The lymphatic drainage of the faucial tonsils / by George Bacon Wood.

The Lymphatic Drainage of the Faucial Tonsils.

BY

GEORGE BACON WOOD, M.D.,

OF PHILADELPHIA.

FROM THE

AMERICAN JOURNAL OF THE MEDICAL SCIENCES,

AUGUST, 1905.

Extracted from the American Journal of the Medical Sciences, August, 1905

THE LYMPHATIC DRAINAGE OF THE FAUCIAL TONSILS.[1]

By George Bacon Wood, M.D.,
of Philadelphia.

(From the Wistar Institute of Anatomy, University of Pennsylvania.)

That various micro-organisms may gain access to the general system through the tonsillar tissues of the throat has been so firmly established that it is not necessary again to demonstrate the absorbing properties of the tonsils and to point out the various infections which may enter through this portal. The fate of the micro-organisms which have entered the parenchyma of the tonsil is dependent upon two factors: first, the pathogenic potency of the germ itself, and, second, the vital resistance offered by the tissues to its invasion. If a non-pathogenic germ enters a crypt it is destroyed probably by the phagocytosis of outwandering polymorphonuclear leukocytes. On the other hand, if the vitality of the germ is sufficiently great, it lives and may penetrate through the epithelium into the interfollicular tissue.

It has been proven by several very thorough and capable investigators that foreign bodies in the crypts can pass through the epithelium into the interfollicular tissue. This absorption is probably dependent upon two factors: first, the action of the muscles of the throat during their various physiological movements, and, second, the presence of a lymph current in the tonsil. The palatoglossal muscle and the palatopharyngeal muscle during deglutition compress the faucial tonsil and force the centrally lying movable bodies toward the periphery. If the foreign body is at the bottom of the crypt it is pushed in an outward direction, and, finding no appreciable barrier in the differentiated epithelium, passes into the tonsil parenchyma. The second factor in the absorption of foreign bodies from the crypts is the constant production of lymphoid cells in the follicles. The interfollicular tissues of the tonsils consists of a fine connective-tissue reticulum interspersed with numerous lymphoid cells. These lymphoid cells may be looked upon as being in constant motion, passing from the follicles in the direction of least resistance. If the cellular metamorphosis of the epithelium has weakened this barrier so that the crypt is in the direction of least resistance, the lymphoid cells break through and pass into the crypt, but more commonly the lymphoid cells pass into the lymph spaces

[1] Candidate's thesis. American Laryngological Association, June, 1905.

which terminate in the trabeculæ of the tonsil and which in their turn empty into the efferent lymphatics of the tonsil. Therefore, the production of lymphoid cells in the follicles causes what we might term a lymphoid current, and this lymphoid current, except when there is an accidental rupture of the cryptal epithelium, is toward the connective-tissue trabeculæ of the tonsil and thence through the lymph radicles to the periphery. A foreign body having gained access to the interfollicular tissue must be influenced by this current. I understand thoroughly that in advancing this idea, I am open to criticism for theorizing about a scientific subject. It seems to me, however, that the above is a probable explanation of the mechanism of tonsillar absorption and helps to substantiate the theory that the faucial tonsil is more important as a source of infection than is the lymphoid tissue on the lateral folds and posterior pharyngeal wall of the pharynx. As regards the absorption of living virulent micro-organisms, it must be remembered that bacteria are not inert foreign bodies, but possess certain vital properties which influence their entrance into living tissue. When uninfluenced by extraneous forces a micro-organism invades living tissue by two methods: first, if it belongs to the motile class the individual bacterium by its own locomotion may carry itself to some more or less distant spot, and, second, micro-organisms may invade tissue by the very act of their growth. This last is the most important method by which the pathogenic germs gain entrance into their host.

It is practically impossible to establish with absolute certainty the relative importance of the different lymphatic masses in the throat as gates of infection. Circumstantial evidence, however, both clinical and experimental, tends to show that the larger the lymphatic mass and the deeper its crypts, the more readily do pathogenic germs pass through the tonsillar tissues to the tonsillar efferents.

The research outlined in this paper is a preliminary report of a series of investigations concerning the lymphatic anatomy and drainage of the tonsils and surrounding portions of the throat. My first investigations concern the faucial tonsil, because in the etiology of infections it is the most important tonsillar structure, and I have not been able to find any reliable published data concerning the glands that receive its efferent lymphatics.

The lymphatic glands of the neck constitute one of the most important chains of glands in the whole body and is probably the chain which is most frequently diseased. The infection which inoculates a lymph gland may possibly come through its efferent lymphatics by a retrograde thrombosis, but much more frequently it follows the current of the lymph stream and enters through the afferent vessels. In the large majority of cases the infection of the cervical lymphatics comes from the nose, mouth, or throat. As a general rule, the efferent lymphatic vessels from a given structure

drain into that lymphatic gland which is nearest it, and, therefore, to understand the importance of the different structures of the nose, throat, and mouth as portals of infection it is essential to have clear in our minds the topographical relations of the deep and superficial lymph glands.

The cervical glands of the neck are divided into two main groups, the superficial or collecting glands and the deep or terminal glands. The superficial are arranged as a sort of collar around the upper part of the neck, with a few irregular extensions. This pericervical glandular circle is composed of the following subgroups:

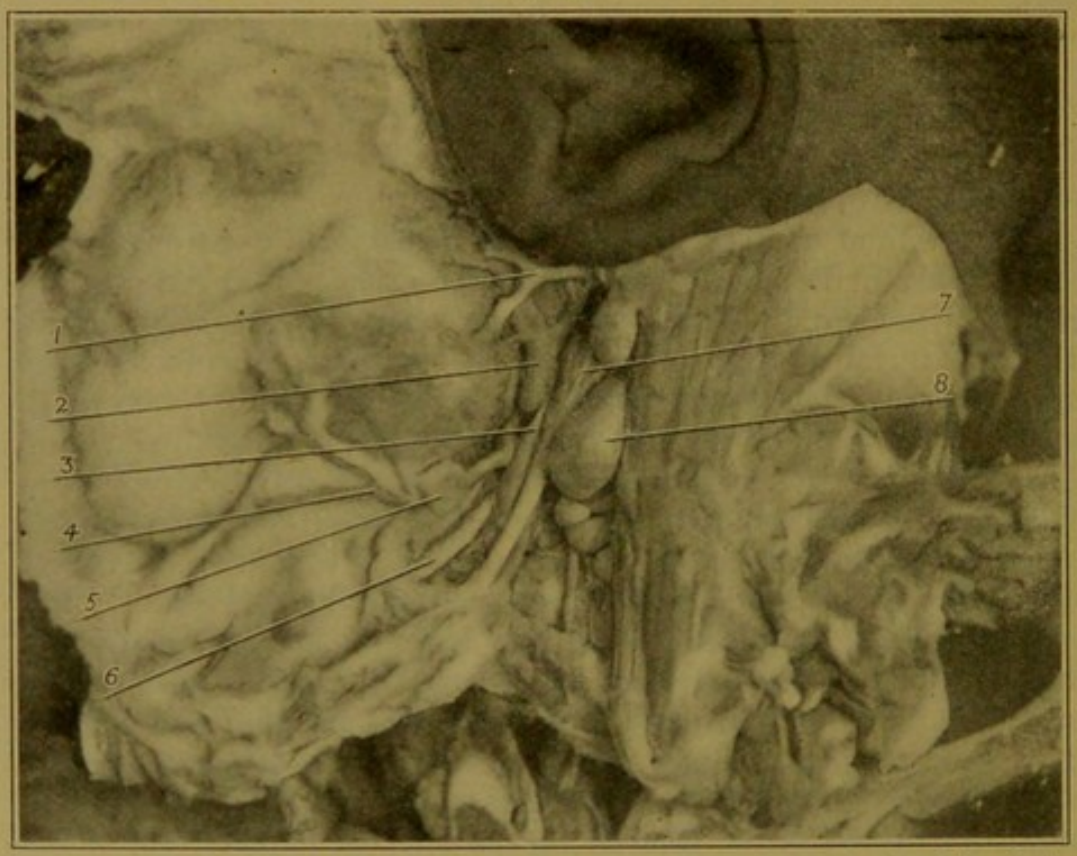
1. Suboccipital group and aberrant glands of the nape of the neck.
2. The mastoid group.
3. The parotid and subparotid groups.
4. The submaxillary group with the facial glands as an offshoot.
5. The submental glands.
6. The retropharangeal glands.

The terminal or deep glands of the neck form a perpendicular chain beneath the sternocleidomastoid muscle. This main set of glands is flanked by several secondary chains of less importance. The superficial glands constituting the pericervical collar receive their afferents from those portions of the external and internal head, which are in more or less close relation with the individual group. The efferents of all these collecting glands empty into the deep chain. The deep cervical lymphatics or the substernocleidomastoid glands constitute in appearance a continuous chain, but for convenience sake they may be divided into an external and internal group. The external glands are placed posteriorly and rest indiscriminately on the insertions of the splenius, levator anguli scapulæ, and scalene muscles, and they are usually continuous with the glands occupying the supraclavicular triangle. The internal glands of the substernocleidomastoid group may be termed the internal jugular chain, because they rest either directly on the internal jugular vein or are immediately adjacent to its external border. The glands of this subgroup are larger than the glands of the external, and some of them are fairly constant in their position. One or two large glands are constantly found beneath the posterior belly of the digastric, just above the spot where the thyrolingual facial vein opens into the internal jugular. A few glands are sometimes found between the internal jugular and the prevertebral muscles. These two main groups of deep glands, the external and internal chains, are united by a great many anastomoses. The external glands receive their afferents from the posterior part of the head and neck, while those of the internal group receive their afferents from the anterior portion of the neck and head, from the mouth, nose, pharynx, larynx, and thyroid body. While the majority of the afferents of the deep glands of the neck are the efferents from the superficial glands, quite

a number of lymph vessels pass directly from the lymph radicles of the throat and nose to the deeper chain of glands. For instance, the majority of the lymph vessels from the vault of the pharynx drain into the retropharyngeal glands, but some of them pass directly to the upper glands of the deep cervical chain without any interruption.

The method of injection employed in the present research was essentially that devised by Gerota. It consisted in rubbing up Berlin blue with pure spirits of turpentine until it assumed the consistency of a rather thin, syrupy liquid. A small quantity of ether is added

FIG. 1



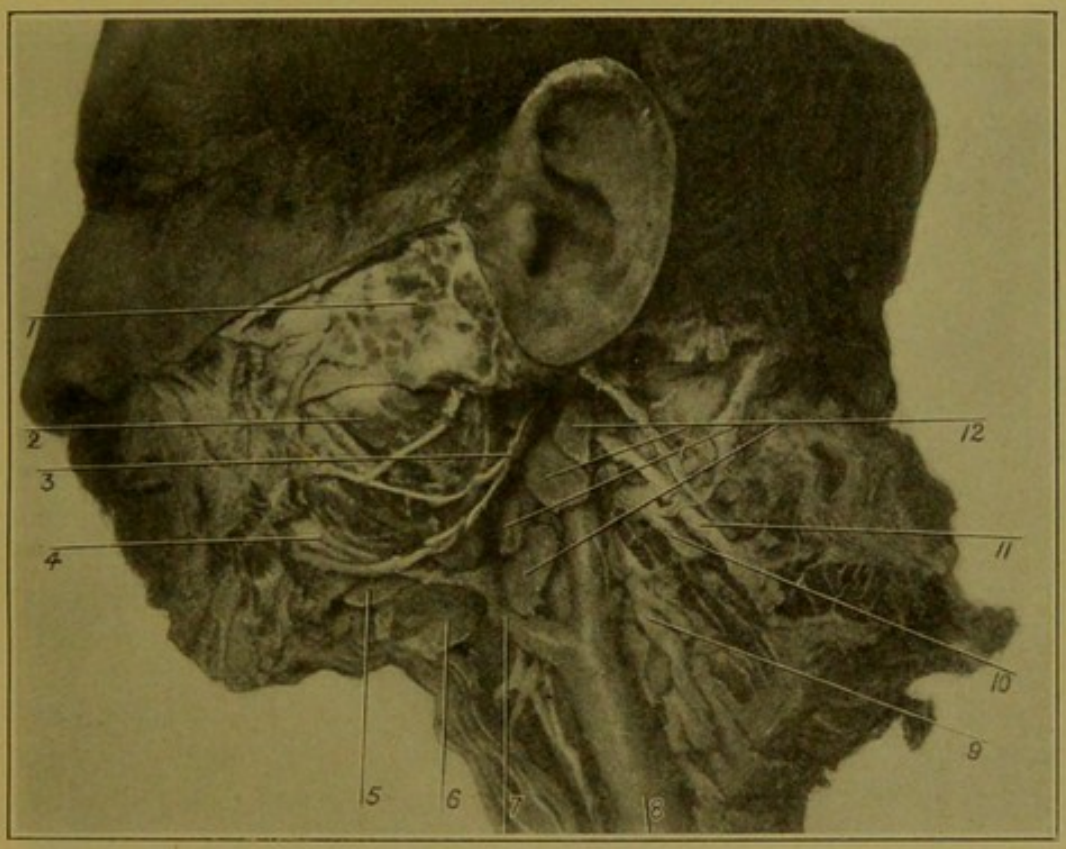
Dissection of the neck of a child, showing an enlarged tonsillar lymph gland and its relation to the digastric and stylohyoid muscles: 1, facial nerve; 2, external carotid artery; 3, stylohyoid muscle; 4, facial artery; 5, submaxillary lymph gland; 6, hypoglossal nerve; 7, posterior belly of the digastric muscle; 8, tonsillar lymph gland.

and the mixture filtered through chamois skin. The coarser granules of the Berlin blue are held back in the filter while a clear, thin, blue liquid passes through as the filtrate. Gentle agitation of the fluid while it is filtering ensures a better mixing of the turpentine, ether, and Berlin blue, consequently a deeper color to the filtrate. The injecting apparatus consisted of a fine glass needle drawn out of a glass tube and attached by a piece of rubber tubing to the nozzle of an easy-working syringe holding about 10 c.c.

The glass needle was inserted beneath the mucous membrane covering the tonsil and held very carefully in its place, while an

assistant made gentle but gradually increasing pressure, according to the ease with which the fluid entered the tonsil. The amount injected was regulated somewhat by the amount of resistance felt in the syringe and also by the distention of the tonsillar tissues. If the injection was properly made the tonsil gradually swelled out becoming two or three times its normal size and of a deep-blue color. The blue fluid in such injections must not be forced in hurriedly, as a certain amount of time is necessary for it to find its way into the lymph spaces and thence through the lymph radicles to the

FIG. 2



Dissection of the neck of an adult, showing enlarged internal jugular lymph glands: 1, parotid gland; 2, masseter muscle; 3, facial nerve; 4, facial artery; 5, submaxillary lymph gland; 6, submaxillary salivary gland; 7, thyrofacial lingual vein; 8, internal jugular vein; 9, brachial plexus of nerves; 10, superficial cervical plexus; 11, spinal accessory nerve; 12, internal jugular lymph glands.

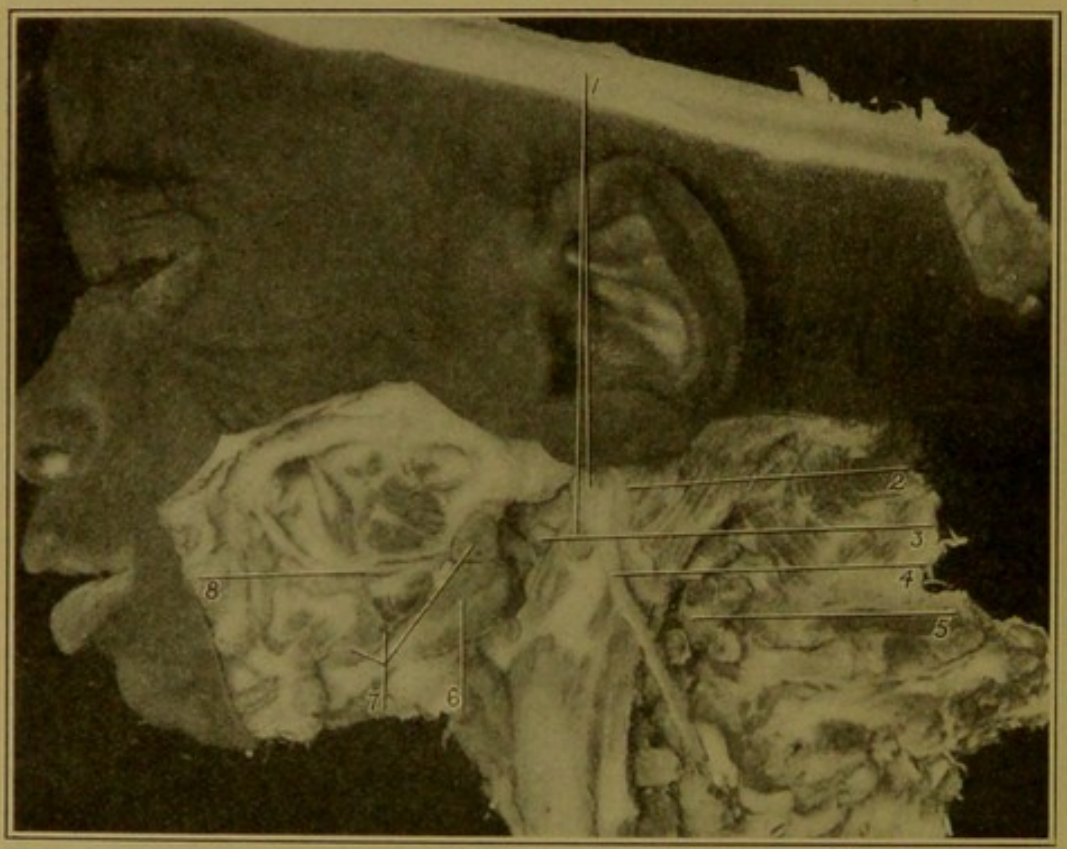
lymph vessels. In injecting the tonsil, it frequently happens that the fluid returns through the crypts. In the case of this regurgitation being so free that internal pressure cannot be exerted, the point of the needle is to be changed until a position is found from which the injected material does not so readily gain access to the crypts. After the injection has been made the excess of material should be washed from the surface by a stream of cold water. Gentle massage of the tonsil with the finger tends to force the injected fluid farther into the tissue. It is best to leave the fresh material in plain

water for several hours before fixing it in 10 per cent. formalin. After fixing the specimen the dissections may be made and the injected gland sought for, special care being exercised to avoid wounding any of the injected lymph vessels

Eight injections were made, some of them resulting in failure, but the majority showing distinctly that the tonsillar lymph follows a fairly constant route. The direction of this drainage as established by these injections is as follows:

The lymph vessels pass from the external portion of the tonsil through the peritonsillar connective tissue, the pharyngeal aponeu-

FIG. 3



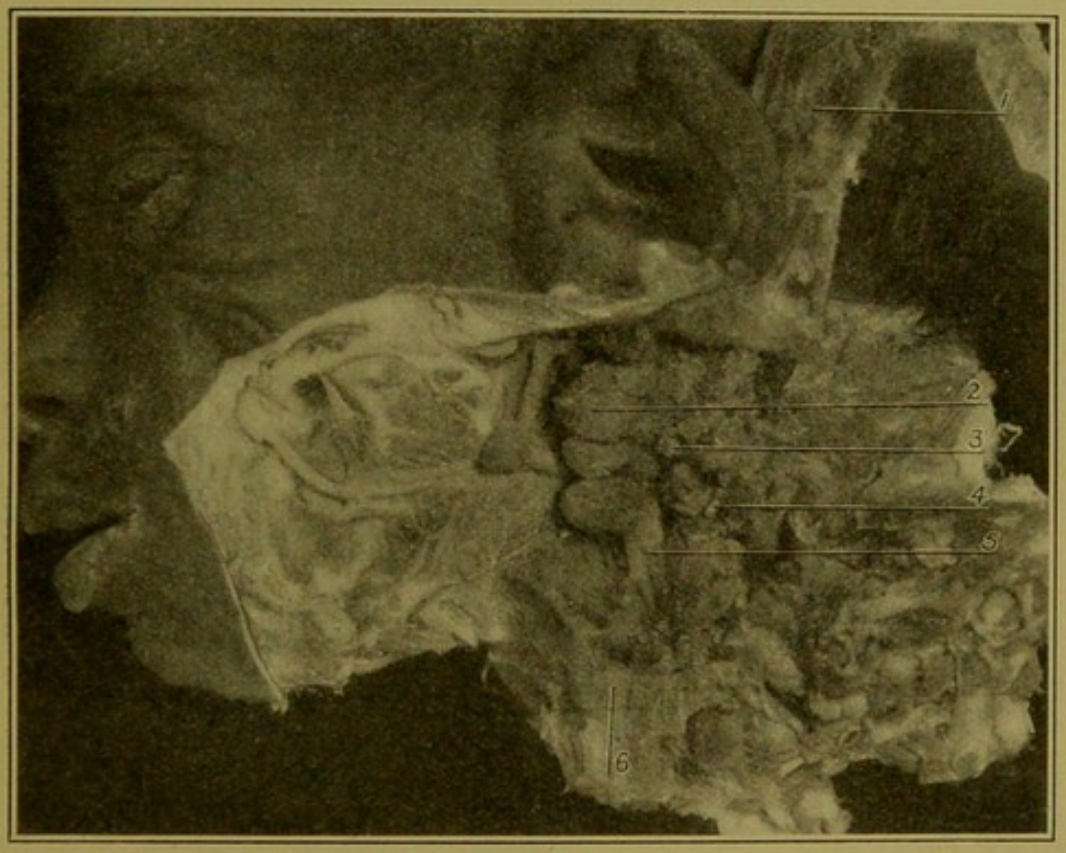
Superficial dissection of Specimen No. VI., showing enlarged tonsillar lymph gland projecting just beyond the edge of the sternocleidomastoid muscle: 1, external jugular lymph glands; 2, great auricular nerve; 3, tonsillar lymph gland; 4, external jugular vein; 5, external glands of the substernomastoid group; 6, submaxillary salivary gland; 7, submaxillary lymph glands; 8, facial artery.

rosis, and the superior constrictor of the pharynx, and, as one or two or more fine small vessels run obliquely in a downward, posterior, and outward course, passing below the facial artery. Bending more posteriorly the lymph vessels next run between the internal jugular vein and the stylohyoid muscle, reaching finally the superior surface of an enlarged lymph gland, placed just beneath the anterior border of the sternocleidomastoid muscle, where it is crossed by the posterior belly of the digastric muscle. The efferent vessels from this gland are generally two or three in number, and pass into the neighboring glands of the internal jugular group. Further

anastomoses which connect the lower glands of the internal jugular group with those receiving the tonsillar drainage form a complete lymph channel, through which the tonsillar lymph finally empties into the jugular lymph trunk.

In none of the preparations did the injected fluid enter into superficial glands, except in one case, where there was an aberrant gland lying on the facial artery near its origin. This gland seemed to be simply an interrupting nodule in the course of the tonsillar efferents. The statement in some text-books on anatomy that the tonsil drains

FIG. 4



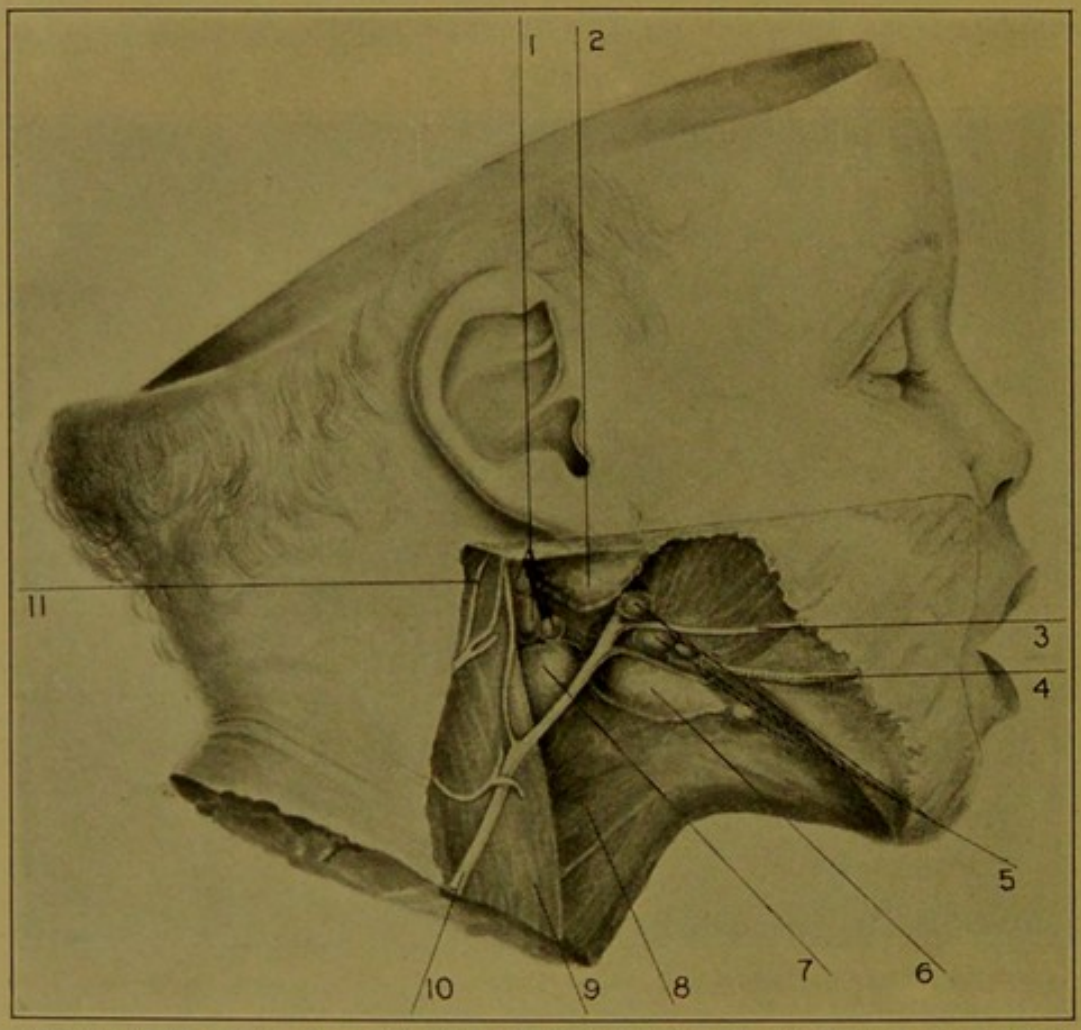
Deep dissection of Specimen No. VI., showing the tonsillar lymph gland and its relation to the substernomastoid group: 1, reflected sternocleidomastoid muscle; 2, tonsillar lymph gland; 3, spinal accessory nerve; 4, branch of cervical plexus; 5, internal jugular vein; 6, omohyoid muscle.

into the posterior gland of the submaxillary group would seem to be absolutely erroneous and very misleading.

Clinically, the gland which becomes enlarged during tonsillar infection appears to be superficial and possibly it is this appearance that has led to the belief that the posterior gland of the submaxillary group is infected through the tonsils. The tonsillar gland, if I may be pardoned for using the term, is placed external and slightly anterior to the internal jugular vein and is embedded in loose areolar tissue containing more or less fat. Consequently, enlargement of this gland means its dislocation outward and forward, and especially

so if the other glands of the internal jugular group become subsequently enlarged; also the action of the substernocleidomastoid muscle would tend to force it anteriorly. If an enlarged gland found at the angle of the jaw belongs to the deep substernocleidomastoid group, it may be pushed back under the muscle of the same name. In cases of enlargement of the submaxillary glands such as result from infection from carious teeth, the glands are found along

FIG. 5

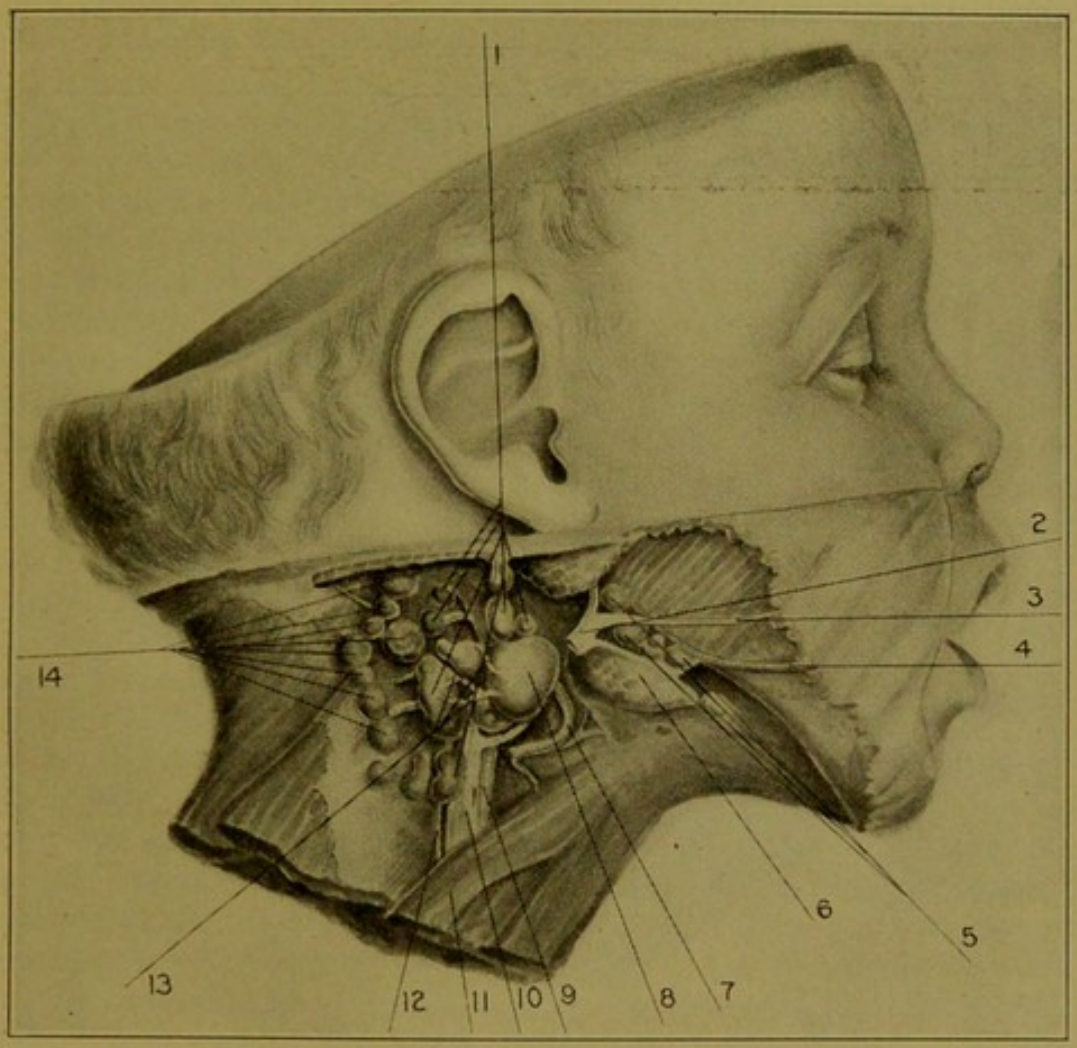


Superficial dissection of Specimen No. II., showing portion of tonsillar lymph gland and its relation to the sternocleidomastoid muscle and the external jugular vein: 1, lymph glands of the internal jugular group; 2, parotid gland; 3, facial vein; 4, facial artery; 5, submaxillary lymph glands; 6, submaxillary salivary gland; 7, tonsillar lymph gland; 8, omohyoid muscle; 9, sternocleidomastoid muscle; 10, external jugular vein; 11, great auricular nerve.

the edge of the jaw and cannot be displaced backward and only slightly downward. In the description of the anatomy of the cervical lymphatics previously given it was stated that where the posterior belly of the digastric muscle crossed the sternocleidomastoid there were constantly found one or two large glands. In a child one week old in which I was able to trace the course of the tonsillar efferent vessels this gland was very little larger than many more of the external jugular group. In children who have reached six or more months

of age this gland was generally twice or three or four times larger than any other, and in every injection of the tonsil it was this enlarged gland that primarily received the blue injecting fluid. Does it not seem possible that this enlargement consequent to birth may be due to the absorption of toxins through the faucial tonsils?

FIG. 6



Deep dissection of Specimen No. II., showing position of tonsillar lymph gland and its connection with other glands of the substernomastoid group: 1, internal substernomastoid lymph glands; 2, external jugular vein; 3, facial vein; 4, facial artery; 5, submaxillary lymph glands; 6, submaxillary salivary gland; 7, superior thyroid artery; 8, tonsillar lymph gland, 9, common carotid artery; 10, internal jugular vein; 11, omohyoid muscle; 12, jugular lymph trunk; 13, efferent vessels of tonsillar lymph gland; 14, external substernomastoid lymph glands.

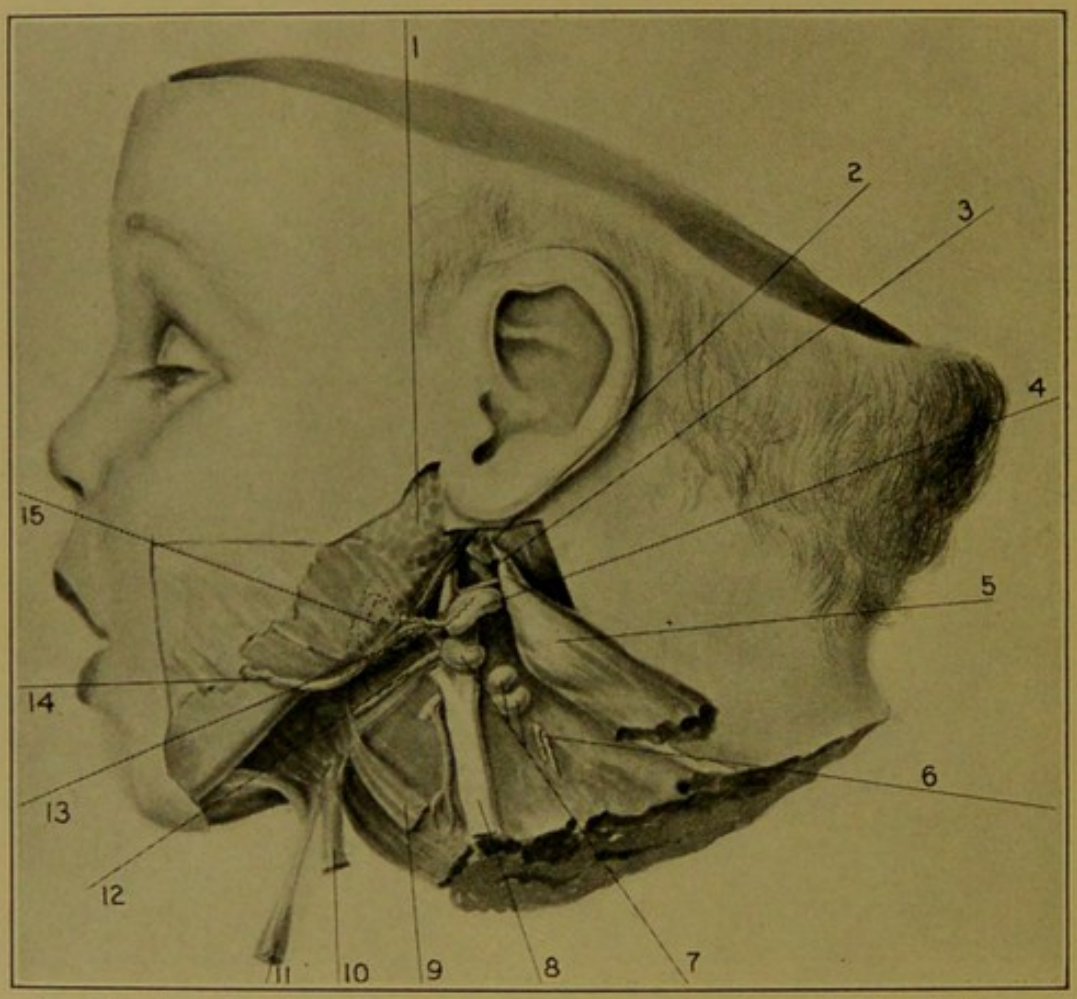
I have chosen to call the lymphatic gland which receives the efferents of the tonsil the *tonsillar lymph gland.* This term is not sufficiently comprehensive, because most probably other lymph vessels from the throat, besides those from the tonsil, drain into this gland, but the most important infections of the cervical lymphatics originate through the tonsil, and because of the importance of the tonsil in the origin of infections, I feel that the term tonsillar is a most

appropriate one. Certainly, it is convenient to be able to easily designate so important and constant a lymphatic gland.

Following are the descriptions of the individual injections of the tonsils. The technique was practically the same in all of them.

SPECIMEN I.—Child about six months old. The injection in this case failed probably because there was some obstruction in the injecting needle. Dissection of the neck showed hypertrophy of the tonsillar lymph glands.

FIG. 7



Deep dissection of Specimen No. IV., showing the efferent lymph vessels of the faucial tonsil entering the tonsillar lymph gland. The posterior belly of the digastric muscle and the whole of the stylohyoid muscle have been reflected downward: 1, parotid gland; 2, stump of the stylohyoid muscle; 3, stump of the posterior belly of the digastric muscle; 4, tonsillar lymph gland; 5, reflected sternocleidomastoid muscle; 6, brachial plexus of nerves; 7, substernomastoid lymph glands; 8, internal jugular vein; 9, omohyoid muscle; 10, stylohyoid muscle; 11, posterior belly of the digastric muscle; 12, hypoglossal nerve; 13, efferent lymph vessel of the faucial muscle; 14, facial artery; 15, position of faucial tonsil.

SPECIMEN II.—Child about six months old. The injection in this case was very successful. The tonsil itself became enlarged and there was a slight overflow of the fluid toward the faucial pillars, the blue color, however, was limited to the fauces. A few injected lymph vessels were seen running posteriorly into the sinus pyriformis and anteriorly toward the base of the tongue. The dissection of the

neck showed that the blue fluid had entered a slightly enlarged lymph gland situated just below the point where the anterior border of the sternocleidomastoid muscle is crossed by the posterior belly of the digastric. The gland was superficial to the digastric muscle just above the facial vein, where it joins the external jugular. A deeper dissection demonstrated that the injected gland belonged to the anterior group of the upper deep cervical lymph glands and had three efferent vessels, which also contained the blue injecting fluid. The connecting lymph vessels between this gland and the jugular trunk were dissected out. The most direct route showed that the lymph current from the tonsil, in order to enter the jugular trunk, had to pass through two or more glands after leaving the tonsillar lymph glands. In this specimen, however, I was unable to find the efferents running from the tonsil to the tonsillar lymph gland. Figs. 5 and 6 were made from this specimen.

Specimen III.—Child one week old. Only a small quantity of fluid was injected into the tonsil. The dissection showed a slight injection of the glands situated just below the posterior belly of the digastric.

Specimen IV.—Child one week old. A rather full injection of the tonsils was made and there was some infiltration of the surrounding mucosa. This injection was very instructive, as by careful dissection lymphatic vessels could be traced running from the infiltrated tonsil directly to the gland situated just below the posterior belly of the digastric beneath the anterior border of the sternocleidomastoid muscle. This lymph gland was considerably injected, but the importance of the specimen was in the demonstration of the efferent lymphatics of the tonsil. The course which the lymphatic vessels took was as follows: Leaving the tonsillar mass and running posteriorly and inferiorly, they pass slightly outward beneath the facial artery, running along the upper border of the lingual vein, then turning directly posterior, they pass between the stylohyoid muscle and the internal jugular vein, reaching the upper surface of the tonsillar lymph gland. Fig. 7 was made from this specimen.

Specimen V.—Child about three months old. Too much fluid was injected in this specimen, and, although the tonsillar lymphatic gland and its efferents contained the blue solution, the extravasation through the connective tissue of the neck was so great as to make it impossible to recognize the topography.

Specimen VI.—Child about three months old. This injection was a most successful one. Quite a large amount of fluid was injected in this case without any extravasation. In the throat the fluid was limited to the confines of the tonsil and the dissection showed that it had followed the lymph vessels through six or more of the upper deep cervical glands. The efferents from the tonsil could be traced passing in a direction very similar to that described under Specimen IV. There were two or three lymph vessels which ran closely together in

a more or less parallel course. At first they passed obliquely downward, posteriorly, and outward until they reached the facial artery. Running beneath this and internal to the stylohyoid muscle and the posterior belly of the digastric muscle, they entered the internal side of the tonsillar lymph gland.

In closing, I desire to express my thanks to Dr. James M. Stotsenburg and especially to Dr. Harold D. Senior for their skilful aid in making the injections.