The Thymus Gland

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Assignment -

Introduction/Scope
To place the assignment into perspective, a sense of context needs to be established. First of all, it was very difficult to find material on the animal Thymus Gland. However, there was plenty of information to be found on the human Thymus Gland. Therefore, this paper will make the assumption that any references to the human Thymus Gland will also apply to the Thymus Gland of the animal or dog. In this regard, as the human possesses a heart, a set of lungs, intestines, etc., the dog also possesses the same types of organs including the Thymus Gland. The only animal Thymus Gland material that was quite readily available was to the culinary Sweetbread. Being a vegetarian and with culinary Thymus out of scope, this paper will not be addressing that aspect of it.

The paper will introduce material as mentioned in the Table of Contents as well as the physical, metaphysical, emotional and spiritual aspects of the Thymus Gland as it pertains to health and well being.

History
The thymus has had a varied history in terms of attribution of function, from at least the time of Galen of Pergamum (130-200A.D.), who named it the seat of the soul due to the halo of mystery that surrounded it as well as due to its close proximity to the heart.[1] Although, Descartes thought that the seat of the soul was the pineal gland.[2] From Galen we can ascertain that the Thymus Gland from the early days was unknown. Galen was the first to note that the size of the organ changed over the duration of a person's life. Galen conducted many nerve ligation experiments that supported the theory, which is still accepted today, that the brain controls all the motions of the muscles by means of the cranial and peripheral nervous systems.[3]

In addition, the thymus was known to the Ancient Greeks, and its name comes from the Greek word *θυμός* (thumos), meaning heart, soul, desire, life—possibly because of its location in the chest, near where emotions are subjectively felt; or else the name comes from the herb *thyme* (also in Greek *θύμος* or *θυμάρι*), which became the name for a "warty excrescence", possibly due to its resemblance to a bunch of thyme.[4]

Historical Function/Function Where is your Junction?
When was the function of the thymus gland understood?
The functions of the thymus were not well understood until the early 1960s, when its role in the development of the body's system of immunity was discovered.[5]

Earlier this century, it was thought that the Thymus Gland had no function beyond puberty.[6]

Like much of medicine, ideas with regard to thymic anatomy and physiology languished for centuries between the Fall of Rome and the 18th century. Signaling a renewed interest in the thymic gland, Vesalius wrote in the 1600s that the thymus was simply a protective thoracic cushion. In the 1700s, the predominant new theory was that the thymus somehow regulated fetal and neonatal pulmonary function. Hence, it became known as the “organ of vicarious respiration.” Others thought that the thymus simply filled the space that would later be occupied by the growing neonatal lungs. In 1777, William Hewson published the first scientific treatise on the thymus. On the basis of findings of his investigations in dogs and calves, Hewson described the evolution of thymic size during fetal and infant life, thus verifying Galen's observation. He concluded that the thymus itself was some sort of modified lymph gland.[7]

From this cited reference we have, “Due to the large numbers of apoptotic (programmed cell death) lymphocytes, the thymus was originally dismissed as a "lymphocyte graveyard", without functional importance”. The importance of the thymus in the immune system was discovered in 1961 by Jacques Miller.[8] He surgically removed the thymus from three day old mice, and observed the subsequent deficiency in a lymphocyte population, subsequently named T-cells after the organ of their origin (T for Thymus). Recently, advances in immunology have allowed the function of the thymus in T-cell maturation to be more fully understood.[9]

The Thymus Gland defined here as: **thy·mus /** (also **thy·mus gland**) • n. (pl. **-mus·es** or **-mi /** -mī/) a lymphoid organ situated in the neck of vertebrates that produces T cells for the immune system. The human thymus becomes much smaller at the approach of puberty.[10]

When autopsies were performed in the elderly, it was found that the gland was quite small. It is now known that in response to acute stress such as infection; it can shrivel to half the size within 24 hours. Subsequently, doctors thought that after puberty the Thymus Gland had no useful function and it was removed in many young children. Remember those days when tonsils were excised in a surgical frenzy! I digress, sorry. Consequently, these children had destroyed immune systems that allowed them susceptibility to infections and chronic diseases and some of these children died from serious illness. Later in the 1950’s and after further medical research, it became clear that children naturally have large Thymus Glands.

Would this be true of dogs, cats, animals? I was unable to find research that pointed to the same. But, again, if infants have large Thymus Glands, we will make the assumption here that puppies, kittens, etc. experience the same growth cycle along with its functionality.

The Thymus Gland is described as relatively large in the newborn infant (about the size of the baby’s fist), and continues to grow throughout childhood up to the age of puberty when it weighs about 1.2 oz. (35 grams), then it gradually decreases in size until it blends in with the surrounding tissue.[11]

From, my research, I found that modern medicine has not always understood the function of the Thymus Gland, but now recognizes the fact that it is closely related to the immune system, possible stress, and general well being.

The main function of the thymus gland is to produce mature T cells. The immature cells produced at the bone marrow, migrate and come into the thymus, where the maturation process takes place. This maturation process is a remarkable one, as it allows only the beneficial T cells to be released into the bloodstream. T cells that evoke a detrimental autoimmune response get eliminated.[12]

Today, we now know that it has a very important function not only physically, but also neurologically (mentally), emotionally and spiritually.

Description/Location

The thymus is an organ that varies in size depending on the age of the individual. It is largest in young animals and shrinks to a very small size in the adult.[13]

In general and simply stated, the thymus is located in the upper part of the chest underneath the breastbone. In infants, the thymus is quite large. It continues to grow until puberty, when it begins to shrink. The size of the thymus in most adults is very small. Like some other endocrine glands, the thymus has two lobes connected by a stalk. The thymus secretes several hormones that promote the development of the body's immune system.[14]

More specifically, the thymus is a flat, long structure with two lobes located in the mediastinum, inferior to the thyroid gland in the neck, posterior to the sternum. The thymus is surrounded by a connective tissue capsule. Similar to other lymphoid tissue, the thymus contains lymphocytes, macrophages, and reticular epithelial cells. The thymus is fully developed at birth, and it continues to grow until puberty. After puberty, it slowly decreases in size. The thymus is important in the development of the immune system. It is the first organ to begin manufacture of lymphocytes. In the absence of the thymus, immunity is significantly lowered. The thymus is considered an endocrine organ because it secretes the hormone thymosin.[15]

A reference source for dogs states that the thymus is located in the front part of the chest cavity, between the trachea (windpipe) and the ribs.[16]

In human anatomy, the thymus is a ductless gland located in the upper anterior portion of the chest cavity. [17]

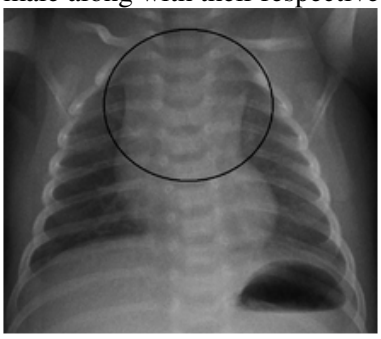
The thymus will, if examined when its growth is most active, be found to consist of two lateral lobes placed in close contact along the middle line, situated partly in the thorax, partly in the neck, and extending from the fourth costal cartilage upward, as high as the lower border of the thyroid gland. It is covered by the sternum, and by the origins of the Sternohyoidei and Sternothyreoidei. Below, it rests upon the pericardium, being separated from the aortic arch and great vessels by a layer of fascia. In the neck it lies on the front and sides of the trachea, behind the Sternohyoidei and Sternothyreoidei. The two lobes generally differ in size; they are occasionally united, so as to form a single mass; and sometimes separated by an intermediate lobe. The thymus is of a pinkish-gray color, soft, and lobulated on its surfaces. It is about 5 cm in length, 4 cm in breadth below, and about 6 mm in thickness. At birth it weighs about 15 grams, at puberty it weighs about 35 grams; after this it gradually decreases to 25 grams at twenty-five years, less than 15 grams at sixty, and about 6 grams at seventy years. [18]

Yet another source describes the thymus gland as a mass of glandular tissue located in the neck or chest of most vertebrate animals. In humans, the thymus is a soft, flattened, pinkish-gray organ located in the upper chest under the breastbone. It is relatively large in the newborn infant (about the size of the baby's fist), and continues to grow throughout childhood up to the age of puberty when it weighs about 1.2 oz (35 grams). Then it gradually decreases in size until it blends in with the surrounding tissue. Beginning during fetal development, the thymus processes many of the body's lymphocytes, which migrate throughout the body via the bloodstream, seeding lymph nodes and other lymphatic tissue. The main cells undergoing this processing are the T cells, a heterogeneous group of cells essential in protecting the body against invasions by foreign organisms. If the thymus fails to develop or is removed early in fetal life, the immune system cannot develop completely. Normally, by the time the infant is a few months old, the immune system has sufficiently formed so as to function throughout life. However, further growth and development of lymphoid tissue still depends on intervention by the thymic cells.[19]

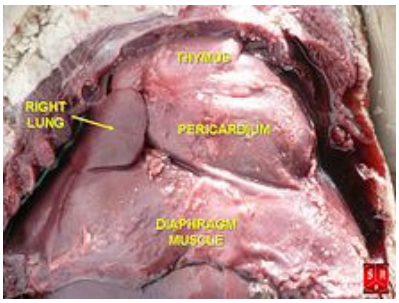
This particular reference is verbatim from the “Nationmaster” reference and only mentioned here again not for emphasis but to demonstrate that this source originally came from Henry Gray, the British anatomist who was born in 1827. He studied the development of the endocrine glands and spleen. Newer editions of *Gray's Anatomy* –and even several recent older ones– are still considered about the most comprehensive and detailed textbooks on the subject. Even the movie, Grey’s Anatomy (different spelling) was named after his book. Henry Gray (1821–1865), in the Anatomy of the Human Body (1918) stated that the thymus (Fig. 1178) is a temporary organ, attaining its largest size at the time of puberty (Hammar), when it ceases to grow, gradually dwindles, and almost disappears. If examined when its growth is most active, it will be found to consist of two lateral lobes placed in close contact along the middle line, situated partly in the thorax, partly in the neck, and extending from the fourth costal cartilage upward, as high as the lower border of the thyroid gland. It is covered by the sternum,

and by the origins of the Sternohyoidei and Sternothyreoidei. Below, it rests upon the pericardium, being separated from the aortic arch and great vessels by a layer of fascia. In the neck it lies on the front and sides of the trachea, behind the Sternohyoidei and Sternothyreoidei. The two lobes generally differ in size; they are occasionally united, so as to form a single mass; and sometimes separated by an intermediate lobe. The thymus is of a pinkish-gray color, soft, and lobulated on its surfaces. It is about 5 cm. in length, 4 cm. in breadth below, and about 6 mm. in thickness. At birth it weighs about 15 grams, at puberty it weighs about 35 grams; after this it gradually decreases to 25 grams at twenty five years, less than 15 grams at sixty, and about 6 grams at seventy years.[20]

See illustrations below of the thymus gland in a young child, a fetus and view of location in the adult male along with their respective references.



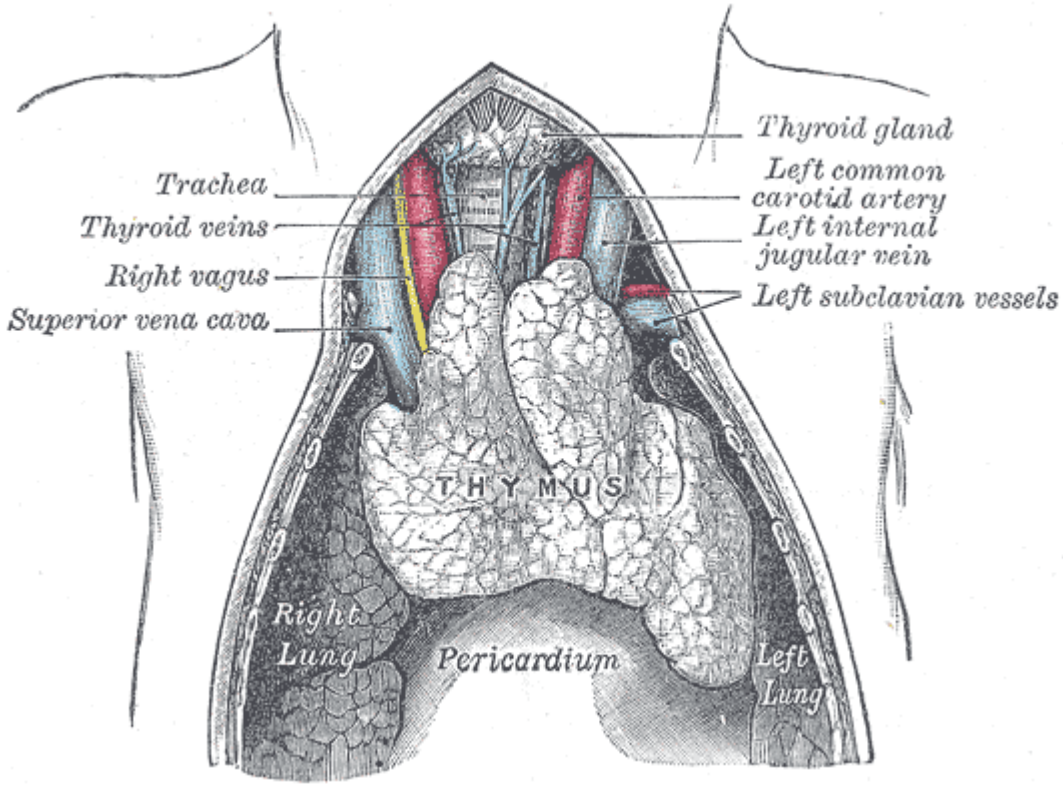
A CXR showing a normal thymus gland in a young child
http://en.wikipedia.org/wiki/File:Pthymousgland.png



File:Thoracic cavity of foetus 2.JPG
http://en.wikipedia.org/wiki/File:Thoracic_cavity_of_foetus_2.JPG



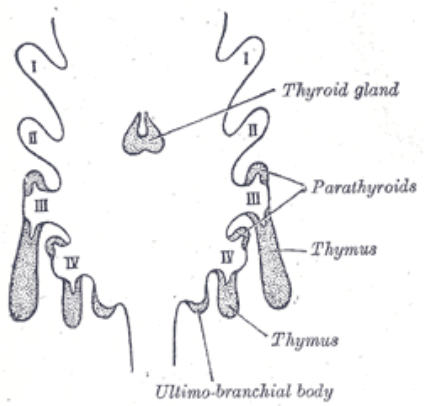
Anterior view of chest showing location and size of adult thymus
http://en.wikipedia.org/wiki/File:DH_thymus.jpg



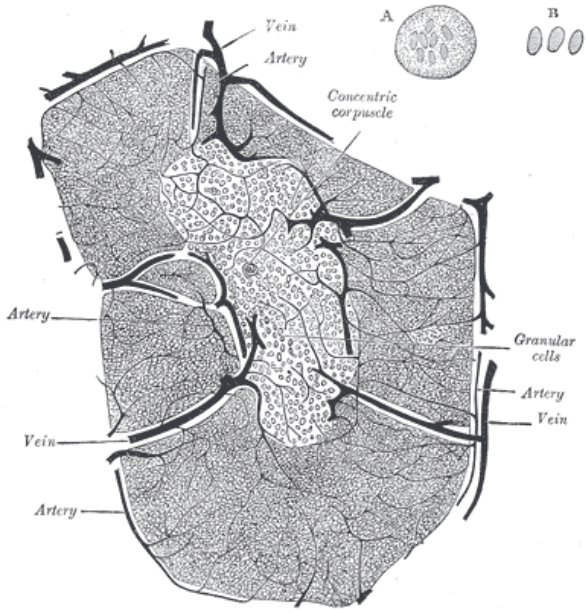
The thymus of a full-time fetus, exposed *in situ.*
http://www.bartleby.com/107/illus1178.html

Development
The thymus appears in the form of two flask-shaped entodermal diverticula, which arise, one on either side, from the third branchial pouch (Fig. 1175), (below) and extend lateralward and backward into the surrounding mesoderm in front of the ventral aortæ. Here they meet and become joined to one another by connective tissue, but there is never any fusion of the thymus tissue proper. The pharyngeal opening of each diverticulum is soon obliterated, but the neck of the flask persists for some time as a cellular cord. By further proliferation of the cells lining the flask, buds of cells are formed, which become surrounded and isolated by the invading mesoderm. In the latter, numerous lymphoid cells make their appearance, and are aggregated to form lymphoid follicles. These lymphoid cells are probably derivatives of the entodermal cells which lined the original diverticula and their subdivisions. Additional portions of thymus tissue are sometimes developed from the fourth branchial pouches. Thymus continues to grow until the time of puberty and then begins to atrophy.[21]

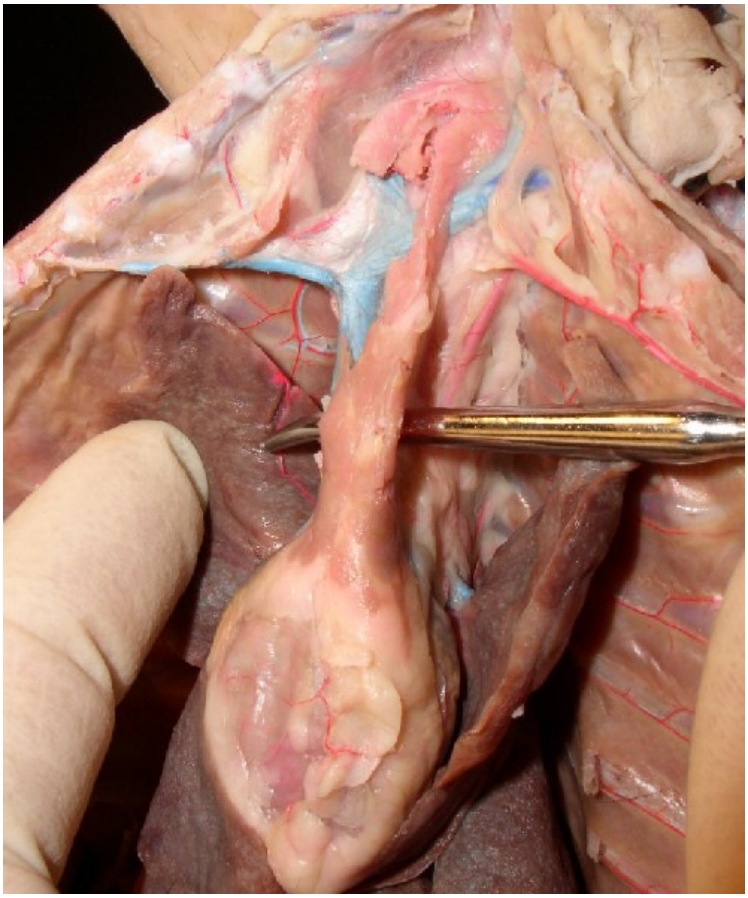
See illustrations below that show the thymus lobes in relation to the thyroid gland. In addition to the structure in a calf showing veins and arteries, a stained of a camel labeled A and B. The next photo is showing the thymus gland (although the reference failed to state if it was human or other) with the explanation that it is an endocrine gland attached to the heart in a crainoventral manner by connective tissues.



Scheme showing development of branchial epithelial bodies. (Modified from Koh.) *I, II, III, IV.*Branchial pouches.
http://www.bartleby.com/107/illus1175.html



Minute structure of thymus. Follicle of injected thymus from calf, four days old, slightly diagrammatic, magnified about 50 diameters. The large vessels are disposed in two rings, one of which surrounds the follicle, the other lies just within the margin of the medulla. (Watney.) *A* and *B.*From thymus of camel, examined without addition of any reagent. Magnified about 400 diameters.*A.* Large colorless cell, containing small oval masses of hemoglobin. Similar cells are found in the lymph glands, spleen, and medulla of bone. *B.* Colored blood corpuscles.
http://www.bartleby.com/107/illus1179.html



In this picture the probe is just under the thymus. http://anatomy.wikispaces.com/Thymus

Structure

Each lateral lobe is composed of numerous lobules held together by delicate areolar tissue; the entire gland being enclosed in an investing capsule of a similar but denser structure. The primary lobules vary in size from that of a pin's head to that of a small pea, and are made up of a number of small nodules or follicles.[22]

The primary lobules vary in size from that of a pin's head to that of a small pea, and are made up of a number of small nodules or follicles, which are irregular in shape and are more or less fused together, especially toward the interior of the gland. Each follicle is from 1 to 2 mm. in diameter and consists of a medullary and a cortical portion, and these differ in many essential particulars from each other. The cortical portion is mainly composed of lymphoid cells, supported by a network of finely branched cells, which is continuous with a similar network in the medullary portion. This network forms an adventitia to the blood vessels. In the medullary portion the reticulum is coarser than in the cortex, the lymphoid cells are relatively fewer in number, and there are found peculiar nest-like bodies, the concentric corpuscles of Hassall. These concentric corpuscles are composed of a central mass, consisting of one or more granular cells, and of a capsule which is formed of epithelioid cells (Fig. 1179). They are the remains of the epithelial tubes which grow out from the third branchial pouches of the embryo to form the thymus.[23] Each follicle is surrounded by a vascular plexus, from which vessels pass into the interior, and radiate from the periphery toward the center, forming a second zone just within the margin of the medullary portion. In the center of the medullary portion there are very few vessels, and they are of minute size.[24]

The thymus is formed from a diverticulum, on each side, from the entoderm lining the third branchial groove, but the connexion with the pharynx is soon lost. The lymphoid cells and concentric corpuscles are probably the derivatives of the original cells lining the diverticulum.[25]

Vasculature
The arteries supplying the thymus are derived from the internal mammary and from the superior thyroid artery and inferior thyroids. The veins end in the left brachiocephalic vein (innominate vein), and in the thyroid veins. The nerves are exceedingly minute; they are derived from the vagi and sympathetic nervous system. Branches from the descendens hypoglossi and phrenic reach the investing capsule, but do not penetrate into the substance of the organ.[26]

Watney (H. Watney (*Phil. Trans.,* 1882) has discovered haemoglobin, and apparently developing red blood corpuscles, in the thymus)[27] has made the important observation that hemoglobin is found in the thymus, either in cysts or in cells situated near to, or forming part of, the concentric corpuscles. This hemoglobin occurs as granules or as circular masses exactly resembling colored blood corpuscles. He has also discovered, in the lymph issuing from the thymus, similar cells to those found in the gland, and, like them, containing hemoglobin in the form of either granules or masses. From these facts he arrives at the conclusion that the gland is one source of the colored blood corpuscles.[28]

Vessels and Nerves
The arteries supplying the thymus are derived from the internal mammary, and from the superior and inferior thyroids. The veins end in the left innominate vein, and in the thyroid veins. The nerves are exceedingly minute; they are derived from the vagi and sympathetic. Branches from the descendens hypoglossi and phrenic reach the investing capsule, but do not penetrate into the substance of the gland.[29]

The lymphatics are described in the next paragraph because is warrants additional information to understand the relationship of the lymph to the thymus.

As previously mentioned above, we need to understand a bit about the lymphatic system so that when we begin to put all the systems together we will have a better understanding of how this system works with all the other systems. The lymphatic system is important because it is the one system that is closely tied to the immune system. However, we will shortly see that all the systems are related as far as the Thymus Gland is concerned.

The thymus is part of the immune system. In its lobules lymphocytes mature into T cells (where T stands for “thymus”) that behave in different ways according to their type. Some are passed into the bloodstream where they perform vital immune functions. Others remain in the thymus to give rise to future generations of T cells.[30]

Lymphatic System Primer & Other Systems
First off, we will need to know where the lymphatic system is and how it functions to bring the relationship together for the Thymus gland.

The lymphatic system is located throughout the body and has many components: Lymph nodes or glands are small round, oval or bean-shaped structures that are located at various locations throughout the body. The lymph nodes are connected to each other by a series of vessels called lymphatics, which carry lymph from place to place. Some lymph nodes lie along the surface of the body (along the neck, under the arms, in the groin, behind the knees), while others lie deep within the body (chest and abdomen).[31]

Then we need to understand the general structure of the lymphatic system, however, it is a complex and vital system primarily responsible for the transportation of lymph and for participating in many immune functions of the body.

Lymph is a milky fluid that flows throughout the system. It contains proteins, fats and a type of white blood cell called lymphocytes. Lymph is collected from the fluid of various tissues and eventually is returned to the blood circulatory system. The lymphatic system provides another route by which fluid can flow from distant tissues back into the blood stream, one that is separate from capillaries and veins. It also carries proteins and other substances away from tissues that cannot be removed or transported directly into the blood system.[32]

Similar to the blood circulatory system, the lymphatic system is comprised of fine channels that lie adjacent to the blood vessels. These lymphatic vessels eventually merge into a rather large vessel called the thoracic duct. As the lymph is carried from distant parts of the body, it is collected into larger and larger vessels until the vessels all converge in the chest and deposit the lymph in the large vein (cranial vena cava) leading to the right atrium of the heart.[33]

The lymph moves through the lymphatic vessels toward the lymph nodes. The lymph nodes lie at varying points along the course of the lymphatic chain and can form clusters in some areas of the body. Lymph nodes have a dense fibrous outer coating, called a capsule and are filled with white blood cells and spaces containing lymph fluid. Several types of white blood cells predominate in the lymph nodes, particularly lymphocytes, plasma cells, and macrophages.[34]

The lymphatic system filters and removes debris from the tissues of the body. Cells produce proteins and waste products. The lymph absorbs these products and carries them away from the tissues because they are often too large to be effectively absorbed and removed by the bloodstream.[35]

The lymph nodes filter out cellular waste products and foreign material in the lymph fluid, including potentially dangerous infectious particles like bacteria and viruses. They trap material received from the lymphatic vessels and provide a site for white blood cells to mount an immune response. They act as a barrier against the entrance of these foreign substances into the bloodstream. [36]

The important point to take away from all this explanation is the fact that the since the thymus cells are produced while still in the fetus, it is a very important part of the immune system in the newborn. It is the site where the earliest immune cells are made and where immune functions take place in the young animal. [37]

What is it With the Systems

Now we will attempt to put it all together and talk about all the systems and how they are related to the Thymus Gland. The Thymus Gland is part of many systems such as the immune system, circulatory system, endocrine system, nervous system and the neuroendocrine immune network. But mainly its role, as described earlier, is with the immune system. One would think that the primary system is the endocrine system because it is considered an endocrine organ as the reference states above. Because its role is so closely aligned with the immune system, therein “lies the rub” or should I say tap! No not beer tap. We will define that later when we begin to make the link between the thymus thump and homeostasis.

The endocrine system is the human body's network of glands that produce more than 100 hormones to maintain and regulate basic bodily functions. Hormones are chemical substances carried in the

bloodstream to tissues and organs, stimulating them to perform some action. The glands of the endocrine system include the pituitary, pineal, thyroid, parathyroids, thymus, pancreas, adrenals, and ovaries or testes. [38]

The endocrine system oversees many critical life processes. These involve growth, reproduction, immunity (the body's ability to resist disease), and homeostasis (the body's ability to maintain a balance of internal functions).[39]

The lymphatic system, functioning along with the circulatory system, absorbs nutrients from the small intestines. A large portion of digested fats is absorbed via the lymphatic capillaries. Fat absorbed from the small intestinal lymphatic capillaries or lacteals is termed chyle.[40]

We have travelled from the thymus gland all the way to the small intestines absorbing digested fats. As stated previously, it is attached to the heart in a crainoventral manner by connective tissues and it helps to mature T lymphocytes for immune system defense with Thymosin. Thymosin stimulates maturation of lymphocytes. Lymphocytes travel through the circulatory system and on and on with every system doing their respective functions. But why is it so special?

Gets Complicated

The reason that the thymus is a specialized organ of the immune system is because it "educates" T-lymphocytes (T-cell), which are critical cells of the adaptive immune system.[41]

The adaptive immune system, also known as the specific immune system, is composed of highly specialized, systemic cells and processes that eliminate or prevent pathogenic growth.
It is adaptive immunity because the body's immune system prepares itself for future challenges.[42]

From here on end, we can become complicated as for as these T cells or T lymphocytes, cell mediated immunity, antigen specific cytotoxic T-lymphocytes, etc. and how these things work at the cellular level. This is beyond the scope of this paper. The Notes list contains references for further reading on this topic. The important thing to take away from these complex definitions is how and where the thymus cells are developed from the get go.

We will now begin to tie the loose ends up to determine how taking care of the Thymus gland during massage techniques helps to enable homeostasis.

Making the Link

We have just observed how complicated and related all those systems are in relation to the immune system. All those cells that reside in all those systems were “born” or differentiated from either the Thymus (T Cells) or Bone Marrow (B Cells) and activated to perform their specific functions. So how does this relate to the thymus thump that is performed during PetMassage ™ and how can it help with health and well being?

Some research suggests that there is a communication link between the immune and nervous systems especially. A citing from this resource states that “complex bidirectional signaling occurs between the nervous and immune systems that impacts the functions of both systems. In response to stressors, the central nervous system has modulatory effects on the immune system through release of hormones, paracrine signals, and by direct contacts between nerves and immune cells. Conversely, in response to antigens and pathogens, immune system activation results in production of cytokines that induce altered neural activity”.[43]

Can we safely say now that the thymus gland is part of the Neuroendocrine Immune Network? How do they communicate? The nervous system and the immune systems communicate through hormones. The thymus continues to grow between birth and puberty and then begins to atrophy; this thymic involution is directed by the high levels of circulating hormones.[44]

New studies reveal that there may actually be a direct link between them. "There are remarkable similarities between the nervous system and the immune system.

- They both contain a variety of highly specialized cells, which are designed for specific tasks. This specialization begins early in development, but remains adaptable even in adult life.
- Memory is an essential feature of both the nervous and immune systems. The brain has the most sophisticated ability to record and recall information, but immune cells also carry biological intelligence gained over millions of years of evolutionary experience. These biological memories are encoded in our genes. They allow us to respond to new challenges as if we've already faced and overcome them in the past.
- Both systems are designed for adaptation, which is the ability to maintain a dynamic balance as previously mentioned homeostasis in an ever changing environment. The body is constantly evaluating incoming impulses and deciding if they are potentially nourishing or potentially toxic. Both the nervous system and the immune system participate in continuous, active surveillance of the surroundings. Useful input is welcomed, while potential threats are quickly identified and avoided.
- The many diverse cells of the nervous and immune systems communicate with each other via potent chemical messengers. Many of these messengers, initially called neuropeptides, are now also known as immunomodulators. Electron microscopes have captured fascinating images of one immune cell directly releasing a chemical messenger into an immune cell of a different type. This process is almost identical to the exchange of information that takes place when a nerve cell releases a neurochemical that travels across a gap, or synaptic cleft, and communicates with a neighboring neuron.

The close similarities in both form and function of the nervous system and immune systems suggest that the immune system can be thought of as a circulating nervous system. Immune cells respond to our ever changing states of mind and mood, whose fluctuations are reflected in the changing chemistry of our brain. In other words, our immune cells are constantly eavesdropping on our mind's internal dialogue."[45] Does this also happen to dogs? Why not. They experience a flight or fight response mechanisms just like us humans. They are either prey or preyed animals, so why wouldn't they be affected in the same way.

Emotions Playing a Role

Temple Grandin, in her book, Animals in Translation, states that animals experience emotion. She says that everyone uses emotion to make decisions. She says that in the brain, reason and logic are never separated from emotion. This, she says is important to understanding fear in an animal. "The single most important thing emotions do for an animal is to allow him to predict the future. Nature seems to have tried to wire animals and people to have *useful* emotions, useful meaning emotions that keep us alive by letting us make good predictions about the future, and good decisions about what comes next."[46] The point she makes about emotions is that it is necessary for survival. One example she sites is calm breeding of Lab dogs. The breeding involves taking out the startle out of Labs, so that when a car backfires, he won't jump and run off with the blind person he's supposed to be leading.[47]

In addition, Temple Grandin states that the body and brain aren't two different things controlled by two completely different sets of genes. Many of the same chemicals that work in your heart and organs also work in your brain, and many genes do one thing in your body and another in your brain.[48] Again, she was referencing the fact of selective breeding of animals. She said that if you over select for any trait at all, eventually you get neurological damage and neurological damage almost always means emotional damage, or at least important emotional changes. So the breeders for the selective breeding of particular traits only check for the physical trait but not the emotional or behavioral changes.[49]

So here we have the connection that emotion and neurons are related. If emotions come from the brain, can we think ourselves out of stress and disease? There are many publications and experiments on the mind/body phenomena. Way too many to get into. The explanation of the thymus cells was bad enough. Suffice it to say that, we have evolved a remarkable system to transmit our mental and emotional states into bodily reactions. Through the mind-brain-endocrine-immune-system network we continuously monitor our internal and external environment and orchestrate a response. These changes can happen instantaneously but have effects that extend well beyond the moment of the event. Learning how to influence these consequences is a hallmark of mind body approaches.

One way humans can influence these changes is through meditation. A relaxing massage may start you on your way. However, I was unable to find that any studies that were done on dogs meditating. Although, by performing a massage on them greatly accelerates their mind body connection. (PetMassage Workshop 2-2012.)[50]

So how does massage play into the role of the mental and emotional responses that is experienced by dogs? But first what is the purpose of massage. Among the many purposes of massage, one of them is to help relieve tension. Now habitual tension fatigues nerves and shortens muscles. Tension that has taken time to harden like cement in the body will take time to dissipate. Habitual tension weakens the stamina of the nerves that inform the body parts how to maintain proper physical alignment in order to maximize the energy flows in the channel. Over the years, habitual contractions shorten the length of the small muscles as well as their associated ligaments and tendons. Shortened muscles add to the aches and pains of maintaining the alignments. Tension activates the nerves (i.e. flight or fight response), the muscles contract, further shortening the muscles, pulling on the insertion points where they attach to bones and ligaments, which then causes fatigue and strain, which then causes blood circulation to diminish, which then blocks the chi in the energy channels. The blocked chi causes pain, which causes more tension and the whole process continues.

So what does a relaxing massage do? Relaxation comes from mentally letting go of habitual tension in the nerves. Can dogs do this? Why not? Nerve relaxation causes muscles to relax. When relaxation occurs, soft tissues and associated fluids; blood, lymph will gradually and gently pull on other soft tissues including ligaments, tendons, and especially fascia. This gentle pulling without tension gradually stretches soft tissues and thereby lengthens them. Large stretching movements are effective on big muscles but not the tiny muscles that are bound up with fascia. The fascia and shortened muscles and tendons will stretch in increments, with plateaus that need time to be transverse before advancing to the next increment. They will not stretch out instantaneously.

How quickly nerves will relax and subsequently strengthen, as well as how rapidly shortened muscles will stretch cannot be predicted. It depends on each individual dog. Just like us humans, all dogs have different genetic make ups and varying degrees of sensitivity and talent in connecting with internal subtle sensations. The presence or absence of trauma can also affect the rate of the process.

Full Circle – Remembering Galen

Taking a look at the spiritual, physical and metaphysical aspect as it relates to the Thymus Gland the world according to Dr. John Diamond's Your Body Doesn't Lie book, he states that in the second century Galen gave the name Thymus to the pinkish grey two lobed organ in the chest because it is said that it reminded him of a bunch of thyme. But the thyme plant itself was so named because it was burned as incense to the gods. Thymus, a Greek God was the rising up of smoke, a sacrificing to the Gods. It was aspiration, songs of praise, spirit and love. It was breath soul. The Thymus was the "seat of life energy". This aspiration took place in the chest cavity considered the inner altar. [51]

In Homer's works, *thumos* was used to denote emotions, desire, or an internal urge. *Thumos* was a permanent possession of living man, to which his thinking and feeling belonged. When a Homeric hero is under emotional stress he may externalize his *thumos*, conversing with it or scolding it. Plato's *Phaedru*s and his later work The *Republic* discuss *thumos* as one of the three constituent parts of the human psyche. In the *Phaedrus*, Plato depicts *logos* as a charioteer driving the two horses *eros* and *thumos* (i.e. love and spiritedness are to be guided by rationality). "In the *Republic* (Book IV) soul ... becomes divided into nous ("intellect"), thumos ("passion"), and epithumia ("appetite"). To its appetitive part are ascribed bodily desires; thumos is the emotional element in virtue of which we feel anger, fear, etc.; nous is (or should be) the controlling part which subjugates the appetites with the help of thumos."[52]

Dr. Diamond places great importance on the activation of the thymus gland in his practice. The thymus gland has many important functions. Among them are: (A) the production in early life of special lymphocytes called T-cells which are vitally important in immunological surveillance, which is directly concerned with resistance to infections and cancer, (B) the activation, after puberty, of the T-cells by thymus hormones, (C) involvement in the flow of lymph throughout the body, (D) the monitoring and regulation of energy flow throughout the body energy systems, initiating instantaneous corrections to overcome imbalances as they occur so as to achieve a rebalancing and harmony of body energy, and (E) the thymus serves as the link between mind and body, being the first organ to be affected by mental attitudes and stress. Hence activation and stimulation of the thymus is an essential, primary foundation of achieving and maintaining positive health.[53]

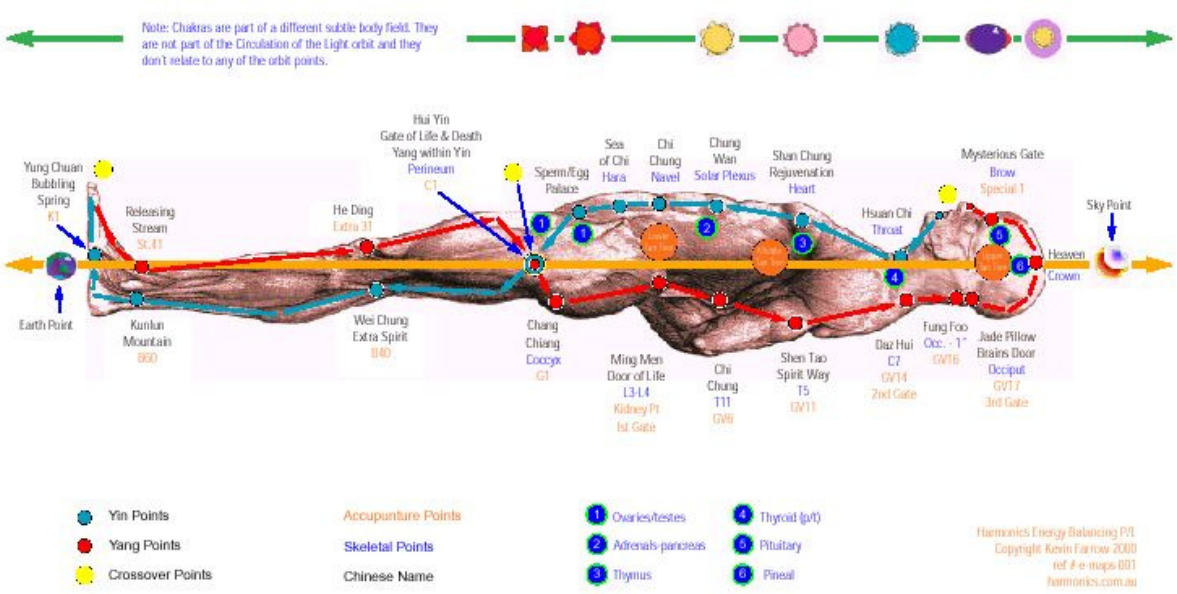
The Goal

The goal of attaining and maintaining health is by obtaining an optimal balance in mental (mind) and emotional (heart) state. Western medical experts refer to this healthy balance as homeostasis. The key to achieving this balance is by relaxation. However, this is easier said than done. The intent of the pet massage practitioner is to be relaxed and to relax the dog. This relaxation depends on intent. If the massage practitioner is relaxed and calm, then the dog will respond with being relaxed and calm. So how does one become relaxed? From breathing properly. Taoist Breathing Techniques offers techniques to train your awareness so that you can become conscious of the inside of your physical body and its energies.[54]

How this relates to the Thymus gland is twofold. As we just proved that the Thymus Gland is affected by the nervous system and the immune system which are connected to the circulatory system, endocrine system, etc. The physical location of the Thymus Gland is in the Heart Chakra, Ayurvedically speaking. It is also associated with the thymus gland. If there is an imbalance in the Heart Chakra, some of the physical situations that may occur are high blood pressure, asthma, allergies, cardiovascular and respiratory disorders, upper back and shoulder problems. There is much more to it when we look at the emotional aspects. The Heart Chakra is our center of love, hope, trust, forgiveness and compassion, so if there is an imbalance, some of the emotional issues are said to be insincerity, difficulty accepting or giving love, self-centeredness, loneliness, lack of commitment, resentment and bitterness. [55] (Deepak Chopra Seminar 5-2009). This correlates to what the Greek physicians and Galen were saying all along.

Secondly, it is all about intention. Isn't that the difference between petting the dog and massage? The following description of the Thymic chakra is by John O'Neill. The Thymic chakra is where "intent" originates; it is the link between the emotions of the heart and the reason of language. It is what makes you inhale a breath before you speak, since this is where the intent behind the words you are about to speak actually starts forming.[56] He continues to describe…..
'So, lets say that your heart feels a certain way about something that it would like to voice. The energy shoots up to the Throat chakra but passes through the Thymic chakra first, giving it a heads up to start getting prepared to speak by drawing a breath - or by stopping the breath to prevent you from speaking. This is why you don't always say what's on the tip of your tongue. This is also why emotions can wreck havoc with your health, as the Thymic chakra can be bombarded by emotions to the point of fatigue. When the Crown chakra speaks, on the other hand, it sends its energy down through the Brow chakra which embellishes it.. The result is creative expression which may or may not be truthful. The Thymic chakra acts as something of a "lie detector" by interfering with energy that is not truthful. This is why we have trouble speaking when we are upset. The flow of energy from the heart is always meant to be peaceful and that's really the only kind of energy that the Thymic chakra "understands"'.[57]

So what does this mean? It means that the seven chakras of the yogic system are gateways to consciousness and the three dantiens of the Chinese system are also gateways to the different levels of consciousness. Does that mean that the Thymus Gland could possibly be part of one of those gateways? Seems that way. See the chart that shows the chakras and their relationships.



http://www.kheper.net/topics/chakras/major_and_minor.html

Summary/Conclusion
It all starts with breathing and intention. We breathe in and out; Yin and Yang. We breathe in oxygen and exhale carbon dioxide. We inhale goodness, we exhale grief, sorrow, things that do not serve us any longer. Our soul's desire is to achieve everlasting love. Think there is a song by this name. Our thymic cells begin in the womb and differentiate and activate to become our guardians to our bodies to protect us physically/internally. Love protects us spiritually/internally. When it's functioning well, the immune system is a magnificently complex and coordinated sequence of responses. The ability to cope with

immune challenges will always be around. It is how we choose to deal with them to balance ourselves to achieve homeostasis. A good and sound way is to relax, breathe, and focus intent on being well. It starts with us and we pass it on to the dogs we massage. They know it, they feel it, and they will mostly appreciate it. By tapping the thymus by performing the thymus thump, we awaken those immune cells through the vibration of tapping. And the communication with all those systems we mentioned previously - begins. The end.

Bibliography

[1]http://books.google.com/books?id=hTI8arzsI-8C&pg=PA1&lpg=PA1&dq=seat+of+the+soul+thymus&source=bl&ots=c5KOij3uP4&sig=KqJLf2kVNFs9v60ylMpfPk85iMI&hl=en&sa=X&ei=rpHLT5KyIcHL2QWqxsXZCw&ved=0CFMQ6AEwBTgK#v=onepage&q=seat%20of%20the%20soul%20thymus&f=false

[2]http://plato.stanford.edu/entries/pineal-gland/

[3]http://en.wikipedia.org/wiki/Galen

[4]http://en.wikipedia.org/wiki/Thymus

[5]COLIN BLAKEMORE and SHELIA JENNETT. "Galen." The Oxford Companion to the Body. 2001.*Encyclopedia.com.* 12 Mar. 2012 <http://www.encyclopedia.com>

[6] ibid.

[7]http://radiology.rsna.org/content/210/1/11.full

[8]http://en.wikipedia.org/wiki/Jacques_Miller

[9]http://en.wikipedia.org/wiki/Thymus and http://onlinelibrary.wiley.com/doi/10.1034/j.1600-065X.2002.18502.x/abstract

[10]"thymus" 2009. *Encyclopedia.com.* (February 29, 2012) http://www.encyclopedia.com/doc/1O999-thymus.html

[11]http://www.encyclopedia.com/topic/thymus_gland.aspx#2

[12] http://www.buzzle.com/articles/organs-of-the-immune-system.html

[13]http://www.petplace.com/dogs/structure-and-function-of-the-lymphatic-system-in-dogs/page1.aspx

[14]http://www.encyclopedia.com/topic/Endocrinology.aspx#1-1G2:3438100274-full

[15]http://medical-dictionary.thefreedictionary.com/thymosin and http://www.howtodowell.com/entry/The-Thymus-The-Massage-connection-ANATOMY-AND-PHYSIOLOGY

[16]http://www.petplace.com/dogs/structure-and-function-of-the-lymphatic-system-in-dogs/page1.aspx

[17]http://www.nationmaster.com/encyclopedia/Thymus-gland

[18]ibid.

[19]The Oxford Pocket Dictionary of Current English. 2009. *Encyclopedia.com.* (February 29, 2012). http://www.encyclopedia.com/doc/1O999-thymus.html

[20]Gray, Henry. *Anatomy of the Human Body.* Philadelphia: Lea & Febiger, 1918; Bartleby.com, 2000. www.bartleby.com/107/. [Date of Printout].
[21]ibid. and http://www.nationmaster.com/encyclopedia/Thymus-gland
[22]http://en.wikipedia.org/wiki/Thymus
[23]Gray, Henry. *Anatomy of the Human Body.* Philadelphia: Lea & Febiger, 1918; Bartleby.com, 2000. www.bartleby.com/107/. [Date of Printout]. and http://www.nationmaster.com/encyclopedia/Thymus-gland
[24]ibid.
[25]http://www.1911encyclopedia.org/Ductless_Glands

[26]http://en.wikipedia.org/wiki/Thymus
[27]http://www.1911encyclopedia.org/Ductless_Glands
[28]Gray, Henry. *Anatomy of the Human Body.* Philadelphia: Lea & Febiger, 1918; Bartleby.com, 2000. www.bartleby.com/107/. [Date of Printout]. and http://www.nationmaster.com/encyclopedia/Thymus-gland
[29]ibid.
[30]http://www.nationmaster.com/encyclopedia/Thymus-gland
[31] http://www.petplace.com/dogs/structure-and-function-of-the-lymphatic-system-in-dogs/page1.aspx
[32]ibid.
[33]ibid.
[34]ibid.
[35]ibid.
[36]ibid.
[37]ibid.
[38]"Endocrine System." UXL Encyclopedia of Science. 2002. *Encyclopedia.com.* 12 Mar. 2012<http://www.encyclopedia.com>.
[39]ibid.
[40]http://www.petplace.com/dogs/structure-and-function-of-the-lymphatic-system-in-dogs/page1.aspx
[41]http://en.wikipedia.org/wiki/Thymus
[42] http://en.wikipedia.org/wiki/Adaptive_immune_system
[43]http://rd.springer.com/referenceworkentry/10.1007/978-0-387-30398-7_4. Age-Related Alterations in Autonomic Nervous System Innervation of Lymphoid Tissue.
[44]http://en.wikipedia.org/wiki/Thymus
[45]"The Wisdom of Healing", Dr. David Simon, M.D., Chaper 13, *Psychoneuroimmunology – Mind, Body, and Immunity*, p.194-4.
[46]"Animals in Translation", Temple Grandin, Chapter 3, *Animal Feelings, Breeding Emotions*, p.127-8.
[47] ibid.
[48] ibid.
[49] ibid.
[50]PetMassage Workshop, 2-2012.
[51]"Your Body Doesn't Lie", Dr. John Diamond, M.D., p.129.
[52]http://en.wikipedia.org/wiki/Thymos
[53] http://www.drjohndiamond.com/qdiamond-wikipediaq/129-thymus-gland-the
[54]"Relaxing into Your Being", B.K. Frantzis, Chapter 1, *Connecting with Chi*, p.39.
[55] Deepak Chopra Seminar, 5-2009.
[56]http://www.kheper.net/topics/chakras/Thymic.htm
[57]ibid.

Notes
For additional reading

- Felten, S.Y., and D.L. Felten. 1991. Innervation of lymphoid tissue. In P*sychoneuroimmunology,* ed. R.Ader, D.L.Felten, and N. Cohen, 27-69. San Diego: Academic Press.
- Renoux, G. and M. Renoux. 1992. The positive regulation of T-cells by the neocortex is likely to involve a dopamine pathway. In *Psychoneuroimmunology*, ed. Schmoll, U. Tewes, and N.P. Plotnikoff, 39-47. Lewiston, N.Y. :Hogrefe and Huber Publishers.
- Nossal, G.J.V.1993. Life, death and the immune system. *Scientific American* 269:52-62.
- The Oxford Pocket Dictionary of Current English. 2009. *Encyclopedia.com.* (February 29, 2012). http://www.encyclopedia.com/doc/1O999-thymus.html
- "thymus gland." The Columbia Encyclopedia, 6th ed.. 2008. *Encyclopedia.com.* 29 Feb. 2012 <http://www.encyclopedia.com>.
- MICHAEL ALLABY. "thymus." A Dictionary of Zoology. 1999. *Encyclopedia.com.* 29 Feb. 2012 <http://www.encyclopedia.com>.
- "Endocrine System." UXL Encyclopedia of Science. 2002. *Encyclopedia.com.* 12 Mar. 2012<http://www.encyclopedia.com>.
- http://en.wikipedia.org/wiki/Cell-mediated_immune_response
- http://www.banyanbotanicals.com/yoga/kapha/thymus.html **Kapha Focus:** Fully filling the lungs as you tap the chest. **Benefits:** stimulates the thymus gland which builds immunity and massages the lungs, heart, bronchial tubes and throat through the vibration of the tapping.

- http://www.kheper.net/topics/chakras/Thymic.htm Just as this chakra acts as a bridge in waking life, between emotion and reason, it also acts as a bridge in dreaming, but in a totally different way. If you have ever had a dream about a person that you would later meet in real life, then you were using this chakra in your dream. If this chakra is open in your "dreaming body" then you will be able to connect your dreams with actual reality, that is, the subject matter of your dreams will be the actual waking world instead of a representation of it. If this chakra is closed in the waking body then the individual will not have the intent to express their emotions even though they can feel them and actually know what they want to say. Correspondently, if this chakra is closed in the dreaming body then you will not have the intent to bridge the chasm between dreaming and waking from the dreaming side, to visit this world while you are asleep. One last important point to mention is that there is a certain vulnerability that this chakra has to being manipulated by outside forces while either awake or dreaming. The end result is the same, you end up dreaming somebody else's dream and sharing their intent for better or worse. The symbol for the Thymic chakra in waking is a map rolled up like a scroll, it represents the path of one's life. The symbol for this chakra in dreaming is a pair of wings, representing the ability to cross the chasm of the unknown under one's own power.
- "thymus gland." The Columbia Encyclopedia, 6th ed.. 2008. *Encyclopedia.com.* 29 Feb. 2012 <http://www.encyclopedia.com>. **thymus** An organ, present only in vertebrates, that is concerned with development of lymphoid tissue, particularly the white blood cells involved in cell-mediated immune responses (see T cell). In mammals it is a bilobed organ in the region of the lower neck, above and in front of the heart. The thymus undergoes progressive shrinkage (involution) throughout life, starting after the first 12 months. Haemopoietic stem cells from the bone marrow migrate to the thymus, attracted by chemotactic factors, and begin to divide and differentiate to form the many subpopulations of T cells. As their progeny cells migrate through the thymus from its cortex to medulla, they interact with thymic ‘nurse cells’ and with each other and are influenced by various extracellular proteins and thymic peptide hormones (e.g. thymosin and thymopoietin). All these

factors help to promote the differential expression of surface antigens and development of distinctive immunological competences.

- http://www.holisticwebs.com/sound/thymus.html The Thymus Chakra, Immune System & Sound Healing, Renee Brodie, The Healing Tones, of Holographic Sound Healing techniques.
- http://www.acupuncture-and-chinese-medicine.com/thymus-tapping.html
- http://www.indiadivine.org/audarya/ayurveda-health-wellbeing/915188-thymus-gland.html
- See also autoimmune disease; immune system; lymphatic system.
- http://en.wikipedia.org/wiki/File:Hematopoiesis_simple.svg
- http://en.wikipedia.org/wiki/Hematopoiesis
- http://upload.wikimedia.org/wikipedia/commons/6/69/Hematopoiesis_%28human%29_diagram.png
- http://en.wikipedia.org/wiki/Hematopoiesis
- http://upload.wikimedia.org/wikipedia/commons/thumb/6/63/Hematopoesis_EN.svg/2000px-Hematopoesis_EN.svg.png
- http://upload.wikimedia.org/wikipedia/commons/a/a1/Hematopoietic_growth_factors.png
- http://en.wikipedia.org/wiki/Multipotent_hematopoietic_stem_cell
- http://en.wikipedia.org/wiki/File:Blood_cells_differentiation_chart.jpg
- http://en.wikipedia.org/wiki/T_cell
- http://en.wikipedia.org/wiki/Adaptive_immune_system
- http://en.wikipedia.org/wiki/Naive_T_cells
- http://en.wikipedia.org/wiki/Cell-mediated_immune_response