SOME POINTS IN THE APPLIED ANATOMY OF THE TONSIL.*

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The fauces tonsil is a collection of lymphoid tissue lying on the superior constrictor fascia and between the fauces pillars. It differs from other collections of the same tissue found in various parts of the alimentary tract throughout its extent only in its size, its compactness and in the arrangement of its lymph nodules about its crypts. There is no reason to believe that the function of the tonsil differs in any way from that of other similar lymphoid tissues. Therefore it may be removed in toto without appreciable loss to the economy.

In this paper I wish mainly to consider the two most important structures of the tonsil from the pathologic and operative standpoint, viz., the crypts and the capsule. I shall refer only casually to the lymphoid tissue, since its study should be undertaken with that of the other lymphoid tissues. This is beyond my purpose here.

THE CRYPTS.

The crypts are developed from solid epithelial buds which begin to make their appearance in the embryo at the fourth month. From this period through fetal life and during the first year of infancy new buds are being formed, which very soon are transformed into hollow tubes, or rather clefts, by a process of shrinkage and cornification of their central cells, which form a core and are expelled as such. The crypts thus formed vary in number from eight to eighteen. Their general direction is outward; those, however, which empty into the supra-tonsillar fossa extend downward and outward. From their openings on the fauces surface of the tonsil they extend deeply into its substance. They may or may not be branched.

The lymphoid tissue is developed in the more superficial layers of the fibrous tissue (tunica propria) immediately surrounding the surface and cryptic epithelium. The deeper layers of the propria are pushed aside by this development and form, on the outer side of the tonsil, a well-marked fibrous investment, the capsule, from the inner surface of which a series of fibrous trabecula extend between the crypts, dividing the tonsil into lobes. The larger of these trabecula extend as far as the propria of the surface epithelium, with which they merge; others become gradually attenuated and are lost in the fine reticulum of the lymphoid tissue.

I shall speak of the capsule in greater detail later and wish now only to call attention to the fact that it forms, with its trabecula, an inverted replica of the epithelium with its cryptic prolongations; that the fibrous fingers on the one side are dovetailed, so to speak, with those of the epithelium on the other; and that the two are separated from each other at any given point only by the development of a single row of lymph follicles. It follows, therefore, that the blinds ends of the crypts lie in very close relation to the capsule. As far as my observations go, they are never in apposition, but are always separated by a very thin layer of lymphoid tissue, usually diffuse. Sometimes a germinal center is interpolated. Ballanger states that the crypts always extend to the capsule. While I think this is histologically untrue, I am sure that his practical application of it is sound, viz., that to obliterate the crypts the tonsil must be removed in its entirety.

The caliber of the crypts varies at different depths. In a strictly normal tonsil I suppose the epithelial surfaces should lie in apposition throughout the whole course of the crypt. I have yet to examine such a tonsil. The nearest approach to this ideal that I have found is one in which the inequalities are not sufficient to cause any considerable accumulation of detritus in the crypt. In the great majority of the tonsils that are removed, either on account of their size or for the relief of constitutional disturbances, marked pocketing of the crypts is found. These pockets may occur at any point; they are almost uniformly to be deep as superficial. The junction of a branch crypt with the main trunk seems especially suited for their development. I have found them in very close relation with the capsule.

Any operation, therefore, done on the tonsil for pathologic conditions in the crypts, and consequent toxic absorption from them, must have for its object their complete obliteration. This can be accomplished only by the complete removal of the tonsil. Operations in which the epithelial face only of the tonsil is cut away, or at best in which a very considerable part of the deeper portion is left, are likely to prove disappointing; the crypts remain, less deep it is true, perhaps, in many cases more capable of drainage, but always possible sources of infection and toxic absorption.

THE EPITHELIUM OF THE CRYPTS.

The epithelium of the crypts, like that of the surface, is of the stratified squamous variety. It presents many interesting changes with age, which have an important bearing on the question of absorption from the crypts, and, as will be shown, to the action of the lymphoid cells upon it. At birth, and up to about the fifth month of infancy, the crypts already formed by the expansion of the central core show an epithelium very similar to that of the surface. It is many layers in thickness, compact, and has a well-defined base which is indented by numerous papillae. Leucocytes have already invaded it, but not in sufficient numbers to affect its integrity. Between the fourth and sixth month of infancy the germinal centers of the lymph nodes first become clearly defined; the lymphoid cells become especially active, and the epithelium of the crypts is invaded by such numbers of them that its basal outline becomes obscured and the deepermost of its cells are separated from each other by masses of lymphocytes, and appear as epithelial fingers extending from the surface of the crypts into the lymphoid tissue. This process goes on until it is not too much to say that the epithelium is

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literally torn to shreds by the lymphoid activity. It presents on the surface an unbroken film of cells, only one or two layers in thickness, and even these are sometimes difficult to make out. In places, loose aggregations of epithelial cells may be discerned deeper below the surface, but their continuity is so broken that they hardly can be regarded as a definite epithelial tissue. This condition of cryptic epithelium is found in all tonsils from the age of one year up to about the age of puberty, when a general diminution in lymphoid activity usually takes place, and with it a change in the epithelium of the crypts the reverse of that just described. The number of migratory lymphocytes diminishes, the epithelial fragments are allowed to drop together and form a more definite and compact membrane, which, however, never attains the uniform solidity and thickness of the surface epithelium. At the same time the fibrous reticulum immediately below the epithelium may become compact and practically free of lymphocytes; it then forms a well-marked tunica propria of the cryptic mucous.

This regeneration, so to speak, of the cryptic epithelium is by no means so general or so complete, nor is the age at which it takes place so constant as its earlier disintegration. Many adult tonsils show great activity of the lymphoid tissue and a cryptic epithelium approaching the childhood type. This is especially true of the epithelium opposite the germinal centers, where the migration of lymphocytes continues most active. In the non-adult the general condition of the tonsil, however, we may expect to find a fairly compact cryptic epithelium.

The structural strength of its epithelium is, I think, a very important factor in determining the amount of absorption that may take place from the crypt. Without considering other forces of absorption, it will be seen from the above description that the cryptic epithelium of the tonsil of childhood, and of the hypertrophied tonsil of the adult, considered as a mechanical force, can offer no very great obstacle either to the invasion of bacteria or to the absorption of their products; other forces must be responsible for immunity to infection. The quiescent tonsil of the adult, however, possesses an epithelium which in itself would seem to be a fairly effective defense against bacterial invasion.

THE CAPSULE.

As described above, in my explanation of its necessarily close relation to the blind end of the crypts, the capsule may be considered as a highly developed tunica propria of the faucial mucous membrane, separated from its epithelium by the development of the lymphoid nodules which compose the mass of the tonsil. As might be expected from this derivation, it completely invests all parts of the tonsil not covered by epithelium and is continuous with the tunica propria of the faucial mucosa. In microscopic sections of whole tonsils with the capsule intact, it appears as a compact layer of fibrous tissue with numerous elastic and striated muscle fibers interspersed. A number of trabeulae of the same composition, except that muscle fibers are only occasionally found, are given off from its internal surface and extend into the substance of the tonsil between the crypts and separate it into lobes. The muscle fibers are said to be derived from the superior constrictor and from the pillars. Those that lie in immediate proximity to these muscles doubtless are so derived, but those that are sometimes found in the larger trabeulae quite remote from the main capsule can hardly be accounted for in this way. A number of mucous glands are found in the capsule, being especially numerous at the sides opposite the faucial pillars. Blood vessels appear at intervals, the larger of which are seen at the junction of the trabeulae with the main capsule, from which point they supply the tonsil through the trabeulae.

The capsule is thin, but tough. In none of my specimens is it over ½ mm. in thickness, except at those points near the pillars where the dissection was accomplished with a cutting edge. It is quite easily separated from the surrounding tissues at its upper half; at its inferior half it is much more adherent, since it is at this point that the larger vessels enter the tonsil.

The structure of the capsule, its toughness, and the ease with which it may be separated from the underlying tissues, make the operation of dissection of the tonsil "in capsule" a very practical one. The dissection may be accomplished largely with blunt instruments after the initial incision through the mucous membrane, but at its lower half the capsule is usually so adherent as to require a cutting edge or a snare to complete the separation. The operation is incomparably neater and more thorough than any other, and is especially to be recommended in all cases in which the tonsil is suspected to be the source of a systemic infection.

The question of hemorrhage after this operation is important. A just estimate of this danger, however, cannot be given until the operation is more generally done. Anatomically, bleeding would seem to be more likely to occur, for the reason that the blood vessels are severed in a tough fibrous tissue which allows them little chance for contraction or retraction. For this reason I prefer the modified operation in which the more adherent part of the tonsil at the lower half of the capsule, at which point the vessels enter, is separated with a snare.

RESULTS IN ADENOID AND TONSIL OPERATIONS. A STUDY OF A SERIES OF CASES.*

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Early in the summer of 1907 I had sent out, from the Throat Department of the Massachusetts General Hospital, the following notice, on postals, to children who had had adenoid and tonsil operations between Aug. 31, 1903, and Aug. 31, 1904: "The Throat and Nose Department of

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