or if possible, just by inspection without the use of tongue depressor. The size and percentage of the obstruction of the palatine tonsils was graded on a scale from 1 to 4 modifying the method

recommended by Brodsky (1989) Tonsil sizes classification performed was as following:

Grade 1= size 0: tonsils were absent or atrophied.

Grade 2= size 1: tonsils filled 0 to 25 percent of the oropharyngeal diameter.

Grade 3= size 2: tonsils filled 25 to 50 percent of the oropharyngeal diameter.

Grade 4= size 3: tonsils filled 50 to 75 percent of the oropharyngeal diameter.

Grade 5= size 4: tonsils filled 75 to 100 percent of the oropharyngeal diameter. Grade 6= size 5: kissing tonsils that filled 100 percent of the oropharyngeal diameter and were coherent.

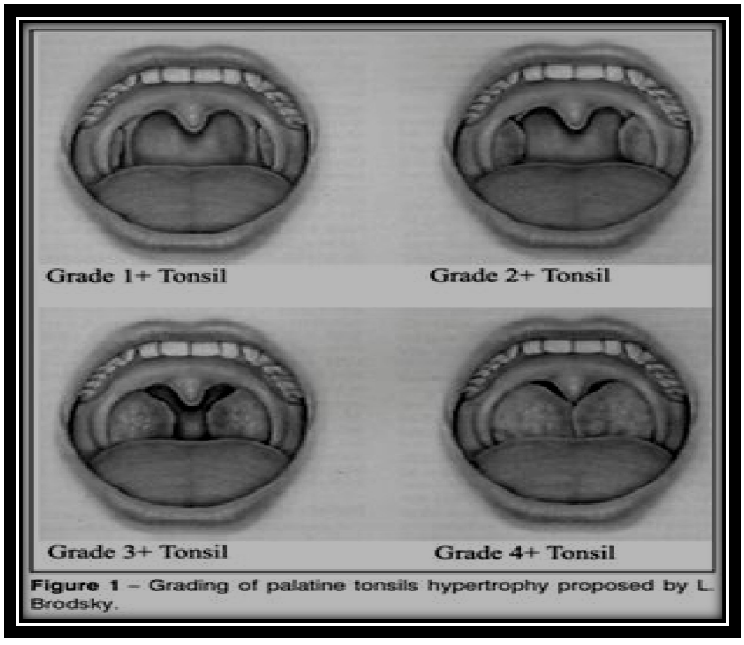

Figure2-5: Grading of palatine tonsis hypertrophy proposed by L.Brodsky

2-4-2 *Tonsillar imaging*

Imaging is important in paediatric assessment as children may be difficult to examine. A formal sleep study i.e. polysomnography may be

used as an objective measure but is expensive and not readily available. It is reserved for those in which the diagnosis is in doubt, unclear history and for documentation prior to surgery (Brodsky1989).

2-4-2-1 *lateral soft tissue x-ray*

A lateral soft tissue x-ray film of the head and neck region will show up the hypertrophic tonsils and adenoid together with associated narrowing of naso and oropharynx but is doesn't determine the objective size of the tonsils (Becker2005).

2-4-2-2 *Magnetic resonance imaging* (*Aren method* 2002)

The size of the tonsils detected on axial measurement of the lower face axial skeletal growth which determined by the intermandibular length obtained from an axial T1 weighted image level of maximal tonsillar cross sectional area, they defined the foregoing level because of speculated role of the tonsils on airway size in children this measurement along the transverse intermandibular line .

2-4-2-*3 Ulrasound examination*

There were two ways of performing an ultrasound examination in the floor of mouth and oropharyngeal areas, transcutaneously that was through the soft tissue of the neck and intraorally in which the ultrasound probe is covered for example with gloves and inserted into the mouth, however special probes existed for application in the oral cavity and deep area of oropharynx. The tonsillar bed examined when the ultrasound probe hold slightly above the hyoid bone in the transverse plane, tilted laterally in submandibular region, the tonsil appears as a hypoechoic relatively well-define structure with multiple echogenic reflection due to small inclusion of air, the size of the tonsils depends on the age and shows

great inter individual variation. Acute inflammation conditions affecting the palatine tonsils are seen as an enlargement with hypoechoic change and loss of clear demarcation from the surrounding tissue. A hypoechoic, clearly define space occupying lesion touching the tonsillar bed can be identified on the ultrasound image, it shows the typical signs of an abscess, a central anechoic area, possibly with isolated internal echoes indicating cell debris and distal acoustic enhancement. Ultrasound may sometimes be a very useful diagnostic tool and examination can also be performed when there is trismus related to infection or inflammation (Heinrich and Bozzato 2013).

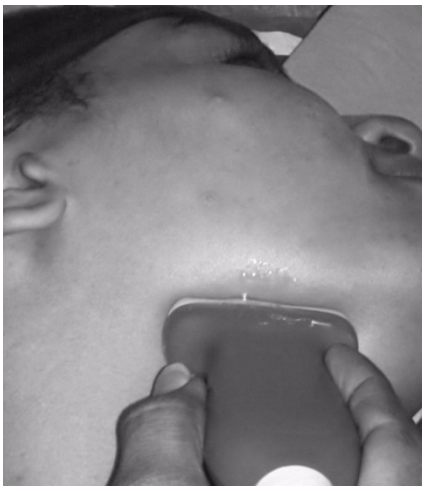

Figure 2-6: Transcutaneous US placed in the angle of lower jaw with the patient in orthostatism and lateral rotation of the head.

Figure2-7: submandibular region, left transverse. The tonsillar bed can best be assessed in this classic view. The submandibular gland (GSM) and the border of the tongue (ZU) form a triangle, within the tonsil (TO) can be identified as a hypoechoic structure anteriorly, the muscles of the floor of the mouth, including mylohyoid (MM) muscle, separate the bed of the submandibular gland from the tongue. Diagnosis: **Normal findings**

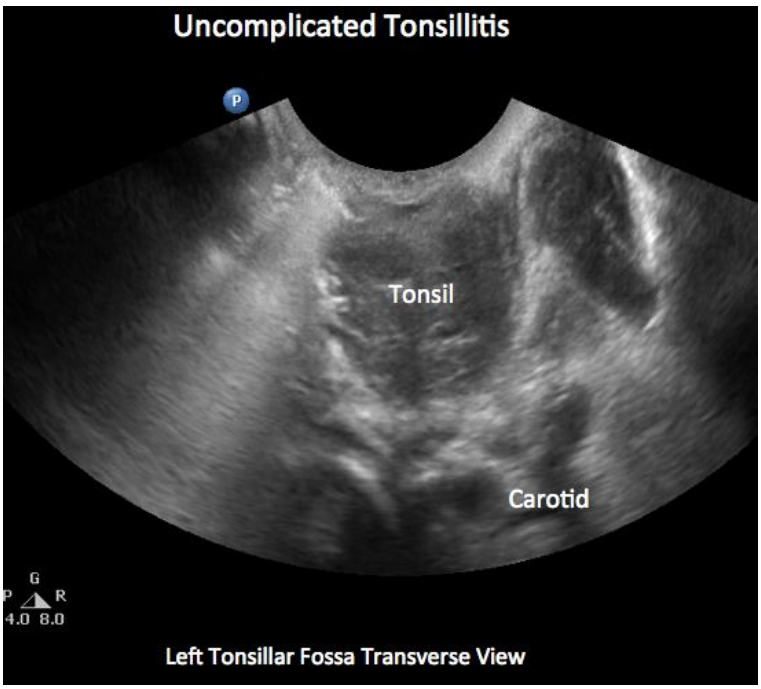

Figure 2-8: Intraoral ultrasound technique to show the tonsil.

2-5 Literature review

The size of the tonsil varies according to the age, individuality, and pathologic status. At the fifth or sixth year of life, the tonsils rapidly increase in size, reaching their maximum size at puberty. At puberty, the tonsils measure 20-25 mm in vertical and 10-15 mm in transverse diameters.(Susan et, al 2005).

Kaneaki .Haraguchi et al (1989) with ultrasonic tomography palatine tonsils and the paratonsillar regions were imaged in viva. The longitudinal and transverse measurements in 65 tonsils were compared with actual size of these tonsillar tissues after tonsillectomy. They found that there was a significant correlation between the ultrasonic measurements and the actual longitudinal and transverse diameters in the 65 tonsils, They expected that the ultrasound imaging is expected to be useful in the diagnosis and therapy of palatine tonsillar disease.

In study done for Turkish population (Murat, et al., 2010) in their research Age-Specific Size of the Upper Airway Structures in Children during Development to investigate the normative values of the upper airway and surrounding tissues during development by MRI. They included 292 of children, who had no sleep disorders or any associated symptom that could be related to breathing disorders. The normative values of mean tonsils width measured and the mean palatine tonsils size increase until 4and 5, and then it stayed at a plateau until 11 years of age. After that the palatine tonsils showed a slight decrease and then stabilized.

During the 12 month study period (Aren et, al 2002) 92 pre adolescence children with normal growth and development age range from 1 to 11 years with a mean 5.69 , 2.51 and mean weight was 22.7, 9.51kg cm

were selected from patients who underwent head and neck MRI . They found that, on an axial plane of T1 weighted images there were following correlation with age and tonsils width (r 0.46 p 0.001). Their finding confirmed a study by (vogler and co- worker 2000) that assessed the thickness of the adenoid pad using a similar methodology they evaluated a single midline MRI, they found that the adenoid grow linearly throughout the first decade of life and reach maximum size between 7 to 10 years of age then progressively diminish until 60 years of age, moreover Aren in their study showed that the tonsils exhibit the same pattern of growth as the adenoid during this period

Also (Wang2010) performed another study to assess Palatine Tonsil size in Obese, Overweight, and Normal-weight Children with Sleep-disordered breathing. They found that despite similar subjective tonsil size in obese and control children, the objective tonsil size, including tonsils, height, thickness, and weight, was larger in obese than in control children, and the mean tonsils volume was significantly greater in obese than in control children with SDB.

Kiyono, et al (1989), in their study of the size of normal hilar lymph nodes measured in autopsy specimens. They measured the normal size of lymph nodes for each region of the hilum by direct measurement of the short and long diameters of each node in the transverse plane of the node and the longitudinal diameter in the vertical plane of the node and they found that Both the maximum normal long transverse diameters and the longitudinal diameters showed a wider variation, ranging from 18 to 10 mm and from 20 to 12 mm, respectively.

Chikui et al,(2000) in study of Multivariate analysis of sonographic finding on metastatic cervical lymph node, contribution of blood flow features revealed by power Doppler sonography in predicating metastasis, they found that the longitudinal diameter of the node is an unreliable criterion in differential diagnosis of cervical node only the maximum transverse diameter of each node was used to determine mean node size.

Also (Cui XW et al.2013) in study of Conventional ultrasound for lymph node evaluation, they said that the short axis diameter increase in particular and seems to be the best parameter in small LNs.

In study done by (Ying et al, 2001) they found that about 90% of lymph nodes with a maximum transverse diameter greater than 5 mm showed vascularity and an echogenic hilus. Smaller nodes were less likely to show vascularity and an echogenic hilus. As the size of the lymph nodes increased, the intranodal blood flow velocity increased significantly ($P < 0.05$), whereas there was no significant variation in the vascular resistance ($P > 0.05$).

CHAPTER THREE

Materials &Methods

CHAPTER THREE
3- Materials and Method

This prospective study was done to determine the normal value of the palatine tonsils size in young Sudanese population. This is first study done in the same subject for Sudanese population.

3-1 Study area and study population

- The study was conducted in Chinese relationship hospital, Fatima alzahra, Alshaheed Altaib primary school and Salsabil kinder garden.
- The populations were Sudanese children there aging from 1 – 15 years in Khartoum state in the republic of Sudan. The patients consisted of 50 children who tonsillectomy was performed for them from July 2013 - March 2014. Preoperative assessment and history for airway obstruction, mouth breathing and recurrent infections were performed.

3-2 The study design and study duration

- The study was analytical prospective study.
- The study was held for seventh months from July 2013 to March 2014.

3-3 Study variable

The variables that collected from each subject include age, gender, weight, longitudinal and transverse diameters, and the echogenicity of the tonsils.

3-4 Sampling

3-4-1 inclusion criteria

- 100 normal children age range from 1 – 15 years.
- 50 patients age range from 2- 15 years.

- The children weights were present.

3-4-2 *exclusion criteria*

- Children with any tonsils disorders exclude from normal study.
- Children with tonsillectomy.

3-5 Data collection

- The data will be collected by using portable ultrasound machine (ALOKA SSD-500), (MINDARY) and 7- 7.5MHZ (ALOKA UST 5512U) high frequency transducer and a hard copy print for documentation.

3-6 Technique

The patients placed in sitting or in supine position with the neck extended and the head rotated away from the side been examined until the angle of the mandible been very clear then the ultrasound probe was placed transcutaneously in transverse plane below the angle of the lower jaw and above the hyoid bone at this position the tonsillar bed appeared clearly as well define, hypoechoic structure below the submandibular gland and superior constrictor muscle and lateral to the tongue.

Figure 3-1: Transcutaneous US placed in the angle of lower jaw with the patient in orthostatism and lateral rotation of the head.

3-7 Method of measurement

In transcutaneous position the probe in transverse plane the tonsil appeared as scallop shape I was measure the longitudinal as the distance from the superior pole to the inferior pole of the tonsils and the maximum transverse width as the distance from the medial aspect to the lateral aspect of the tonsils all measurement in centimeter. Moreover I applied the power Doppler to tonsillar bed to assess the blood flow of inflamed tonsils by inspection.

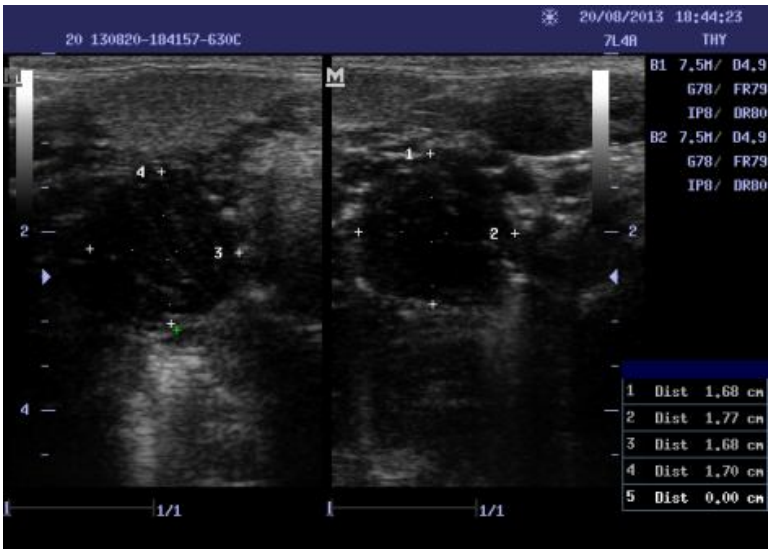

Figure 3-2: method of measurement of the tonsils diameters**.**

3-8 Data analysis

From above measurement the mean value, standard deviation and the height and transverse were computed for tonsils separately for each age group. The analysis was done use the statistical packages for social sciences (SPSS) frequency distribution of all variables were produce, using suitable table and graph.

All p values were base on paired t- test and the cutoff value for statistical significant was set at.

CHAPTER FOUR

Results

CHAPTER FOUR

The Results

The present study was done to determine the normal range of palatine tonsil dimensions in normal Sudanese population and to compare the measurement of the present study with previous studies and find out that if is any different between the result of the present studies and previous one.

A total of 150 children between the age 1- 15 years old were scanned from July 2013- March 2014 by using portable ultrasound machines (MINDARY-ALOKA SSD) and 7- 7.5MHZ high frequency transducers and a hard copy printer for documentation.

The subjects were divided in to four groups according to the age. The result were expressed as mean ± SD. Group 1age 1-5 years from (4.07±1.1) weight (13.76±2.4), group 2 age from 6-10 years (8.16±1.3) weight (20.88±5.6), group3 age from 11-15years (12.92±1.5) weight(40.5±12.8) and inflammatory group age 2-15 years from (8.10 ± 1.5).

The subject age, gender, weight and clinical diagnosis were obtained. Tonsil size measured in each case and Doppler flow obtained in inflammatory cases, all data were included in data work sheet and then the whole 150 cases were analyzed using excel and SPSS.

The following figures are twelve scatters plot show the correlation between the measured tonsil size and age and corresponding measurement of size all between 1-15 years.

Table 4-1 shows the mean and standard deviation of the age, weight and measurements of the both tonsil diameters in three groups of normal subjects. The classification of cases, group (G) 1, 2, 3 according to the age.

Table 4-1 shows the means of age and weight of normal subject groups, and the mean total of measured height and transverse of the both tonsils .In addition to the standard deviation for each one.

Groups	**Age**	**Weight**	**height (Rt)**	**Transverse (Rt)**	**height (Lt)**	**Transverse (Lt)**
G1	4.07±1.1	13.76±2.4	1.41±0.2	1.3±0.2	1.42±0.1	1.29±0.2
G2	8.16±1.3	20.88±5.6	1.52±0.1	1.43±0.2	1.56±0.1	1.46±0.1
G3	12.92±1.5	40.5±12.8	1.51±0.2	1.43±0.1	1.57±0.2	1.48±0.1

G1 = age from 1- 5 years
G2 = age from 6- 10 years
G3 = age from 11-15 years

Table 4-2describe the significance of the dependent variables height and transverse diameters according to the gender using 2-tailed (t-test) at p=0.05.the significant of the height and transverse diameters of the both tonsil, right measured .294 and .081 left measured .316 and .065 respectively.

Table 4-2 describe the significant of the dependent variables according to the gender using 2-tailed (t-test) at p=0.05.

Independent Samples Test (Gender)		
	t	Sig. (2-tailed)
height Rt	1.056	.294
Transverse Rt	1.767	.081
height Lt	1.010	.316
Transverse Lt	1.875	.065

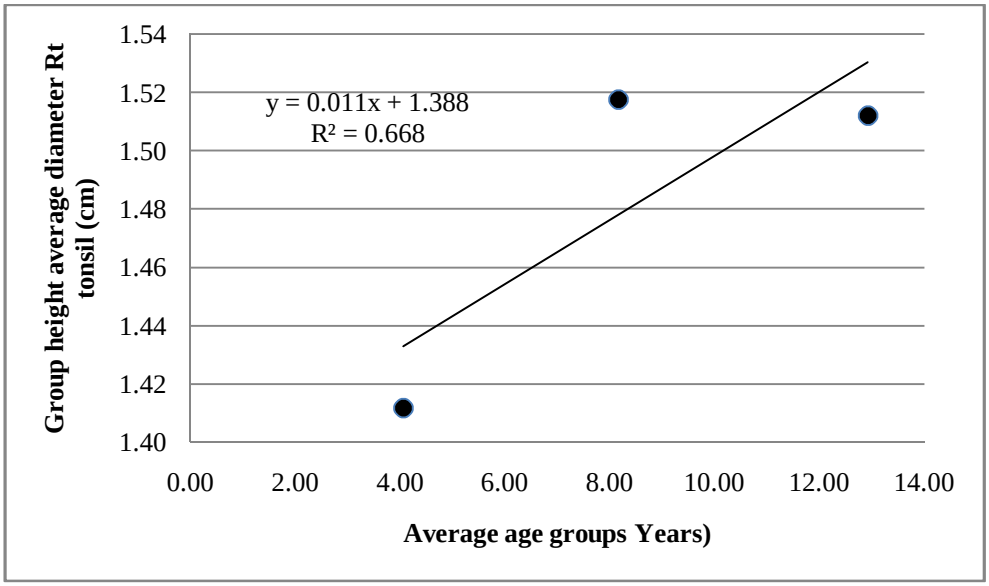

Figure 4-1.scatter plot for the measured height diameter (cm) of the right tonsils by age groups (years) with the linear regression.

Figure 4-1a scatter plot use to show the correlation between the measured height diameters of the right tonsils and corresponded average age groups. A regression equation and the correlation squared were calculated, the regression equation as follow:

Height diameter RT tonsil = 0.11age+1.388

The correlation squared was

$R^2 = 0.668$

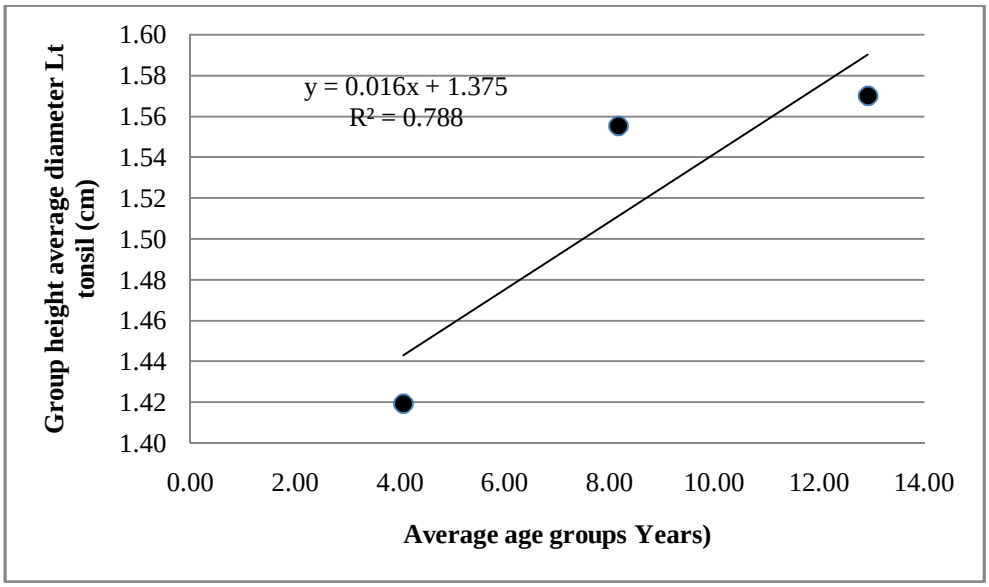

Figure 4-2.scatter plot for the measured height and diameter (cm) of the left tonsils by age groups (years) with the linear regression.

Figure 4-2 a scatter plot use to show the correlation between the measured height diameter of the left tonsils and corresponded average age groups. A regression equation and the correlation squared were calculated, the regression equation as follow:

Height diameter LT tonsil = 0.16age + 1.375

The correlation squared was:

$R^2 = 0.788$

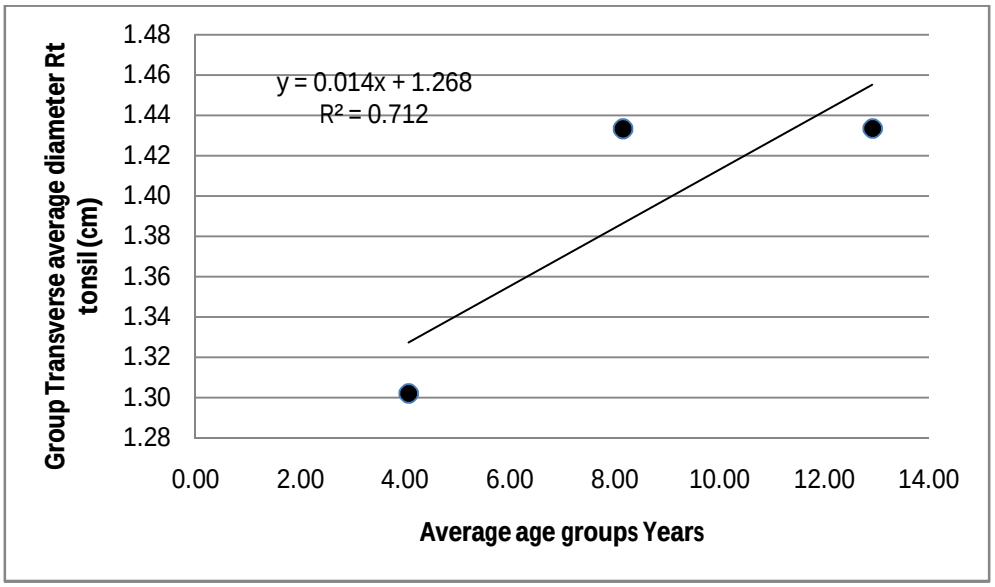

Figure 4-3.scatter plot for the measured transverse diameter (cm) of the right tonsils by age groups (years) with the linear regression.

Figure 4-3 a scatter plot use to show the correlation between the measured transverse diameters of the right tonsils and corresponded average age groups. A regression equation and the correlation squared were calculated, the regression equation as follow:

Transverse diameter RT tonsil = 0.14age+1.268

The correlation squared was:

$R^2 = 0.712$

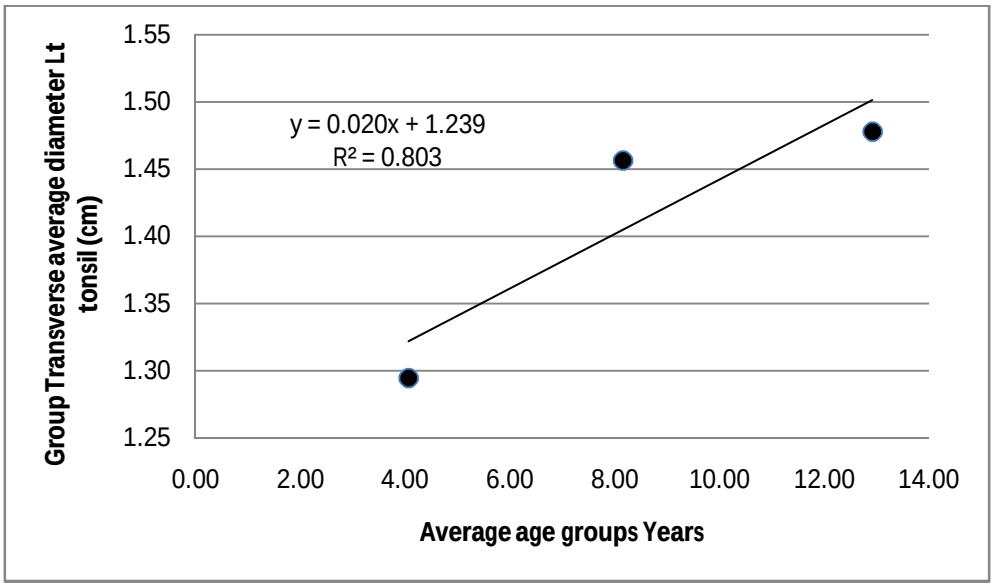

Figure 4-4.scatter plot for the measured transverse diameter (cm) of the left tonsils by age groups (years) with the linear regression.

Figure 4-4 a scatter plot use to show the correlation between the measured transverse diameters of the left tonsils and corresponded average age groups. A regression equation and the correlation squared were calculated, the regression equation as follow:

Transverse diameter LT tonsil = 0.20 age + 1.239

The correlation squared was:

$R^2 = 0.803$

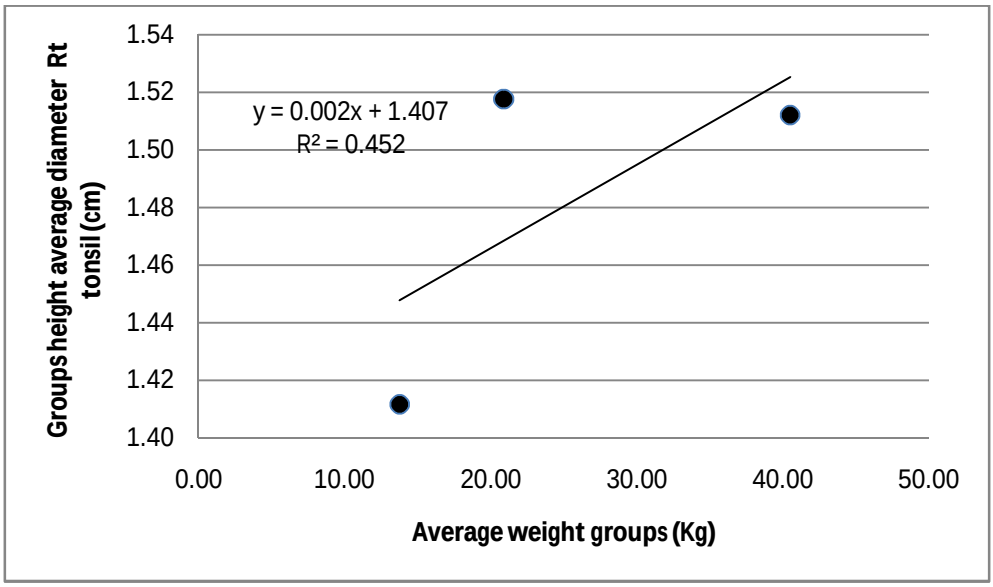

Figure 4-5.scatter plot for the measured height diameter (cm) of the right tonsils by age groups weight (kg) with the linear regression.

Figure 4-5 a scatter plot use to show the correlation between the measured height diameters of the right tonsils and corresponded average weight groups. A regression equation and the correlation squared were calculated, the regression equation as follow:

Height diameter RT tonsil = 0.02weight+1.407

The correlation squared was:

$R^2 = 0.452$

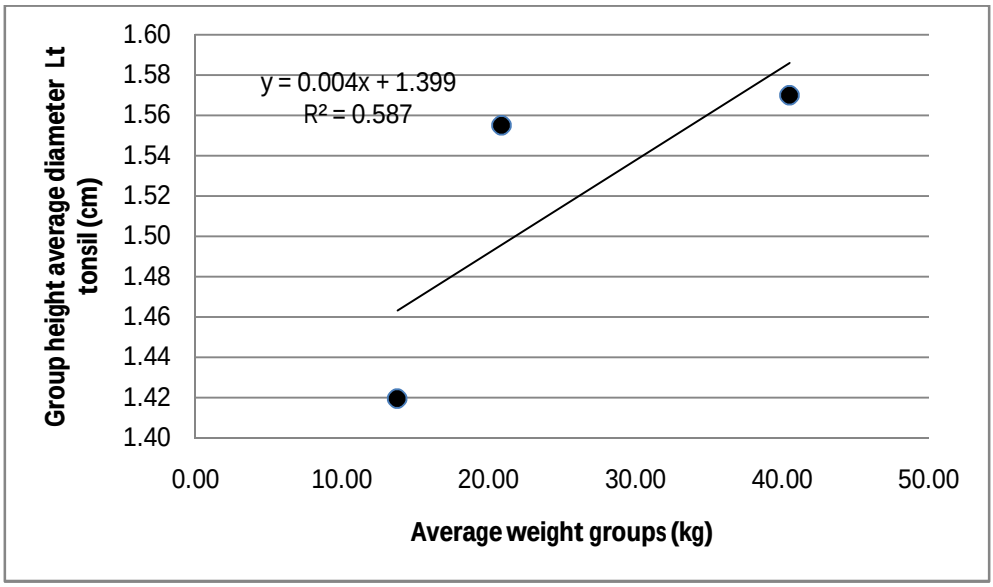

Figure 4-6.scatter plot for the measured height diameter (cm) of the left tonsils by age groups weight (kg) with the linear regression.

Figure 4-6 a scatter plot use to show the correlation between the measured height diameters of the left tonsils and corresponded average weight groups. A regression equation and the correlation squared were calculated, the regression equation as follow:

Height diameter LT tonsil = 0.04weight + 1.399

The correlation squared was:

$R^2 = 0.587$

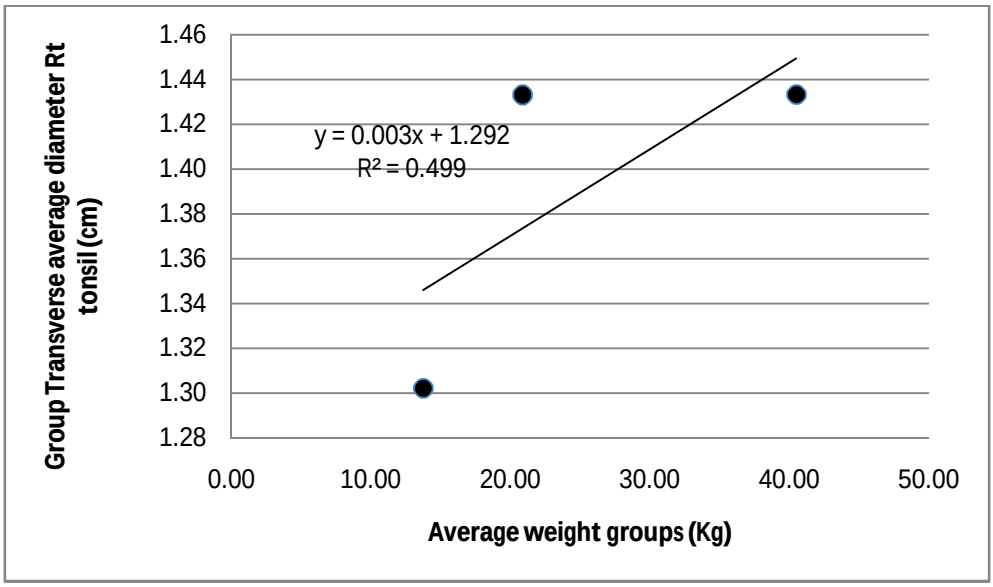

Figure 4-7.scatter plot for the measured transverse diameter (cm) of the right tonsils by age groups weight (kg) with the linear regression.

Figure 4-7 a scatter plot use to show the correlation between the measured transverse diameters of the right tonsils and corresponded average weight groups. A regression equation and the correlation squared were calculated, the regression equation as follow:

Transverse diameter RT tonsil = 0.03weight + 1.292

The correlation squared was

$R^2 = 0.499$

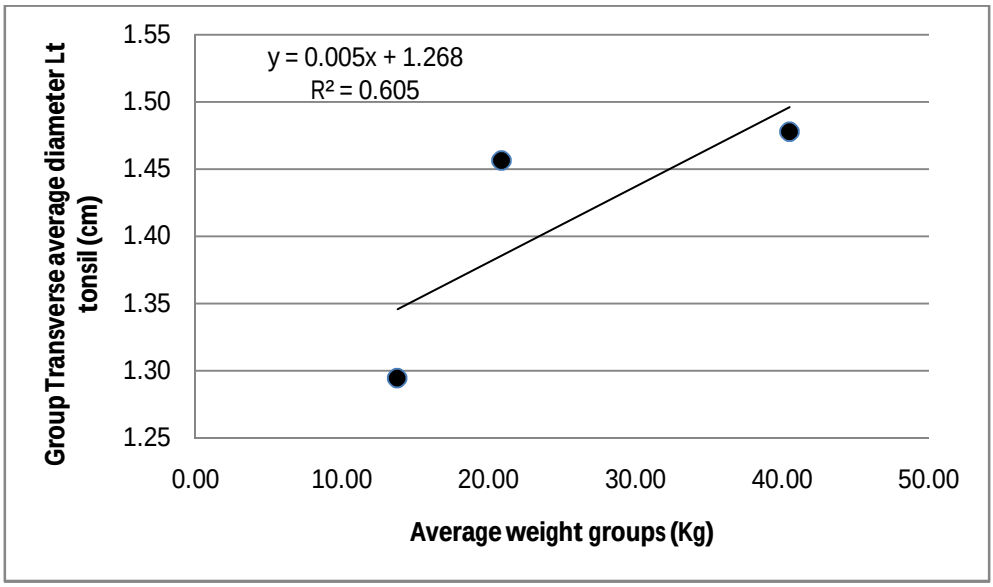

Figure 4-8.scatter plot for the measured transverse diameter (cm) of the left tonsils by age groups weight (kg) with the linear regression.

Figure 4-8 a scatter plot use to show the correlation between the measured transverse diameters of the left tonsils with corresponded average weight groups. A regression equation and the correlation squared were calculated, the regression equation as follow:

Transverse diameter LT tonsil = 0.05weight + 1.268

The correlation squared was

$R^2 = 0.605$

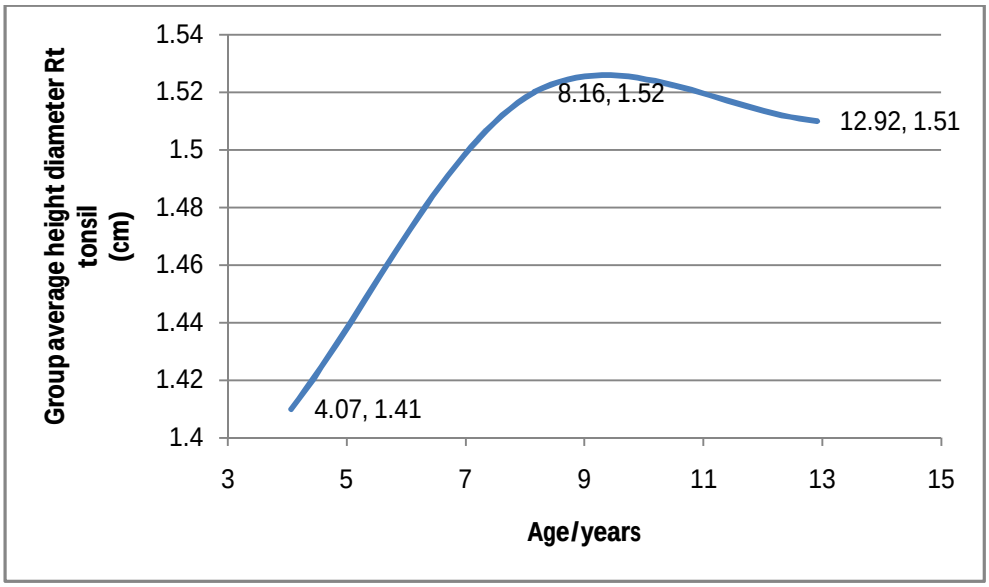

Figure 4-9.scatter line show correlation of right tonsil dimension (cm) with age groups (years).

Figure 4-9.scatter line use to show the correlation between the measured heights of the right tonsils with corresponded average age groups.

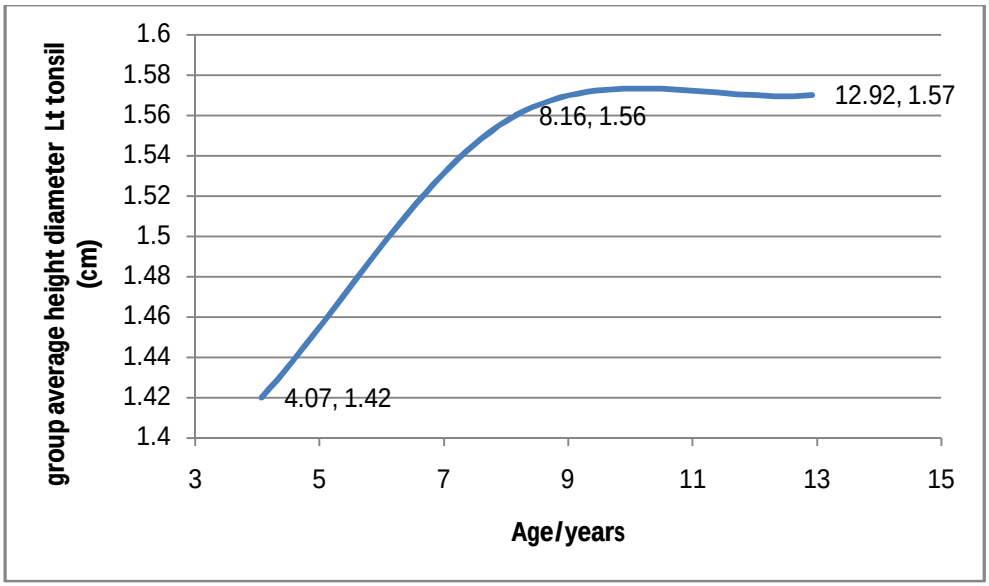

Figure 4-10.scatter line show correlation of left tonsil dimension (cm) with age groups (years).

Figure 4-10.scatter line use to show the correlation between the measured heights of the left tonsils with corresponded average age groups.

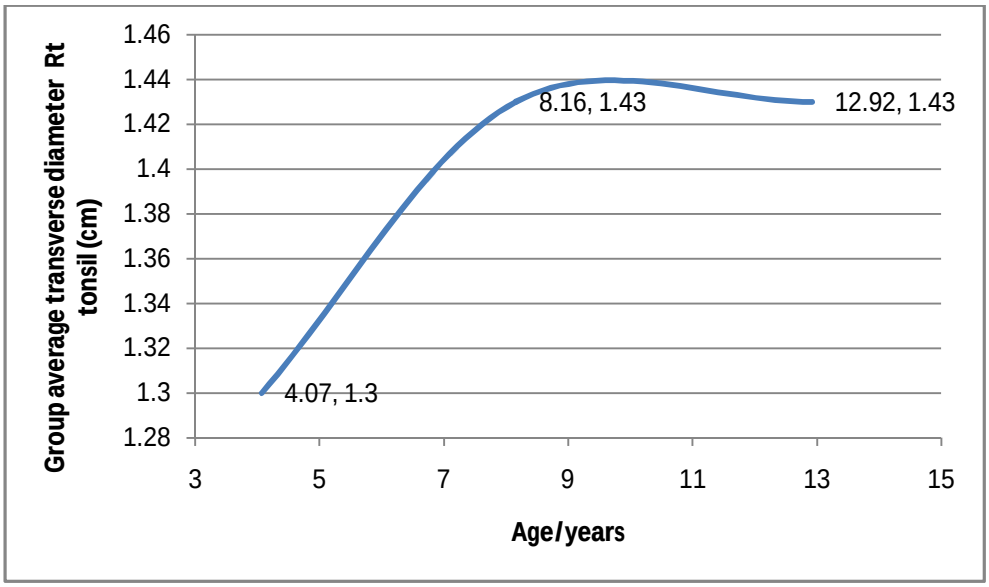

Figure 4-11.scatter line show correlation of right tonsil dimension (cm) with age groups (years).

Figure 4-11.scatter line use to show the correlation between the measured transverse diameters of the right tonsils with corresponded average age groups.

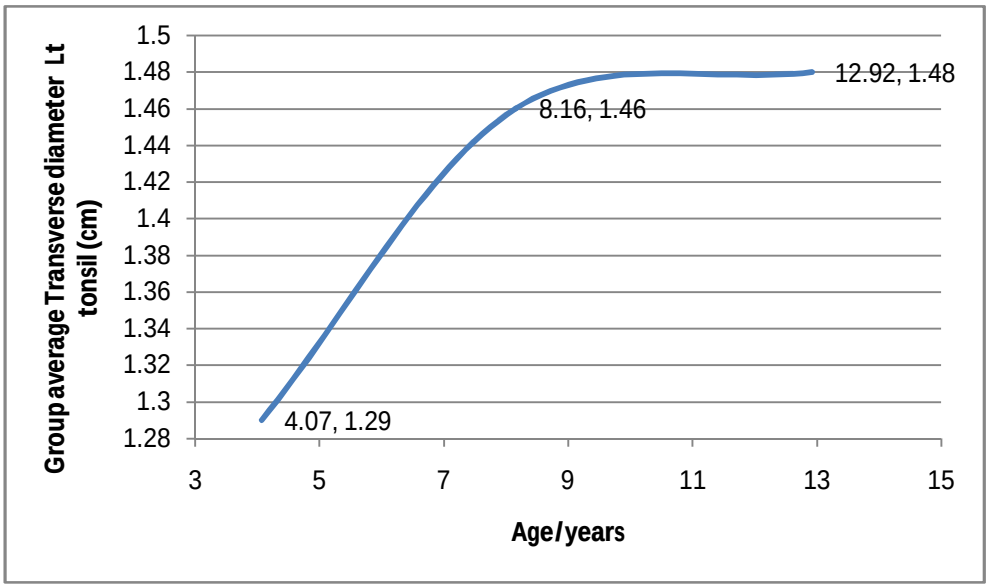

Figure 4-12.scatter line show correlation of left tonsil dimension (cm) with age groups (years).

Figure 4-12.scatter line use to show the correlation between the measured transverse diameters of the left tonsils with corresponded average age groups.

Table 4-3 describe the significant of dependent variable height and transverse diameters in between age group using F- test at p= 0.05.The significant of height and transverse diameters of the right and the left tonsils measured .016 , .001 and the left tonsils measured .000,.000 respectively.

Table 4-3 describe the significant of dependent variables in between age group using F- test at p= 0.05.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
height Rt	Between Groups	.199	2	.099	4.354	.016
Transverse Rt	Between Groups	.321	2	.160	7.311	.001
height Lt	Between Groups	.384	2	.192	10.197	.000
Transverse Lt	Between Groups	.557	2	.279	14.312	.000

Table 4-4 shows the significant of paired samples correlation between the height diameter in both tonsils as pair 1 and transverse diameter in both tonsils as pair 2 using 2-tailed (t- test) at p =0.05. The significant of pair 1 measured 0.0001 and pair 2 measured 0.003.

Table 4-4 show paired sample correlation between the height diameters in both tonsils and transverse diameters in both tonsils using 2-tailed (t-test) at p=0.05.

Paired Samples Test			
		t	Sig. (2-tailed)
Pair 1	height Rt – height Lt	3.905	0.0001
Pair 2	Transverse Rt – Transverse Lt	3.034	0.003

Table 4-5 represented the total frequency and percentage of Doppler blood flow in inflamed right tonsils as the flow normal, increase, or decrease, absent or in the wall.

Table 4-5 represented the total frequency and percentage of Doppler blood flow in inflamed right tonsils

Doppler flow Rt	Frequency	Percent
Normal	10	19.2
Increase	21	40.4
Decrease	13	25.0
Wall	6	11.5
Absent	2	3.8
Total	52	100.0

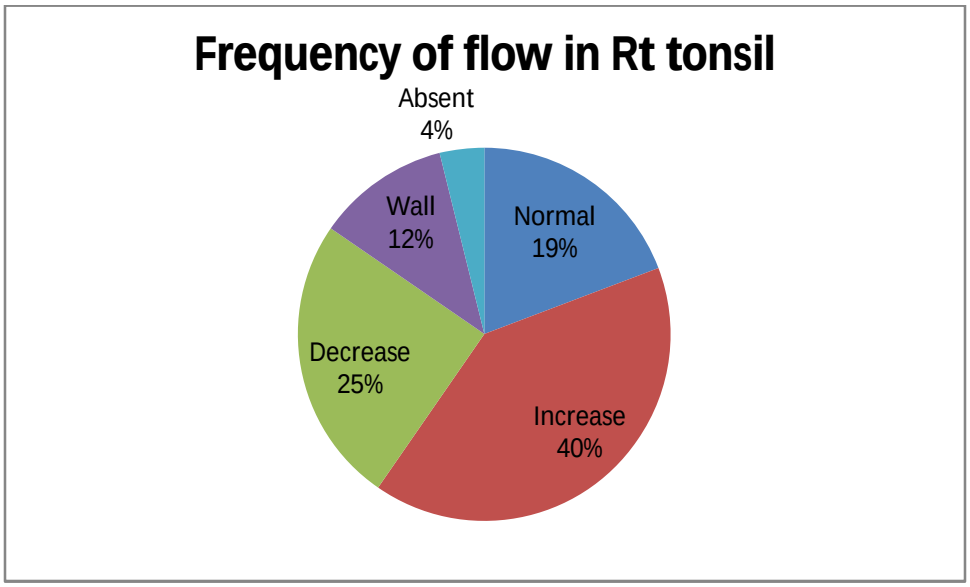

Figure 4-13. A pie graph shows the frequency of the grade for 52 tonsils (Rt).

Figure 4-13. A pie graph use to show the frequency and percentage of Doppler blood flow in inflamed right tonsil as the flow normal, increase, or decrease, absent or in the wall.

Table 4-6 represented the total frequency and percentage of Doppler blood flow in inflamed left tonsils as the flow, normal, increase, or decrease, absent or in the wall.

Table 4-6 represented the total frequency and percentage of Doppler blood flow in inflamed left tonsils.

Doppler flow Lt	Frequency	Percent
Normal	9	17.3
Increase	22	42.3
Decrease	13	25.0
Wall	6	11.5
Absent	2	3.8
Total	52	100.0

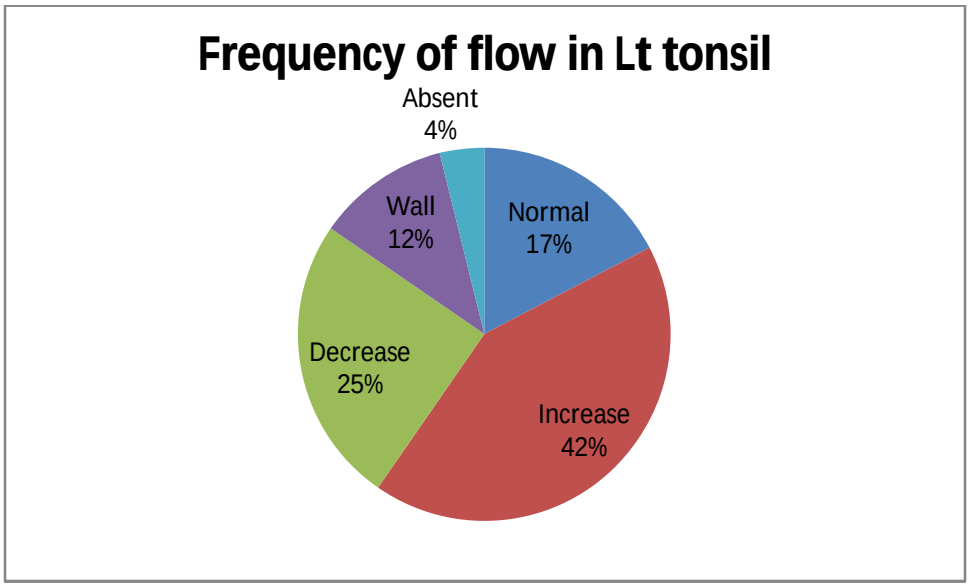

Figure 4-14. A pie graph shows the frequency of the grade for 52 tonsils (Lt).

Figure 4-14. A pie graph use to show the frequency and percentage of Doppler blood flow in inflamed left tonsil as the flow normal, increase, or decrease, absent or in the wall.

Table 4-7 describe the significant of dependent variable height and transverse diameters of the right tonsil between and within age groups using F-test at p=0.05.The significant of height and transverse diameters of the right tonsils with age group measured.772 ,.046 respectively. Blood flow effect on the height and transverse (only width show significant effects.

Table 4-7 describe the significant of dependent variables of the right tonsil between and within age groups using F- test at p= 0.05.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
height Rt	Between Groups	.114	4	.029	.450	.772
	Within Groups	2.977	47	.063		
	Total	3.091	51			
Transverse Rt	Between Groups	.594	4	.148	2.626	.046
	Within Groups	2.657	47	.057		
	Total	3.251	51			

Table 4-8 describes the significant of height and transverse diameters of the left tonsil between and within age groups using F-test at p=0.05.The significant of height and transverse diameters of the left tonsils with age group measured .532,.022 respectively. Blood flow effect on the height and transverse (only transverse show significant effects).

Table 4-8 describe the significant of height and transverse diameters of the left tonsil between and within age groups using F- test at p= 0.05.

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Height Lt	Between Groups	.167	4	.042	.798	.532
	Within Groups	2.461	47	.052		
	Total	2.628	51			
Transverse Lt	Between Groups	.663	4	.166	3.165	.022
	Within Groups	2.462	47	.052		
	Total	3.125	51			

Table 4-9 describe the cross tabulation of the total Doppler blood flow in the both tonsils as flow increase, normal or decrease, absent flow or within the wall of the tonsils.

Table 4-9 describe the cross tabulation of the Doppler blood flow in the both tonsils.

		Doppler flow Lt					
		Normal	Increase	Decrease	Wall	Absent	Total
Doppler flow Rt	Normal	9	0	1	0	0	10
	Increase	0	21	0	0	0	21
	Decrease	0	1	12	0	0	13
	Wall	0	0	0	6	0	6
	Absent	0	0	0	0	2	2
Total		9	22	13	6	2	52

Table4-10 show the mean and standard deviation of the height and transverse diameters of the both tonsils in respect to blood flow status (increase, normal or decrease, absent and within the wall).

Table 4-10: show the mean and standard deviation of the height and transverse diameters of the both tonsils in respect to blood flow status.

	Rt tonsil		Lt tonsil	
Blood flow	height	transverse	height	transverse
Normal	1.4±0.2	1.5±0.2	1.45±0.2	1.42±0.2
Increase	1.5±0.2	1.6±0.3	1.52±0.2	1.61±0.3
Decrease	1.5±0.2	1.6±0.2	1.47±0.2	1.52±0.2
Wall	1.6±0.3	1.7±0.2	1.65±0.4	1.77±0.2
Absent	1.6±0.2	2±0.1	1.52±0.3	1.86±0.1

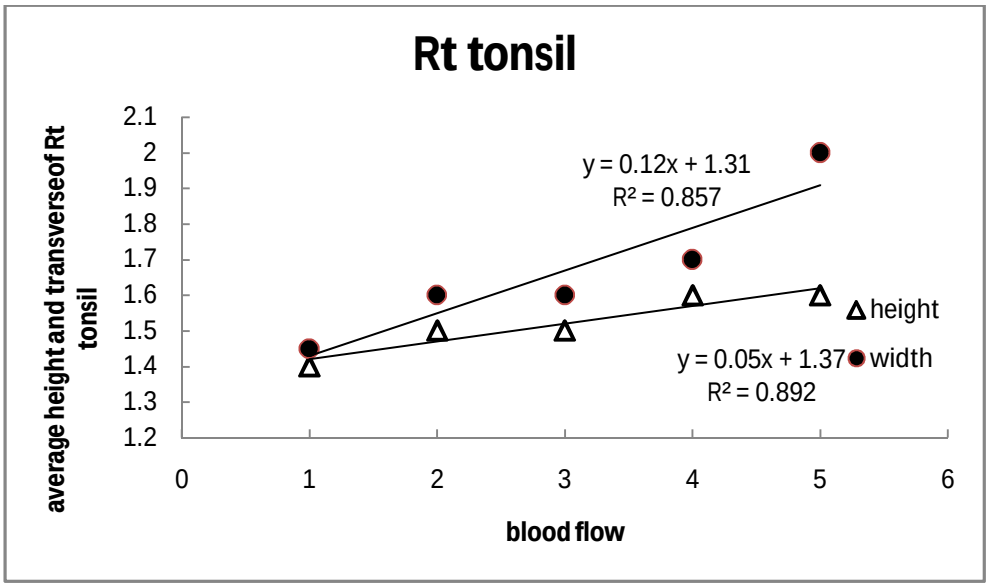

Figure 4-15 scatter plot for the measured height and transverse diameters of the right tonsils in respect to the blood flow status with the linear regression.

Figure 4-15 a scatter plot use to show the correlation between the measured height and transverse diameters of the right tonsils in respect to the blood flow status where each of the five condition (normal, increase, decrease, wall and absent) given a code of 1, 2, 3 up to 5 respectively with the linear regression and correlation. A regression equation and the correlation squared were calculated, the regression equation as fallow:

Transverse diameter RT tonsil = 0.12 blood flow +1.31

The correlation squared was:

$R^2 = 0.857$

Height diameter RT tonsil = 0.05 blood flow +1.37

The correlation squared was:

$R^2 = 0.892$

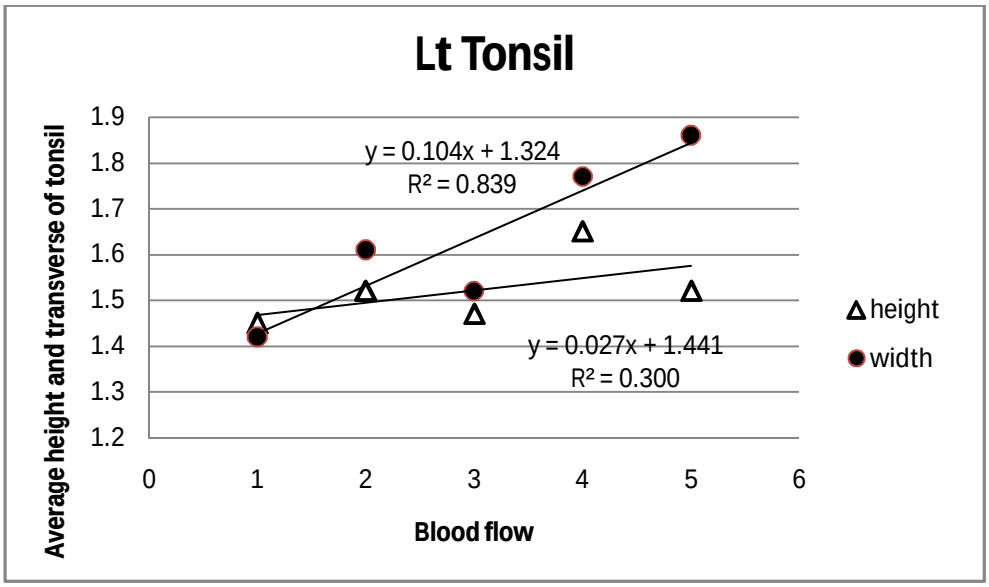

Figure 4-16 scatter plot for the measured height and transverse diameters of the left tonsils in respect to the blood flow status with the linear regression.

Figure 4-16 a scatter plot use to show the correlation between the measured height and transverse diameters of the left tonsils in respect to the blood flow status where each of the five condition (normal, increase, decrease, wall and absent) given a code of 1, 2, 3 up to 5 respectively with the linear regression and correlation. A regression equation and the correlation squared were calculated, the regression equation as fallow:

Transverse diameter LT tonsil = 0.104 blood flow +1.324

The correlation squared was:

R^2= 0.839

Height diameter LT tonsil = 0.027 blood flow +1.441

The correlation squared was: $R^2 = 0.300$

CHAPTER FIVE

Discussion

Conclusion &Recommendations

CHAPTER FIVE

1-5 Discussion

The present study was done to determine the normal range of palatine tonsil dimensions in normal Sudanese children. This is first study done in the same subject for Sudanese population, and to compare the measurement of the present study with previous studies and find out that if is any different between the result of the present studies and previous one.

A total of 150 Sudanese children between the age 1- 15 years old were scanned from July 2013- March 2014 by using portable ultrasound machines (MINDARY- ALOKA SSD-500) and 7-7.5MHZ high frequency transducers and a hard copy printer for documentation.

The subject age, gender, weight and clinical diagnosis were obtained. Tonsil size measured in each case and Doppler flow obtained in inflammatory cases, all data were included in data work sheet and then the whole 150 cases were analyzed by using excel and SPSS. Scatters plot, regression equation, correlation, mean, standard deviation and the significance of the study at p=0.05 were obtained.

The subjects were divided in to four groups according to the age. The result were expressed as mean ± SD. Group 1age 1-5 years from (4.07±1.1) weight (13.76±2.4), group 2 age from 6-10 years (8.16±1.3) weight (20.88±5.6), group3 age from 11-15years (12.92±1.5) weight (40.5±12.8) and inflammatory group age 2-15 years from (8.10±1.5) see table 4-1.

The study shows that in an independent samples t-test there was insignificant difference between both tonsil diameters (height p=.294/.316 transverse p=.81/.65) and gender at p> 0.05 see table (4-2) that means the gender not contributed factor in tonsil size.

In group one normal subject age rang 1-5 years mean and standard deviation of age 4.07± 1.1. The study shows that there is a linear correlation between the tonsil size and age in which the right tonsil height and transverse diameters increase by factor (0.73/0.46) cm for each year starting point at 1.1year respectively.

In group two normal subjects age rang 6-10 years mean and standard deviation of age 8.16± 1.3.The study shows that there is a linear correlation between the tonsil size and age in which the right tonsil height and transverse diameters increase by factor (0.2/0.07) cm for each year starting point at 1.2, 1.3 year respectively.

In group three normal subjects age rang 11- 15 years mean and standard deviation of age12.92± 1.5. the study shows that there is a linear correlation between the tonsil size and age in which the right tonsil size increase by factor (0.2/0.13) cm for each year starting point at 1.2, 1.3 year respectively. Murat, et al, 2010 noted that, the tonsil size decrease after 11 years but in this study the size slightly increase (0.13) is suggested to be result for two reasons. The first one being the 11 years subjects included in this group which had made an observable effect which could be over come if included in group 2. The second reason is suggested to be the weight factor which was other factor that influence the size of the tonsil, will be discuss later.

In group four inflammatory cases age rang 2- 15 years mean and standard deviation of age 8.10± 1.1. The study shows that there is a linear correlation between the tonsil size and age in which the right tonsil height and transverse diameters increase by factor (0.1/0.16) cm for each year starting point at 1.4 year respectively.

More over the study also show that there is a linear correlation between the measured right tonsil size (height, transverse diameters) and age in all normal subjects in which the right tonsil size increase by factor (0.11/0.14) cm for each year respectively see figure (4-1),(4-3) and a linear correlation between the measured left tonsil size (height, transverse) and age in all normal group cases in which the tonsil size increase by factor (0.16/0.20) cm for each year respectively see figure (4-2), (4-4).

Also the study shows a linear correlation between the right tonsil size (height, transverse diameters) and weight in all normal subjects in which the right tonsil size increase by factor (0.02/0.03) kg for each year respectively see figure (4-5), (4-7)and a linear correlation between the left tonsil size (height, transverse) and age in all normal subjects in which the tonsil size increase by factor (0.04/0.05) kg for each year respectively see figure(4-6), (4-8). This result confirmed by the study of (wang et al, 2010) they found that obese children with sleep disordered breathing had larger palatine tonsils than did normal weight children with sleep disordered breathing.

When speculate to the measurement of the tonsil size height and transverse diameters the significance in paired sample t-test pair 1(p=0.0001) and pair 2 (p=0.003) see in table (4-4) and ANOVA test the significant of height in right and left tonsil (p=.016, .000) and transverse

diameter (p=.001, p=.000) respectively see in table (4-3) , study shows difference in normal height and transverse diameters of tonsil in and in between three normal age groups. This finding agreed with (Kiyono et al 1989) finding in study of the size of normal hilar the lymph node measurement they found that both the maximum normal long transverse diameters and the longitudinal diameters showed a wider variation.

Moreover the study shows that the normal height diameters differ from the right to left tonsils. That means that the normal height diameter of the tonsil don't increase with constant manner according to the age. These findings suggest that the height diameter may not have a reliable contribution to predict the tonsil size. The other finding indicates that the transverse diameter thus can be use with confidence in estimation of tonsil size. This finding is consistent with study done by (Chikui et al, 2000) they found that the longitudinal diameter of the node is an unreliable criterion in differential diagnosis of cervical node only the maximum transverse diameter of each node was used to determine mean node size. Also (Cui XW et al.2013) they said that the short axis diameter increase in particular and seems to be the best parameter in small lymph nodes.

Also the study shows that the transverse diameter of the tonsil continued to grow linearly and reach the maximum size at 10 years of age while after 11year slightly decrease and then stabilized see figure (4-11) and figure (4-12). This finding confirm by the results of MRI studies done by (Aren et al, 2002) and (songu et al, 2010). Comparing the results with that of (Aren et al, 2002) by MRI it was found that the palatine tonsil reach maximum size between 7 to 10 years progressively diminished until 60 yr of age (r=.678) which is less than in present study (r=.894) which shows

stronger correlation this different may be due to the small sample used in Aren study or may be due to the difference in modalities used.

On the other hand in inflammatory group the study describe that there is a linear correlation between the measured right tonsil size (height, transverse) and Doppler blood status in which the right tonsil size increase by factor (0.05/0.12) for each respectively see figure (4-15) and also there is a linear correlation between the left tonsil size (height, transverse) and Doppler blood status in which the tonsil size increase by factor (0.03/0.10) for each respectively see figure (4-16).

Also the study shows a strong correlation between the height and transverse diameters of inflamed right tonsil and the blood flow of it, in which the correlation R^2 =0.892 and 0.857 respectively see figure (4-15), but the ANOVA test for significance showed insignificant difference between the height of the both tonsil and Doppler blood flow and showed significant difference between the of transverse diameter of the both tonsils and Doppler blood flow, significance of the height diameters (p=0.772, 0.532) and transverse diameter (p=0.046, 0.022) see table (4-7), (4-8) . That means the blood flow effect on the height and transverse but only transverse diameter show significant effects. Compared this finding with that of (Ying et al, 2001) they found that about 90% of lymph nodes with a maximum transverse diameter greater than 5 mm showed vascularity and an echogenic hilus. Smaller nodes were less likely to show vascularity and an echogenic hilus. As the size of the lymph nodes increased, the intranodal blood flow velocity increased significantly ($P < 0.05$).

5-2 Conclusions

The study shows a strong correlation between the age and transverse diameter of the tonsil but it also shows a significant difference between the height diameter and the age when considering the size of the tonsils from 1-15 years. The transverse diameter can be used with accepted confidence in estimation of normal value of palatine tonsil size in children.

The blood flow can be a reliable indicator for the tonsillitis or enlargement of the tonsils. All tonsils disorders can be assessed successfully with ultrasound.

5-3 Recommendations

- Using locally assessed normal values for Sudanese children in ultrasound investigations.
- Using ultrasound skills to diagnose the child tonsils status.
- Study could be done for various populations.
- Make a comparison between the measurements taken by ultrasound and MRI to determine which is more accurate in measuring of the tonsils.

Suggestions for future studies

- In for coming studies should increase the sample size to cover the difference in population to gain results of more accurate and comprehensive.
- The next study should evaluate the tonsil artery and vein by Doppler ultrasound.
- Future studies should compare the size of palatine tonsils in Sudanese society according to different region.

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Images

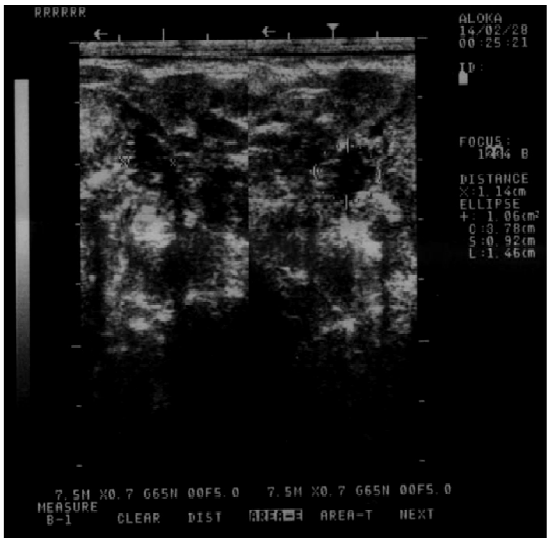

Image1 showed: 21 month male child with 10 kg tonsils measure RT (1.06x1.10) LT (1.0x 1.20).

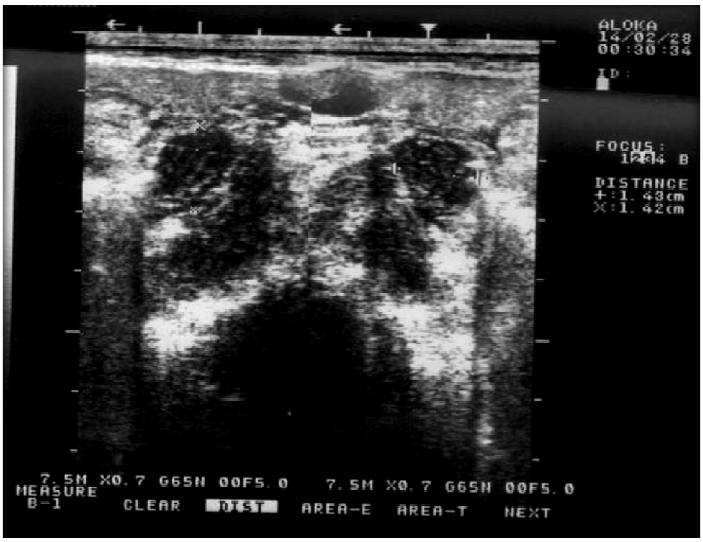

Image3showed:3 year female child with 11kg tonsils measures RT (1.43x 1.42) LT (1.43x1.42).

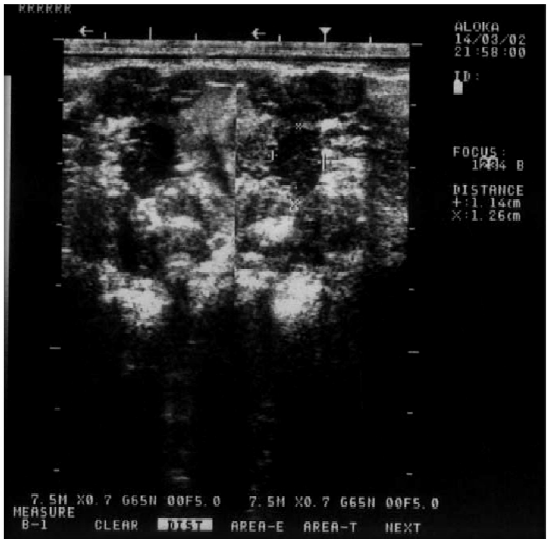

Image 2 showed: 2 years female child with 8 kg tonsils measures RT (1.10 x 1.10) LT (1.26x 1.10).

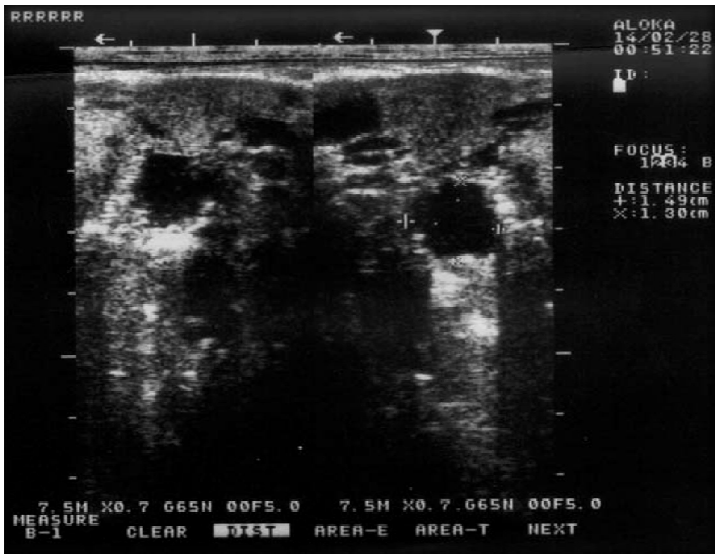

Image 4 showed: 4 years female child with 11.5 kg tonsils measures RT (1.48 x 1.30) LT (1.49x 1.30).

Image 5 showed: 3 years female child with 10kg tonsils measures RT (1.13x 1.12) LT (1.24x1.10).

Image 7 showed: 5 years female child with 15 kg tonsils measures RT (1.24x 1.40) LT (1.25x1.40).

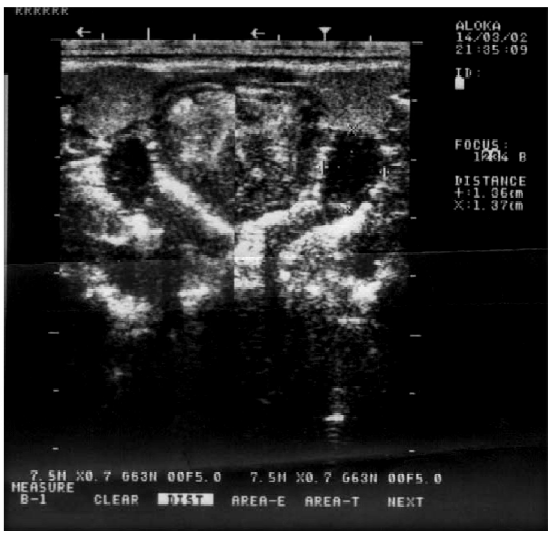

Image 6 showed: 5 years female child with 14kg tonsils measures RT (1.19x 1.34) LT (1.36x1.38).

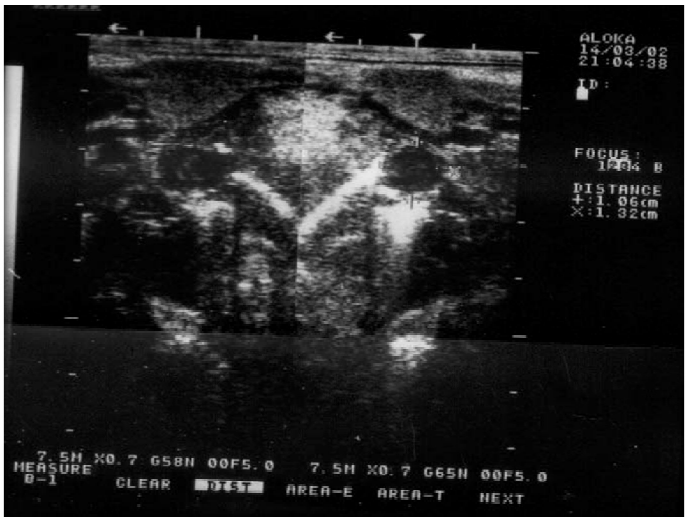

Image 8 showed: 5 years male child with 12 kg tonsils measures RT (1.38x 1.10) LT (1.32x1.06)