THE LARYNGOSCOPE.

VOL. XXIV. ST. LOUIS, MARCH, 1914.

No. 3.

ORIGINAL COMMUNICATIONS.

(Original Communications are received with the understanding
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FIXED SOURCES OF ALL HEMORRHAGE FROM TONSIL- LECTOMY AND ITS ABSOLUTE CONTROL.*

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Four years ago I had the pleasure of bringing before your Society a new method of tonsillar enucleation. For several years prior to that time I had been trying the various and sundry operations on tonsils, as advised in text-books, with varying and sundry results. Rarely, however, could any result be called satisfactory, the reason for which, as I eventually found, being that by no method practiced at that time could a clean and complete enucleation be uniformly procured. That complete and lasting relief from diseased tonsils could be assured only through their complete removal I had already become thoroughly convinced, and with that object in view I gradually evolved the method described to you then and demonstrated in a clinic at the Moses Taylor Hospital.

As recently, even, as that date the proposition of complete removal of the faucial tonsils had to be defended, since the almost universal practice was to cut away merely a part of the tonsil, usually only that part which might be found projecting into the oropharynx beyond the margins of the faucial pillars. The operation was technically termed tonsillotomy, though a popular expression used both by physicians and the laity, "snipping off the tonsils," clearly expressed the process.

Thus I came to you commending and demonstrating my method of enucleation under the title, "Tonsillectomy, why, when and how."

*Read before the Lackawanna County Medical Society, Scranton, Pa., February 3, 1914, and demonstrated in a clinic at the Moses Taylor Hospital the following day.

Owing to the incomplete stage of research work that I was then carrying out in the anatomical laboratories of the Jefferson Medical College, on the circulation of the head and neck with particular reference to the tonsils, I postponed the publication of that paper till the fall of 1911, when it was read before the Section on Eye, Ear, Nose and Throat, of the Pennsylvania State Medical Society and published in the November number of the *Pennsylvania Medical Journal*, under the title, "Tonsillectomy, why, when and how: with a preliminary report of investigations concerning the blood supply and anatomic relations of the faucial tonsils."

Since that time I have continued to operate by the same method, and have been gratified to learn that some of you, after a series of several hundred cases, report the same satisfactory results that I claimed—namely, a complete, clean enucleation, with no traumatism, no destruction of or injury to any surrounding structure, leaving each faucial pillar intact, smooth-edged and with perfect symmetry of the two sides of the throat, and attended with or followed by less hemorrhage than by any other method I have known.

I believe the same to be true to-day. But there was one phase of the subject left in a stage of marked incompleteness, as I have learned through further research, so it is to correct an error in my earlier opinion and to give you the benefit of my latest conclusions that I come to you at this time. No tonsil can be enucleated by any method without the severing of certain blood vessels, and any severed vessel affords always a possible source of hemorrhage. Thus nearly every operation by any method has been attended by more bleeding than would be desired, if the operator knew a satisfactory means of control, while some bleed to the point of alarm, and more than a few deaths even have resulted therefrom. It is a lamentable fact that of all those in the medical profession who would dare do any kind of surgical operation, probably more have had the temerity to attempt operation on the faucial tonsils with less knowledge of their anatomy than upon any other part of the human body. In fact, I doubt if any other part of the human body has been subjected as frequently to bad surgery as has the faucial tonsil, or if in any other part of the body blood vessels have been severed with as careless concern and their subsequent conduct left to chance as in operations upon the tonsils. This is not a merely casual remark, but stated advisedly from twelve years of observation. I used to think that most of the cases of direful results of tonsil operations, cited by those or friends of those on whom a tonsil operation was advised, were greatly exaggerated or even en-

tirely fictitious. But after a few cases that have been brought to my attention in more recent years, my credulity has developed almost to the point of accepting the most fanciful citations as fact.

Why have so many men, who likely would shrink from attempting even the most minor surgery, been emboldened to operate upon the tonsils? Surely there must be a good reason, and my object in calling attention to this state of affairs is not to deter any one from attempting surgical work that he is *capable of doing*, but to emphasize the *importance of preparation* for the performance of an operation that has long been regarded too lightly. I believe in the conscientiousness of the average medical practitioner, and it is to those who are ever willing to improve their methods that I appeal.

Probably nearly all medical men to some extent study and observe and thereby make use of the accumulated experience of their predecessors; and likely most of us feel justified in attempting what others, under similar circumstances, have done and absolve ourselves from censure if we meet with no greater success than did they. A few, however, are not so easily contented and break away from the beaten path.

When it had been taught for years by our best-known laryngologists that to operate on the tonsils was a minor and simple procedure that hemorrhage *might* follow, but that the quantity of blood lost was not often sufficient to be *serious*, and nothing further was mentioned as a means of control, who could blame anyone who "snipped them off" and gave no further thought, unless hemorrhage did "become alarming?"

I believe that not only should all hemorrhage at the time of operation be regarded as serious till under control, but that no patient should be allowed to leave the operating room till every possible source of subsequent hemorrhage is obviated.

In my review of the literature on hemorrhage from tonsil operations I consulted over thirty text-books on the nose and throat, the authority upon which the majority of practitioners depend for instruction in preparing for an operation, or to which they appeal in an emergency. In only two did I find mentioned any particular location within the tonsillar fossa from which hemorrhage might be likely to occur; none offered any means of its control immediately following operation; while the majority did not suggest any need for attention to hemorrhage unless it should become "serious" or "alarming."

Consider the following which are taken from text-books as measures to be tried: Ice applied internally and externally; very hot applications or hot gargles; local applications of astringents or styptics, or gargling with them; pressure, either held in place by an attendant or by variously devised clamps; if bleeding points can be seen they may be seized with forceps and hemorrhage stopped by compression or torsion, or the forceps may be left in place; suturing the faucial pillars together or suturing the pillars over a pledget of gauze; sitting the patient upright in bed that when sufficient blood has been lost, syncope will lower the pressure and the hemorrhage cease; ligation of the external carotid artery.

Objection to the whole list of measures enumerated can be summarized briefly as follows: Those that may be classed under mild or conservative measures are too uncertain to rely upon where the loss of blood has assumed or is even approaching a "serious", or an "alarming" stage, to say nothing of the discomfort to which the patient is subjected in their application.

All the rest, which may be termed radical or extreme measures are in a more or less degree detrimental to the patient's constitutional condition or to the perfection of the local result.

Prior to one year ago I had considered the suturing of the faucial pillars together or over a roll of gauze the safest final resort in hemorrhage and had never failed to find that procedure effective. I cannot conceive of any situation, however, in which so extreme a measure as ligation of the carotid artery would be necessary or in any wise justified.

Those authors who state that "if bleeding points can be seen, they may be seized, etc.," have erred in the admission of the "if," for, I believe that with the *rarest* exception, *definite* sources of all hemorrhage can be localized and effectively controlled. It was the localizing of this fixed source of all severe hemorrhage that led me to abandon the pillar suturing process for the simpler and safer technic that will herein be described.

The phenomenon known as hemophilia, of course, is a too well established reality to be denied, but that the frequency of its occurrence has been greatly exaggerated there is not the shadow of a doubt, and the term "bleeder" has eased the conscience of a multitude of occasional surgeons and shielded the inability or futile efforts of the more experienced.

To a large degree the fault has existed in the erroneous opinions and teaching concerning the circulation of blood to and from the

tonsil. Before taking up, then, the means of hemorrhage control, which is the primary object of this paper, a brief consideration of the structures immediately surrounding the tonsil, the tonsillar setting, is necessary to its full appreciation.

The faucial tonsil is an irregularly spherical glandular body, about three-fourths enclosed within a membranous capsule which is glistening on its outer surface and from the inner surface of which the tonsillar tissue springs, set between the palato-glossus and palatopharyngeus muscles, with its capsular surface in contact with the aponeurosis of the superior constrictor muscle, and its exposed surface directed inwardly toward the isthmus of the fauces.

The outer, capsular surface of the tonsil, thus fitted into this muscular encompassed recess, is normally unattached to the aponeurotic wall except at the margins of the palato-glossus and palatopharyngeus muscles where the attachment is circumferential about the margin of the inner, exposed surface of the tonsil. There is no stem or stump forming a deep attachment by which the tonsil is held or through which the blood vessels pass as some seem to have believed. Hence all blood supply to the tonsil must come from without the tonsillar recess, penetrating the recess wall and then the tonsillar capsule. It is upon the source, course, and ultimate distribution of the arteries entering the tonsillar recess that anatomists have differed and surgeons have been misled.

In the preliminary stage of my research, I agreed with the anatomists, and stated in my paper three years ago that the blood supply to the tonsils seemed to "include branches from the dorsalis linguae; from the lingual; ascending palatine and tonsillar branches from the facial; a small palatine branch from the ascending pharyngeal; and a small branch from the descending palatine—the tonsillar artery carrying the principal supply.

It is perfectly true that the arterial branches enumerated reach the tissues which enter into the formation of the tonsillar fossa, but they do not all perforate the wall of that fossa nor do they all eventually reach the tonsil itself. The tonsillar branch of the facial which has generally been supposed to be the principal artery to the tonsil seems not to enter into the tonsillar circulation at all, but with an anastomotic branch from the dorsalis linguae it supplies the plica triangularis and the muscles entering into the formation of the wall of the lower half or two-thirds of the tonsillar fossa. The tonsillar branch of the ascending pharyngeal sends twigs into the upper parts of the wall of the tonsillar fossa, but

like the tonsillar artery, they *do not* pass through the muscular fibers, through the capsule and into the tonsil itself.

Thus there remain two arteries, the ascending palatine branch of the facial and the descending palatine branch of the internal maxillary from which by an anastomosis outside the fossa a single artery is formed that enters the fossa at its superior extremity, (Figure 1), passes downward between the capsule and the muscular aponeurosis for a distance of about one-half inch before penetrating the capsule to reach the tonsil, (Figure 9). Thus, my observation of four years ago that the blood vessels, both arterial and venous, penetrated the tonsillar capsule near its midpoint, superoinferiorly, and from a quarter to one-half inch from the margin of the anterior pillar was correct, but my erroneous deduction was that these vessels were derived from the severally specified sources, and that they entered by way of the anterior pillar directly into the tonsil.

Numerous, then, as are the small arterial branches surrounding the tonsillar fossa none penetrate directly through the wall and the capsule into the tonsil. One must admit always the possibility of slight variations in the positions and branches of arteries and even of anomalies, but the distribution and course of vessels as above described I believe to be present in at least 95 per cent of all cases. This estimate is based upon clinical observations and upon anatomic research in the Daniel Baugh Institute of Anatomy.

Accompanying the artery there is a vein that runs from the tonsil upward, passing out of the fossa at the point the artery enters, and joins the palatine plexus just above the fossa. A small vein also emerges from the tonsil at the same site as the other vein and runs downward between the capsule and the wall of the fossa to reach the pharyngeal plexus. Thus in the average case by the enucleation of the tonsil, one artery and two veins are the principal vessels severed, and since the venous oozing is of temporary duration, there remains but the one artery to be dealt with in the control of hemorrhage.

By my method of tonsillar enucleation this artery is usually severed by the snare at the point of its entrance into the tonsillar fossa (Figure 10), though occasionally at its point of entrance into the tonsil, one-half to three-quarters of an inch inferiorly, behind the external border of the anterior pillar.

When the latter result occurs, the remaining free portion of the artery may be left dangling within the fossa. (Figure 14). There

is no doubt that this condition has misled many in the belief that they were dealing with a "bleeder," since the various applications or attempts at pressure to what seemed to be the point of hemorrhage only served to shift the loose end of the artery to a different location—hence the conclusion that "as soon as one bleeding point was controlled another would start."

It matters not, however, where the vessel be severed, at its entrance into the fossa, at its capsular penetration, or at any intervening point, the process of hemorrhage control is the same; namely, grasp the artery at its entrance into the superior extremity of the fossa, pass a suture ligature of No. 1 catgut underneath it and tie. (Figure 11). By retracting the superior margin of the anterior pillar this artery can be demonstrated following the enucleation of every tonsil. At the site of its entrance into the fossa there is a slight, stump-like projection of connective tissue, (Figure 10) through which the artery and vein pass, which renders the cut end of the artery quite accessible to the grasp of the hemostat. (Figure 11.) The retraction of the pillar, and the grasping of the artery must be done with care to avoid injury to or laceration of the wall of the fossa, since the muscles forming the wall are exceedingly thin and of delicate fibers. Laceration of the wall may be attended by more or less hemorrhage from the small arterial branches supplying the surrounding muscles. (Figure 1). A seeming exception to the above stated arterial distribution is occasionally seen when the artery is severed near its tonsillar entrance and remains adherent to the wall of the fossa instead of dangling as previously cited. In such cases the bleeding is seen to flow near the center of the fossa wall.

Occasionally a bleeding vessel may be found to persist in or near the base of the fossa, being one of the small terminal branches of the tonsillar or dorsalis linguae arteries that has penetrated the wall or the plica into the fossa. If so, it should be grasped and ligated the same as the other and more important artery. I have found it necessary to do this in about two per cent of cases. Regarding the artery in the superior extremity, it is my custom now to ligate it immediately following the removal of every adult tonsil, whether there be profuse bleeding or not. In children they are ligated if the bleeding does not cease entirely within a few minutes. In other words every patient must leave the operating room with perfectly dry tonsillar fossae.

When through extra-capsular infections, particularly peritonsillar abscesses, the capsule has become adherent to the fossa wall

at any point, the freeing of such adhesions in the enucleation process usually leaves a rough, abraded muscular area from which there may result considerable capillary oozing, or even a freely bleeding small artery which has penetrated the muscular wall from without. If the resulting hemorrhage be an oozing from the roughened surface, an application of ten per cent nitrate of silver will control it; should there be a distinct vessel, however, then a suture ligature should be used as in the other instances.

I have never had to use more than two ligatures in any tonsillar fossa, and I have never had any bleeding subsequent to the patient's leaving the operating room since I have adopted this method of control. Thus the simplicity of its application, the security of its control of hemorrhage, the absence of any interference with function of the pillars, either immediate or ultimate, and the absolute freedom from discomfort to the patient I feel should justify my full commendation of the method herein described.

The application of this technic is intended to follow only the complete enucleation of tonsils and since I still believe my own operation for tonsillectomy to be the most satisfactory one yet devised, I have had the artist, Miss Peters, make a series of drawings which, with the legend beneath each figure, will more clearly elucidate each step of the process than my verbal description as published some years ago.

The following drawings which are intended to illustrate each successive stage of the technic were sketched from the actual operation, but not all from the same patient.

Ether anesthesia is preferred in all cases; a straight operating table is used, the patient lying flat upon the back with head turned at an angle of forty-five degrees to the right, assistant on left, sponge nurse back of operator, light reflected with head mirror.

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Figure 1. Diagram showing the blood supply to the tonsil and the surrounding structures. 1. Descending palatine branch of internal maxillary a. 2. True tonsillar a.—formed by an anastomosis of descending palatine and ascending palatine branches. 3. Palato-pharyngeus m. (Posterior tonsillar pillar.) 4. Palato-glossus m. (Anterior tonsillar pillar.) 5. Hyoglossus m. 6. Dorsalis linguae a. 7. Common carotid a. 8. Superior thyroid a. 9. External carotid a. 10. Internal carotid a. 11. Lingual a. 12. Middle constrictor m. 13. Facial a. 14. Occipital a. 15. So-called tonsillar a. 16. Ascending pharyngeal a. 17. Ascending palatine a. 18. Posterior auricular a. 19. Tonsillar branch of dorsalis linguae a. 20. Styloglossus m. 21. Tonsillar branch of ascending pharyngeal a.

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Figure 2. Anesthetizer's finger retracting cheek. Scissors, closed, held in operator's left hand, used merely as a retractor drawing forward the anterior pillar to enable the submerged tonsil to be grasped by tenaculum in operator's right hand without catching any part of the pillar. Tongue depressor is held by assistant.

Figure 3. Showing imprint of the body of the tonsil contained within the fossa back of the anterior pillar. The plica triangularis is seen extending inward from the margin of the pillar over a portion of the free surface of the tonsil.

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Figure 4. Cutting with scissors into tonsil, anterior to margin of posterior pillar, the tonsil being drawn forward and outward with tenaculum.

Figure 5. Tonsil drawn by tenaculum towards opposite side—while anterior incision is made into tonsillar tissue posterior to margin of anterior pillar. These two incisions, about one-quarter of an inch deep are made so that they unite in the upper part of the tonsil above the tenaculum. The object of these incisions is to permit the tonsil contained within the capsule to split when traction is made with the second tenaculum (Figure 6) and thus result in complete eversion of the tonsil. Note that each incision is made into the tonsillar tissue near the margins of the pillars but not attempting to separate the tonsil or capsular attachment from the pillars.

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Figure 6. Showing the second tenaculum being applied, grasping the tonsil within the anterior incision made with scissors. The first tenaculum is then removed and by traction with the remaining tenaculum the eversion process is completed. The grasp is made within the anterior incision because the greater part of a submerged tonsil is always imbedded back of the anterior pillar. For this reason it will be seen when the tonsil is removed that the anterior incision was practically through the middle of the tonsil, from which point traction with the second tenaculum more easily and evenly accomplishes the eversion.

Figure 7. The tonsil perfectly everted. Note from the position of tenaculum how much tonsillar tissue was turned out from behind the anterior pillar. In this stage the whole capsular surface which fitted convexly into the concave fossa is entirely without the fossa, completely everted and held simply by the marginal, circumferential attachment to the anterior and posterior pillars, around which line the snare is then placed.

Figure 8. Snare placed back of all out-turned tonsillar tissue and drawn against the capsular attachment to the pillars. As the screw is run down by the assistant the operator, holding to the shaft of the snare with one hand and tenaculum with the other, directs the gradually reduced loop of wire in the proper line of severance.

Figure 9. Diagram showing line of capsular attachment to faucial pillars, and location of arterial penetration of capsule. 1. Descending palatine branch of internal max. a. 2. Capsular surface of tonsil. 3. Anterior faucial pillar. 4. Posterior faucial pillar. 5. Uvula. 6. Line of capsular attachment to faucial pillars. This also marks the line of capsule severed by the snare after the tonsil has been everted. 7. Margin of plica triangularis. 8. Base of tongue. 9. Ascending palatine branch of facia a. 10. Faucial or exposed surface of tonsil. 11. Entrance of true tonsillar a. into tonsil, showing also irregular distribution of arterial branches within the capsule. This point of entrance is occasionally slightly more posterior, though all variations could probably be covered by a radius of one-sixth inch. 12. True tonsillar a. and its course from entrance into fossa to its entrance into the tonsil, running between the capsule and aponeurosis of the muscular wall. Occasionally the superior portion of its course is more posterolateral to the tonsil, though eventually entering the tonsil near the same point as here specified.

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Figure 10. The right fossa shows the position of faucial pillars immediately after the enucleation has been completed. Each pillar margin is left smooth and perfectly intact. On the left side the anterior pillar is retracted superiorly to expose the point at which the true tonsillar artery enters the fossa and the vein passes out. These severed vessels with surrounding connective tissue leave a small projecting stump which facilitates the grasping of the artery with the hemostat. Radiating downward from this stump can be seen two or three small vessels running beneath the muscular aponeurosis. These are veins that permeate and at times penetrate the superior constrictor muscle wall from without, running upward to join the palatine plexus.

Figure 11. Showing how the stump is grasped with hemostat and the introduction of the suture ligature with short slightly curved needle. The needle penetrates the tissues on the floor of the fossa at just sufficient depth to hold the cutgut in place while it is being tied above the artery. Immediately following the enucleation of the tonsil I usually hold a gauze sponge pressed firmly within the fossa for about a minute to check the first flow of blood before the hemostat is applied.

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Figure 12. Showing manner of holding the ligature ends for tying. The right hand end of the ligature is held well outside of the mouth, thus giving a clear view of the field of operation, while the other end is held secure by being wound around the little or ring finger of the left hand, leaving the index finger free to press downward upon the knot as it is drawn upon the vessels. Two knots are sufficient for security.

Figure 13. After the process of suture-ligation is completed the two sides of the throat should look like the above view. The cross marks indicate the location of the ligatures within the superior extremities of the fossae, being entirely hidden from view by the anterior pillar after the retractor is removed.

Figure 14, showing the occasional occurrence referred to where the artery was severed at or near its entrance into the tonsil, leaving the remaining portion detached from the wall and dangling loosely from its superior point of entrance into the fossa. This condition has no doubt perplexed many operators from the fact that while it is bleeding and the fossa is filled or covered with blood the artery itself cannot easily be seen, giving the appearance of multiple points of hemorrhage as its position is shifted in attempts to apply astringents or pressure, etc., according to the older methods. By the suture-ligature method, simply retract the pillar and grasp with hemostat in the usual way at its upper entrance into the fossa and introduce suture-ligature as shown in Figure 11.

Figure 15. Needle-holder designed to facilitate the introduction of the ligature-carrying needle. The angle at which the needle has to be introduced and drawn through rendered the process very awkward and difficult with the various styles of straight holders.