Abstract: Thymus is a bilobed organ usually situated in the superior mediastinum. Thymus is normally active until puberty and as age advances it undergoes considerable fibro-fatty degeneration and is replaced by fatty tissue. We found a persistent thymus in an adult male cadaver aged 70 years approximately. It apparently looked healthy. Hence the objective of this study was to know the morpho-histology of a persistent human thymus gland. Associated with this we also found a concurrent absence of isthmus of thyroid gland. Thymus obtained was processed according to the standard procedures and sections were stained with Haematoxylin & Eosin stain to study the age related changes of the thymus gland. Stained sections of thymus revealed a normal, healthy architecture of lobes of thymus. Knowledge regarding these morpho-histological features of the persistent thymus is important for clinicians and radiologists for the differential diagnosis of any mediastinal mass or presence of ectopic thymic tissue before doing any investigative procedure.

Key Words: Thymus, Age changes in thymus, Persistent thymus, Morphohistology of thymus, Agenesis of thyroid isthmus

Introduction:
The thymus is a lymphoid organ. It is a soft, encapsulated, bilobed organ. Its two lobes are joined in the midline by means of connective tissue that merges with the capsule of each lobe. It is located in the superior mediastinum in front of the ascending aorta and below the level of left brachiocephalic vein.(1) The thymus is biggest in the early part of life, particularly in puberty. As age advances it undergoes considerable fibro-fatty degeneration which hides the existence of thymic tissue. Embryonic origin of thymus is from the third pharyngeal pouch. In addition to the main thymus, separated thymic tissue may be seen scattered around the thymus, and such ectopic thymic tissue is sometimes encountered in unusual mediastinal locations.(1) Thymus plays a significant role in the early development and function of the immune system as T lymphocytes development and maturation take place within it.(2) In children the gland is pyramidal in shape and firmer than in later life, when the amount of lymphoid tissue is greatly reduced. With age, the thymus becomes thinner and greyer, and infiltrated by yellow adipose tissue. It can either undergo atrophy or can persist abundantly than usual. As age advances, it may be replaced by connective tissue or adipose tissue and contain little thymic tissue.(3) Age associated changes of the thymus is said to be reversible.(4) Increased incidence of serious infections in old age has been related with decreased thymic function.(5) Researchers opine that reduction in thymic function may result in greater susceptibility to tumours, rheumatic diseases, growth disorders and general geriatric conditions.(6) Hence we performed this morphohistology study of a persistent thymus which was found in an adult male cadaver. This histology study was taken into consideration due to the limited literature which is available in this regard and to compare our findings with earlier findings. Associated with this, we also report an associated variation of the thyroid gland in the same cadaver.

Material and Methods
The present study was conducted in the department of Anatomy, Melaka Manipal Medical College, Manipal. The study was conducted on a, possibly active, persistent thymus

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Citation

Open Access Archives
http://cogprints.org/view/subjects/OJHAS.html
http://openmed.nic.in/view/subjects/ojhas.html

Submitted: Dec 9, 2015; Accepted: Dec 30, 2015; Published: Jan 30, 2016
that was found in an adult male cadaver aged 70 years approximately. The thymus was irregularly shaped and looked somewhat like a butterfly (Figure 1). It was greyish brown in colour and was flattened anteroposteriorly. Its two lobes were separated only in the upper part, close to the thyroid and were fused with each other in the lower part. It extended from root of the neck to the superior mediastinum. It covered the lower part of trachea, brachiocephalic veins, arch of the aorta, brachiocephalic trunk, common carotid arteries and pericardium (Figure 2).

The following morphometric features of thymus were noted:

- Weight of thymus gland: 25 gm
- Length (from upper pole to lower pole of the gland):
  - Right lobe - 12 cm, Left lobe - 11 cm
- Maximum breadth (transverse): 9 cm
- It was supplied by small thymic branches of brachiocephalic trunk.

The gland was then dissected out and preserved in 10% formalin. 3-4 pieces of the gland tissue were obtained from different areas of the gland. These were processed, embedded in paraffin and sections were obtained on clean glass slides. The sections were stained with Haematoxylin & Eosin stains and examined under the microscope under different magnifications and photographs were taken (Figure 3).

![Figure 1: Figure showing the isolated human thymus obtained from male cadaver. Its two lobes are separated only in the upper part and firmly fused with each other in the lower part.](image)

![Figure 2: Figure showing the position and morphology of the persistent thymus (THY) in the cadaver. PR: pericardium, RL: right lung, LL: left lung.](image)

![Figure 3: Histology of thymus showing the increased capsular thickness and septum, presence of lymphocytes in cortex and medulla and no definite lobular demarcation. The Hassall’s corpuscle can be seen in the medulla.](image)

Observations and Results

The microscopic study of the H&E stained sections under lower magnification showed distinct cortex and medulla with few adipocytes in the upper part of the gland. However, in the lower part, some adipocytes were present in the septa. The cortex was made up of densely packed cells mainly the T-lymphocytes and medulla consisted of few lymphocytes. A few Hassall’s corpuscles were found in the medulla. Some blood vessels were also observed in the sections. Under high magnification we observed some aging changes like the capsule was present but it was thick due to fibrosis, separation between lobules were not well demarked and interlobular septa had disappeared. Hassall’s corpuscles seen were large in size which indicates normal activity of the gland.

Associated with this persistent thymus we found a concurrent variation related to the thyroid gland in the same cadaver. We found the absence of isthmus of the thyroid gland. The two lateral lobes of the thyroid gland (LT) are present on sides of trachea (TR). TC: thyroid cartilage, CC: cricoid cartilage, THY: thymus, IJV: internal jugular vein.

![Figure 4: Dissection of the front of neck showing the absence of isthmus of the thyroid gland. The two lateral lobes of the thyroid gland (LT) are present on sides of trachea (TR). TC: thyroid cartilage, CC: cricoid cartilage, THY: thymus, IJV: internal jugular vein.](image)

**Discussion:**

In recent years, the adult thymus has been considered as an entirely atrophied organ. Thymic involution is directed by the high levels of circulating hormones. Upon atrophy, its size and activity are markedly reduced, and the organ is primarily...
replaced with fat. But, it has considerable importance in surgical field in surgeries involving the parathyroids and thyroid gland and also in immunology because of the recent discoveries in transplantation immunology. Published literature on thymus is mainly based on clinical and immunological aspects and on ultrasonographic and radiological studies. Hence we decided to do the morphohistology study of the thymus which was found persistent in an old aged adult male cadaver.

Thymus develops from the ventral elongated endodermic epithelium of primitive pharynx at the level of the ao end enlarges progressively to form the thymus gland. Eventually the thymopharyngeal duct disappears.(8) As both lobes develop independently, each lobe has its own separate blood supply, lymphatic supply and nerve supply.(7) The human thymus, after an initial burst of rapid growth in childhood and early adolescence, undergoes progressive atrophy.(9) Some researchers have studied weight, age changes, location and other morphometric parameters of thymus gland.(4,10) But their study was limited to fetus only. A few researchers have also studied the involution and age changes of thymus gland in adults.(11,12) Our findings were in correlation to these studies. In standard textbooks of Anatomy, it is stated that in old age, thymus gland commonly weighs only about 10gms.(13) But in our study the thymus weighed 25 gm and did not show any pathological features. A histological study conducted on 40 human thymuses reported that, in old age, there is definite increase in the thickness of capsule and interlobar connective tissue with Hassall's corpuscles decreasing in number but increasing in diameter.(14) According to Raju Sugavasi et al, age related changes were - increased capsular thickness, separation between lobules not well demarcated and disappearance of interlobular septa. The Hassall’s Corpuscles were less in number, large in size and diameter. Parenchyma was arranged as small islands and was replaced by connective and adipose tissue. According to M. Raica et al, involutionary pattern of thymus gland. Knowledge regarding any mass in the region of neck and mediastinum and to locate the presence of any ectopic thymic tissue in the pathway of descent of thymus.

Thus persistent thymus can function well even in old age to developing immune cells, ultimately resulting in autoimmunity and the production of acetylcholine receptor antibodies.(8) Thymus in adult life may be normal or abnormal and its morphological features are important for surgeons. Thorough knowledge of dynamic changes, ectopic location and normal variation of thymus is necessary before performing any invasive procedures. This fact is also clinically very important for radiologists to make differential diagnosis in case of presence of any mediastinal mass.(19) Knowledge regarding anatomy and embryology of thymus is important to locate the presence of any ectopic thymic tissue in the pathway of descent of thymus.

Our next important observation which was associated with the persistent thymus was the presence of thyroid gland without an isthmus. Agenesis of isthmus of thyroid gland is a developmental anomaly. Phylogenetically isthmus was absent in amphibians, birds and some mammals. Agenesis of isthmus may not cause clinical symptoms by itself and its diagnosis is secondary, primary being the existence of other thyroid pathologies. Devi Shankar et al have explained in their studies that the thyroglossal duct arises from the endodermal epithelium of primitive pharynx at the level of 2nd and 3rd thymopharyngeal arch. As it descends downwards, its caudal end bifurcates and gives origin to thyroid lobes.(20) So agenesis of isthmus is a developmental anomaly, which may be possibly due to high separation of thyroglossal duct which results in the formation of two independent thyroid lobes not connected by the isthmus. Agenesis of isthmus of thyroid gland is rare in humans its incidence varying from 5% to 10%.

Since it is very rare and congenital, isthmus agenesis should be kept in mind for safe thyroid surgeries and to avoid complications during various neck operations. Clinically the diagnosis of agenesis of isthmus can be easily made with techniques like scintigraphy, USG, CT, MRI prior to any surgical procedure. When absence of isthmus is observed, a differential diagnosis against thyroiditis, neoplastic metastasis, autonomous thyroid nodule, primary carcinoma and infiltrative diseases such as amyloidosis should be considered.(21) These types of variations should be kept in mind during trans thyroid tracheostomy procedures also.(20) Tracheostomy can be potentially dangerous in such cases of absence of isthmus of thyroid gland if a pre-procedure examination is not carried out.

Conclusion
Though in many literatures, it is stated that the thymus gland is replaced by adipose tissue in old age but in present study, we found its persistence. This study will be helpful to pathologists, surgeons and radiologists while dealing with any mass in the region of neck and mediastinum and to enhance the knowledge regarding persistence and involutionary pattern of thymus gland. Knowledge regarding the presence of thyroid tissue without isthmus is very important for successful thyroid surgeries.

References