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CERVICAL CYSTS AND FISTULAE

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Senior Thesis Presented to the University of Nebraska College of Medicine, Omaha, 1938.
OUTLINE

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PART I.

Introduction.

The subject of Cervical cysts and fistuæ has, for the past century, been one for considerable speculation and controversy. The relative scarcity of patients presenting this condition, together with the wide varieties of its manifestations has made accurate study difficult, thus allowing considerable room for theorizing and speculation. Anatomists and Embryologists in the past have attempted to analyse the condition through the study of normal embryology, but the exact mechanism is far from conclusive. It is worthy of note that prior to one hundred years ago, only one article had been written describing this condition and then it was not until after Wenglowski's investigative work in 1912 that any amount of literature was written, although those articles written in the latter half of the nineteenth century are considered as invaluable contributions in this field! Undoubtedly with the advent of aseptic medicine and surgery, coupled with more accurate diagnostic methods the condition is being recognized more frequently and the later series of articles discuss this condition partly as an embryonic and medical curiosity and partly to emphasize the necessity of instituting proper therapy.
As one reviews the literature he cannot help being impressed by the accuracy of the powers of observation and deduction of the anatomists and embryologists of the middle and latter half of the nineteenth century. These observations and deductions still stand today as the foundation upon which later research is built.

Although cervical cysts and fistulae is quite rare several of the large clinics each reported seeing from seventy-five to one hundred cases over a span of ten years. A large number of these cases did not present themselves primarily because of this condition, but with other complaints and these anomalies were accidently discovered through the routine course of examination.

Cervical cysts and fistulae may be defined as an embryological epithelial rests and defects occurring in the cervical region with the branchial clefts or portions of the derivatives persisting as embryological rests and characterized by rarely being present at birth and finally appearing as a mid-line or lateral cervical swelling or as a chronic discharging sinus producing no symptoms except those of pressure or as a disturbing intermittent discharge of mucoid material.

Cervical cysts and fistulae may first be classified as to location, lateral or branchial and thyroglossal or midline.
In writing this thesis no attempt, whatsoever is being made to draw any conclusions but rather to permit each reader to formulate his own ideas and conclusions from the material gathered and contained therein. The purpose of this thesis, therefore, is to summarize the best literature written on this subject in such a manner that the reader will have a brief, handy, obtainable reference in the library. No attempt or effort can be made to cover all the literature written and published but the best articles and the works of the leading anatomists, embryologists and clinicians of the past century have been read and abstracted in an attempt to present the essential points, findings and arguments concerning the subject of Cervical Cysts and Fistulae. Case reports have been purposely omitted because of the wide variety of manifestations which would ultimately lead to confuse the problem and in no way aid to clarify the question. The aim, therefore, is to so organize the literature read in such a manner as to give the reader as near complete an account of each phase of the subject as is possible with the hope that this thesis will be of aid in stimulating clinicians to recognize this embryological malformation and to institute the proper therapy.
PART II

History

Historically, cervical cysts and fistulae have been studied since 1789. Prior to this date no literature has been recorded describing the condition. However, since 1880 this subject has been a fertile field for considerable study, speculation and theorizing. In 1789 Hunczowski described a swelling of the neck, together with his clinical findings. This was thought to be a branchial cyst by later authors, Carp and Stout (13). Hunczowski, himself, did not know or offer any explanation as to the etiology or diagnosis of the condition and merely recorded it as a case study.

In 1825 Rathke, reputed as being one of the most accurate observers by Sutton (67), found evidence, in the embryos of chickens, pigs and horses, of branchial clefts so characteristic of those found in fish. Rathke was, also, the first to observe fissures in the neck region of human embryos. From the description it becomes apparent that with the increasing knowledge of the anatomy and embryology of the branchial clefts and derivatives, the etiology of cervical cysts and fistulae will become more clearly understood.

Four years following Rathke's observations, Dzondi,
in 1829, described congenital fistulae as "trachial fistulae", Sutton (67), but he failed to connect these with the condition described by Rathke. In 1832 Åscher-son, published an article stating that cervical cysts and fistulae were related to the branchial clefts and not in relation to the trachea. He based his statement on his observing the opening in the pharynx and not in the trachea. He also concluded that the "higher in the neck the fistulae is found, the higher the cleft involved. Meyer (50).

In 1864, Heusinger reviewed Rathke and Ascherson's works in connection with his own forty-six reported cases and definitely emphasized the relation of these cysts and fistulae to the branchial spaces. He was of the opinion that the second cleft was responsible for branchial cysts and fistulae, but basing his work on the conclusions or statements of Ascherson he found that a large number of these openings were low, therefore the fourth cleft must be the one most often involved, Sutton (67), Meyer (50).

Cussett, 1877, while studying the embryology of the human neck noted the first arch appeared about the fif-teenth day, while the fourth arch not until the second month. He further noted that these arches were composed
of two epithelial surfaces separated by mesoderm; that the external portions grew quite rapidly and were normally obliterated early. If this did not occur he could visualize "all kinds of" pathological conditions developing as cysts, fistulae, tumors etc. Sutton (67).

About eight years later His made an extensive anatomical study of the neck region and concluded that cervical fistulae were normal to the fifth embryonic month; that the sinus precervicalis was the thymic anlage; and mentioned the relationship of the fistulae to the precervical sinus. From this point His was of the opinion that the inner opening of a fistulae depended upon which cleft broke through into the precervical sinus thus, if the second broke through the inner opening would be in the tonsillar fossa; if from the third the opening would be under the plica nerve laryngei; and the inner opening of the fourth would be in the pyriform sinus. Later work of His showed that he found evidences that the thymus was not a derivative of the sinus precervicalis, as his first belief, but that it developed from the third branchial cleft, Meyer (50).

In 1886 Rabl stated the second branchial cleft alone was involved in these anomalies, the third could not be involved because of the thymus gland origin and neither
could the fourth due to the thick mesenchymal layer.
Rabl believed these anomalies were formed by simple rupture of the closing membrane into the sinus precervicalis, thus establishing a congenital fistulae.

J. Bland Sutton in 1887 reviewed some of the popular theories of the embryological development of the Branchial cysts and fistulae and made special reference to embryology of the external ear and the fistulae located there. He attributed this to the first branchial cleft and concluded that no one cleft is involved solely but any of the first three may develop or form cysts and fistulae, Sutton (67)

Several years following Rabl's work two scientists attempted to clear up the muddle of literature. Although, until 1890, there had been comparatively few articles published, each author presented a different theory as to the origin. All this lead to considerable confusion and Kostaneicki and Milecki attempted to organize this literature and clearify the embryology. These men did little or no original work, themselves, but their efforts, reasoning and conclusions are still valuable. These authorities were concerned mainly with the embryology and advanced these points, Meyer H.W. (50). The inner opening remained in about the same location independent of the external opening's location. The inner
that the lateral cysts and fistulae were derived solely from the thymic duct. Wenglowski published the results of his work in 1912 and 1913.

Since this time the articles written have been exceedingly numerous, with the investigators being divided with Kingsbury and Bailey, on one side, maintaining the second cleft and precervical sinus alone is responsible for these anomalies, and at the other extreme H. W. Meyer championed the theory of Thymic duct origin as advocated by Wenglowski. Dowd in 1916 has done considerable work in Europe and agrees with the theory of Kostaniecki and Milecki. One of the most recent articles written by Todd and Gass 1938, where they state one cannot say that every cyst or fistulae has only one origin but that every cleft above the third is capable of forming these anomalies, thus agreeing with J. Bland Sutton.

The history of mid-line cysts and fistulae dates back to the same period as the lateral cysts and fistulae. Writers prior to His in 1890 included these anomalies along with the lateral cysts and fistulae. However, in 1890 His in his study of the anatomy and embryology of the neck advanced the theory that these anomalies were remnants of the thyroGLOSSAL duct and not due to the branchial clefts at all, Meyer (50). In the same year
opening seemed to be located in the lower tonsillar fos-
sa near the root of tongue.

That these fistulae were of branchiogenic origin there was not much doubt, but from which cleft they or-
iginated was the matter of greatest discussion. Follow-
ing this work of Kostaneicki and Milecki in 1890 numerous other observations were noted--of significance being the fact that most of the external openings occurred along the medial border of the Sternomastoid muscle and that the inner openings were at the base of infratonsillar fossa. These observations were those of such men as Durhan, 1894, (27) Senn 1884, (60) Kyle, 1902 (42) and numerous others. However, from about 1890 to 1912, however, there had been no great advancement in the findings of these struc-
tures. From 1912 until the present day there has been considerable written. Probably one of the most elaborate pieces of works done in this field was that of Wenglowski, Meyer, H. (50). This investigator spent four years studying embryos, ranging in size from 2 mm to 49mm, plus about 169 autopsies on both children and adults. His studies consisted of both microscopic and reconstruc-
tion by wax models. Wenglowski showed that the thymus developed from the third branchial cleft and in its descent it followed very closely the course which the branchiogenic fistulae follow, and concluded, therefrom
Kanthack (36) attempted to disprove His's theory of thyroglossal duct origin. For the next decade this was a much debated point and in 1894 Durham (22) and Bland Sutton (67) well illustrated this point in discussing the embryology. While these authors in their own minds, agreed with His yet they stated that conclusive proof was still lacking. In 1908-1912 Wenglowski, by means of his detailed anatomical and embryological studies proved conclusively that the origin was not from branchial clefts directly but as rests of the thyroglossal duct tract. Meyer (51)
PART III
Lateral Cysts & Fistulae

Embryology.

To fully understand the anomaly present one must first have a knowledge of the normal development of the neck with special reference to the branchial clefts and derivatives. The first embryological discoveries associated with the branchial clefts in mammals was done by Rathke in 1825 when he was studying pig embryos. In 1827 von Baer discovered four clefts in human embryos. From this time dates the study of the embryology of the branchial apparatus. In 1877 Cusset stated that the first arch appeared on the fifteenth embryonic day and the fourth arch about the second month. In 1881 His noted these arches had a tendency to overlap as a telescope due to the more rapid growth of the arches more cephalad and on the outer portion. G. Born in 1883 stated the pavement epithelium in the third arch was the thymus anlage. His disagreed with this and expressed the opinion the thymus was a derivative of the sinus cervialis but later, 1899 he agreed to the third cleft origin. In 1912 Wenglovski published an article on the embryology of the branchial apparatus which climaxed eight years of study of embryos ranging from two and six tenths millimeters to fifty-nine millimeters.
The 2.6 mm. embryo shows the first and second branchial arches present with indications of the first branchial cleft forming. The first arch shows distinct free edges anteriarly bordering the mouth cavity. Arch 2 in this embryo lies close to the heart anlage. Between the two the first cleft is developing. On sagittal section the first pharyngeal pouch is present and is running parallel to the first cleft.

In the 6.5 mm. embryo the development is almost complete for the branchial apparatus, which lies obliquely from downward and anterior to upwards and posterior with the entire structure resting almost on the heart anlage. The advances of each arch at this stage is Arch 1 has divided into two portions; the lateral portion will ultimately form the upper jaw and the anterior portion which later becomes the mandibular area. The first cleft presents itself with a depression at the posterior end which is cylinder like and ending in a thin membrane. This is destined to become the external auditory canal and tympanic membrane. The first pharyngeal arch is divided into three portions, two lateral and one medial. The lateral portions are semicircular while the medial portion is separated from the lateral by two depressions and is destined to form the body of the tongue. The first pharyngeal pouch is also divided into two parts.
The lateral is to develop into the middle ear and into the lobe of the ear. The outer and medial portion separates the lateral portion of the tongue from the medial pharyngeal arch.

The second branchial arch is also divided into two portions in the 6.5mm embryo. The thickened lateral portion (operculum) covers the third arch. The anterior meets the corresponding portion from the other side forming a narrow thin strip. The second branchial cleft is hidden under the operculum. This portion has two parts. The lateral being a deep and narrow with a thin membrane separating it from the branchial pouch. The medial portion becomes shallow toward the mid-line. The second pharyngeal arch runs into the posterior wall. This structure becomes narrower in the mid-line and does not fuse with the corresponding arch from the opposite side as a so-called "furcula" lies between the ends. The direction of pharyngeal arches are opposite to that of the corresponding branchial arch. The medial part of the former turns downward which the medial portion of the latter points superiorly. This forms an "X" where they cross. The second pharyngeal pouch is deeper than the first and is separated from the second branchial cleft by a thin membrane.

The third arch is smaller than the first and second
and lies closer to the mid-line. More than one-half this structure lies under the operculum, formed by the second arch, and fuses with the structure. The medial end, however, becomes markedly thinner and disappears. The third branchial cleft is similar to the second but is smaller and shorter. From the observation and studies of the third pharyngeal arch is seen an arch that is shorter than the previous one, coursing an upward and horizontal direction forming an "X" with the second pharyngeal arch. In the center of the "X" thus formed is the "furcula". The third pharyngeal pouch is shorter than the second with an oval lumen.

The fourth branchial arch is the smallest and lies beneath the third. This arch is also divided into two portions, the anterior portion which fuses with the anterior portion of the third. The fourth branchial cleft is more shallow but wider than the third cleft. It is bent at an angle of 60° and opens anteriorly and laterally. Like the fourth branchial arch, the fourth branchial cleft is hidden in the depression formed by the lower border of the superior arches and the free arch-like margin of the lateral border of the neck which grows outward and forms an angle at the transition of the head into the chest. This groove is called the sinus
cervicalis by His and Rabl and these anatomists claim it is formed from the lateral outgrowth and overlapping of the second arch, Bailey (5). Wenglowski (73) on the other hand advocated this sinus is formed by the third arch overlapping the fourth and the second playing no role at all, Wenglowski maintains, if the second arch were involved a triangular area would result with the third and fourth arches being completely covered. The fourth pharyngeal arch courses medially to the "furcula" where it divides and forms the entrance into the epiglottis.

The fourth pharyngeal pouch is only a long broad depression in the 6.5 mm. embryo.

In the eight millimeter embryo the arches have developed into larger and more massive structures with the branchial cleft corresponding to the arches but have been pushed downward by the growth of the lateral portions of the branchial arches.

The complex of the first branchial arch shows more clearly the two portions with definite indications of maxillary and mandibular derivations. The first branchial cleft by this time shows the external auditory canal, which originates from the posterior portion, is fully developed and is actually separated from the cleft by a
small process. The first pharyngeal arch shows the medial portion, tongue anlage, to be considerably enlarged. Between the anterior anlage of the tongue and the second pharyngeal arch lies the first pharyngeal pouch.

Advances shown by the second complex are most marked. The second branchial arch is massive, especially the lateral portion which has extended laterally and inferiorly overlapping the third and fourth arches. McKenty (48) states this overgrowth leaves a recess, the precervical sinus. The portion posteriorly grows over the mouth of the precervical sinus forming the operculum. Under this operculum the sinus retains its connection with the outside via the precervical duct. This sinus and duct are later obliterated by the growth of the tissues of the neck and the hyoid bone. The second branchial cleft is quite deep and separated from the pharyngeal pouch by a small oval membrane. The second pharyngeal pouch is essentially the same as in the 6.5 mm embryo. Pharyngeal pouch two is generally narrower than previously noted,
although the medial portion becomes wider, and deeper so that where the pouch meets the pharyngeal wall it turns downward at right angles and ends in a thin closing membrane.

The third complex like the second is larger generally, than in the 6.5 mm embryo. The third branchial arch is thicker and more massive, with a short lateral portion. The lower border of this arch is pointed and according to Wenglowski (73) forms the neck. Most anatomists say that while this may have been the finding on the embryos Wenglowski studies. The consensus of opinion is that the lateral portion of the third arch pushes out and aids in the obliteration of the pre-cervical sinus, Bailey (5), Shedden (61), and Carp and Stout (13). The third branchial cleft and pharyngeal arches show no marked changes. The third pharyngeal pouch by this time is oval at its opening but widens out as it gets deeper. In the lateral portion is a closing membrane. In the posterior lower wall is a process running downward and forward, the anlage of the thymus.

The fourth branchial arch is small and is covered by the second and third arches. The fourth branchial cleft is shallow and is separated from the pharyngeal pouch by a thick mesenchyme layer. The fourth pharyngeal arch is short and thick, corresponding
in direction with the branchial arch. It ends in the mesially in the "furcula". The fourth pharyngeal pouch also has an oval entrance with a wide base. The mesial portion is taken up by a canal passing forward--the anlage of the lateral lobes of the thyroid.

In embryos of his age the fifth and sixth branchial arches are present. The fifth presents itself as a thick triangular area with its base downward and apex pointing superiorly. The fifth cleft is formed on the floor of the precervical sinus.

The fifth pharyngeal arches and pouches are not seen. The sixth branchial arch is only indicated at the lower end of the servical sinus with the sixth branchial cleft, like the fifth being located on the floor of the precervical sinus.

The precervical sinus in the eight mm embryo is large and deep. The entrance is elongated and oval and is bounded superiorly by the lateral portion of the second branchial arch, inferiorly by the wall of the chest and neck. The cavity is large and extends to the second branchial cleft. The cavity is filled up largely with the third, fourth, fifth and sixth arches.

By the time the embryo is eleven mm long the branchial apparatus is in the process of retrogression.
Only three arches are visible as the sinus precervicalis is closed from without. The first arch has developed to the extent that the maxillary and mandibular processes are quite marked. The second arch is large and conical with the lateral portion thicker and more massive extending downward over the more inferior arches to the chest wall. The medial portion join in the midline anteriorly as a narrow strand forming the thyroid bone. The third arch is definitely smaller. Seen from within one notes the marked retrogression of the branchial apparatus and the development of the definitive structure derived from them. The tongue takes on a real form, although the body and base are still separate. The base is being formed by the medial ends of the second and third pharyngeal arches. The epiglottis is wide and not well shaped as yet. In the posterior portion of the third pharyngeal pouch are smaller canals—one on either side. These are the thymic ducts.

In the twelve and thirteen mm embryos further retrogression is noticeable. Only the first and second arches are seen. A small depression marks the course of the new absent sinus. The first arch is well differentiative into the maxilla and lower jaw and lip. The second arch is conical and horizontal. Due to the
downward displacement of the heart the neck now begins
to take form.

As seen from within, the arches are low, their
contours confluent, and the pouches are small shallow
grooves. Arches two and three can still be made out
laterally; medially they go to make up the tongue.

In the fourteenth millimeter embryo the branchial
apparatus has disappeared and the jaw is well formed.
On internal examination the tongue is nearly completely
formed. Near the base, however, two transverse folds
are present; the remnants of the second and third
pharyngeal arches. Epiglottis and arytenoids are well
developed and the thymic duct openings are still visible.

By the time the embryo is nineteen millimeters long
there is no remains of any of the branchial apparatus.
The neck is longer and better developed with the muscu-
lar contour now being made out. The tongue and alveolar
arches are completely formed. The epiglottis is separa-
ted from the base of the tongue by a depression.

In the discussion of the embryology thus far, three
important derivatives have been omitted, and the develop-
ment of each will be discussed separately. The thymus,
external ear and the median lobe of the thyroid. The
last mentioned will be discussed under mid-line cysts and
fistulae.
Knowledge pertaining to the development of the thymus dates back as early as 1831 when Arnold found two passages, one on either side of the trachea, that he interpreted as belonging to the thymus, Meyer (50). His was the first to attempt to trace the development of the thymus, Lipschutz (45). He first believed this structure came from the second, third and fourth pharyngeal pouches, later, in 1886 he said it came from the depths of the sinus precervicalis. In 1889 he stated it originated from the branchial cleft and ten years later he averred that it developed from the third pharyngeal pouch.

Hammer, in 1902-1904 reported on examinations of embryos of various ages, Meyer (50). He states that he found no evidences in the three-five millimeter embryos while in the eight millimeter he found in the corner of the third pharyngeal pouch, a pocket running downward and mesially, converging with that of the opposite side. In 18.5 mm. embryo he illustrated the thymus as long strands on either side of the pharynx and esophagus connecting the gland with the pharynx. He called this the thymo-pharyngeal duct.

According to H. W. Meyer (50), the best work done on the embryology of the thymic duct was through the
studies of Wenglovski. In 1912 this investigator reports that in the 6.5 mm. embryo the third pharyngeal pouch in its lateral and inferior portion, is in contact with the third branchial cleft. From about this region a bag-like depression forms in the pouch, and passes downward and somewhat laterally. As it passes the fourth pouch it crosses a similar out-pocketing—the thyroid anlage (lateral lobes).

By the time an embryo is 8 mm. long the thymopharyngeal duct is markedly elongated, the lumen is patent and the duct runs a wavey tortuous course as it pushes its way downward through the embryonic mesenchyme.

In the 12-13 mm. embryo the thymus is well developed. It is a long strand with two limbs, thickened at the lower end. The upper short limb passes downward in the space between the lateral ends of the third and fourth arches. It lies closer to the third, and at the point where it curves onto the lateral pharyngeal wall it forms a fold, later the arcus palatopharyngeus. From here the upper limb passes almost horizontally outward and downward and comes very close to the side of the neck. At this point the thymic ducts lie close to the remaining cysts of the sinus cervicalis, which lie laterally and posteriorly. At this point, according to
Wenglowksi, the thymic duct or limb becomes angulated and passes into the lower limb, which runs downward forward and medially. The thymus anlage has a lumen, throughout, except at the thickened lower end. The thymus canal enters the lateral pharyngeal wall in the third pharyngeal arch where the latter curves upward over the base of the tongue.

At the 14 mm embryo stage the thymus is at its greatest development. All parts or still present. The duct lumen are beginning to disappear, the pharyngeal opening embryo has grown two changes have taken place--the lower end takes on the form of a gland. At the same time retrogression takes place at the upper portion of the anlage. Throughout the course of the thymic duct solitary epithelial rests are seen which, microscopically are lined with squamous and ciliated epithelium.

In the 19 and 20 mm. embryos the sections of retrogression is the most prominent feature. It is unusual at this phase of 2-3 month embryos, to find epithelial rests near the pharynx, while laterally and below such rests are quite prominent.

The development of the middle and external ear is intimately connected with the first and second branchial arches and the grooves. The first pharyngeal groove
elongates and flattens out to form the eustachian tube and the tympanic cavity. Later, at the end of the second month this tube constricts down to form a round elongated tube with the blind outer end enlarging to form the tympanic cavity. These structures, thus formed, are surrounded by mesenchyme tissue which develops into the middle ear ossicles. As there portions are chondrifying definite connections can be established to their original branchial origin. The malleus and incus from the first branchial arch through their connection with Meckel's cartilage, Arey (2). The stapes from the second branchial arch via the connection with Ruchener's cartilage, Arey (2). The tympanum originated from the closing membrane that separates the first pharyngeal cleft from the first branchial groove. Further proof of this origin is found by the nerve supply to this area, N. V and VII which being the Trigeminal and Facial supply the derivatives of the first and second branchial arches, Arey (2).

The external ear is developed around the first branchial groove. As early as 1887 J. Bland Sutton (67) gave as accurate embryological description of this formation as the modern anatomists and embryologists, Arey (2) and more recently Ladd and Gass (43) have described the embryology in this manner. The external ear is a
modification of the first branchial groove together with additions from the branchial arches bounding the grooves." Thus we have the external acoustic meatus representing the groove itself which at first is in contact with the entoderm of the pharyngeal pouch but soon loses this with growth of the head.

Around this branchial groove develops the auricle, deriving part of its tissue from the first arch and part from the second. About the sixth embryonic week six hillock's develop around the groove, three on either side. The mandibular or first arch gives rise to the tragus hillock (1), the helix hillocks (2 & 3), while the hyoid or second branchial arch gives rise to the antitragus hillock (6) and the anti helix hillock (4 & 5). Later there is fusion between hillocks 2 & 3 and 4 & 5 to form the helix and antihelix respectively. There is also a band like connection between 1 and 6 via a later nodule (lobule) or expanded auricular fold. Between 5 and 6 a narrow band connects the antitragus with the antihelix. Some authors who have been studying the embryology of the ear recently believe this hillocks or mounds to the areas of very rapidly proliferating mesenchymal tissue.

In summarizing the embryology and anatomy of the cervical area, according Ladd (43) and Baumgartner (8)
that in the first two to three weeks of embryonic life there develops four and possibly five branchial clefts which run almost parallel to one another, coursing obliquely downward, forward and somewhat medially. These external grooves separate the adjacent structures into six rounded branchial arches which ultimately form the lower part of the face, and the neck. Each external groove is matched internally by an outpocketing of the foregut, the two portions of this compound structure being separated by a membrane and lined externally by ectodermal tissue and internally by entodermal tissue.

From the first complex, then, Arch I and cleft the pharyngeal arch and cleft is ultimately developed these structures. Arch I gives rise to the mandible, lower lip, maxilla, muscles of mastication the anterior part of the tongue, incus, and malleus. From the corresponding first branchial groove develops the external acoustic meatus and portion of the auricle. From the first branchial pouch are formed the auditory tube and tympanic cavity, with the tympanic membrane being formed from the closing membrane between the first pharyngeal pouch and branchial cleft.

From the second complex the following structures
develop. From the arch develops the structure of the upper neck, including the lesser corner of the hyoid bone, stapes, styloid process, the posterior portion of tongue and the sinus precervicalis. From second pouch develops the tonsillae area and anlage. The second, third and fourth branchial and pharyngeal grooves disappear leaving no trace.

The third, fourth and fifth branchial arches persist in the form of the hyoid, thyroid and cricoid cartilages respectively.

From the third pouch develops the thymus anlage and glands while the fourth pouch gives rise to the lateral thyroid lobes, and the parathyroids.

As early as 1828 Rathke described cervical cysts and fistulae in humans Carp and Stout (13). At this time Rathke theorized that if the lower branchial clefts were not obliterated a fistulae would be formed with the connection to the pharynx being established by the rupture of the closing membrane between the pharyngeal pouch and branchial cleft. Rathke left this theory hanging in air, and although he asserted from what mechanism these cysts and fistulae were formed it was not until the time of Rabl and His 1886 who independently advanced the theory that the cervical sinus was in-
involved in this mechanism. Rabl, according to Carp and Stout (13), was the first embryologist to clearly state the cervical sinus was involved in the formation of branchial cysts and fistulae. Rabl said as the second arch became larger it grew laterally, posteriorly, and inferiorly overlapping the inferior arches, but in the process a cavity was formed, which was lined with epithelium of the stratified squamous type. Normally, with the proper embryological developments of the neck the opposing epithelial surfaces are brought together first and the epithelium is absorbed. However, this process may fail to occur in part of the tract or in its entirety. From the above explanation Rabl formed this hypothesis.

(a) The external opening may be high or low in the neck, depending on the downward extent of growth of the second branchial arch.

(b) The blind end of an incomplete external fistula is a continuation of the vestigial remains of the ectoderm of the precervical sinus.

(c) If the second arch obliterates the precervical sinus, but the second furrow persists and communicates with the pharyngeal entoderm, an incomplete internal fistula results.
(d) A cessation of complete downward growth of
the second arch, accompanied by a break, through the
mesoderm at the level of the second furrow, a complete
branchial fistula will be produced.

(e) If the internal and external openings are both
absent and the precervical sinus is not completely ob-
literated, a cyst will result.

In the same year that Rabl advocated the hypothe-
sis concerning the formation of branchial cysts and
fistulae His, also proposed this same theory His,
however, went into more embryological detail and ex-
plained the reasons how he made these conclusions. He
explained that normally in the embryology of the bran-
chial apparatus the branchial clefts and pharyngcal
pouches paralleled each other in their course and were
separated by a thin membrane—the closing membrane.
Thus one can readily see the simplicity and the probabi-
lities that a closing membrane may perforate into the
cervical sinus. Three years after His original work,
in 1889, he stated he could see no reason why the in-
ternal opening could not be located at the level of
any of the clefts, although he was still of the opinion
the second was most often involved because the sinus pre-
cervicalis (Rabl's sinus cervicalis) was the result of
the rapid growth and telescoping of the second branchial
arch, thus the uppermost portion of the sinus would naturally be pointing toward the second cleft.

Senn (60) in 1884 an American Surgeon two years before Rabl' and His' work advocated that either the second or third cleft may be involved as the cysts and fistulae are most frequently found in these regions. He also, states these anomalies are in intimate relationship with the sheath of the large vessels of the neck, usually in the carotid triangle above the omohyoid muscle.

Although Senn was the first to advocate the theory that any cleft may be responsible, J. Bland-Sutton (67), 1887 was the first to give concrete, logical reasoning for this theory. In his article Sutton reviewed the embryology of the external and middle ear showing how in this development there could be an incomplete closure and obliteration of various portions of fusion. (Bland-Sutton reported on a dissecting a foetus with a malformed ear in which there was found present a fistuleaus tract leading to the pharynx in the region of the first branchial complex. However, he states that these complete fistulae are not to be confused with those found only in the auricle which are due to faulty fusion of the tubercles of the pinna.
In 1890 Kanthack (36) contributed the following to the embryological theory. He did not add another theory but expressed the opinion that although the pharyngeal pouches do not communicate with the outside the branchial fistulae are due to a rapture of the closing membranes into the cervical sinus, thus agreeing with the theory of His and Rabl. Kanthack further emphasizes these fistulae are due to (a) a deficient closure of the sinus cervicalis of Rabl and His and (b) to the persistence of only the second inner branchial groove which has torn through into the cervical sinus.

During this same year two physicians undertook to analyse all the literature concerning these embryological anomalies that had been written up to 1890. These two men, Kostaneicki and Melicki drew from the theories these points (a) the internal openings were all noted in the tonsillar fossa, (b) that most of the external openings occurred along the medial border of the Sternoclidomastoid muscle and that these openings do not correspond to the area of the cleft from which it developed but open in the middle and lower anterior portions of the neck, whereas the cleft progressed posteriorly. From these bits of data together with the
various theories already formulated they proposed the cervical sinus theory with the second branchial cleft being the point of rupture into the pharynx. When these men were asked concerning aural, fistulas they added the factor of infection, but reminding the inquirers that the second arch aided in part of the ear embryology. Kostanicki and Melicki claim that in the face of an infected fistula or cyst the external opening may be located elsewhere (Meyer (20)).

Other proponents of this theory were Whitacre (75) McKenty (48), Miller (52) Whitman (76) Carp (12), Bailey (3), (7), and Brown (11).

Whitacre reviewed the embryology of the cervical region and formulated the following conclusion or points: (1) The mesoblastic tissue of the neck undergoes complete circular segmentation to form five branchial arches, and between each is an outer and an inner deep cleft separated by a thin closing membrane. (2) A breaking through of this membrane will furnish a connection between the skin and throat. (3) The inner opening is always in the region of the tonsil, the location of the second cleft. (4) The outer surface of cleft two forms the sinus cervicalis which provides a fistulous pathway between the throat and the skin at a point
distal to the inner opening. (5) The external opening may be anywhere from the angle of the jaw to the sternum along the anterior border of the sternomastoid muscle. (6) The first, third, fourth and fifth clefts can never give rise to a fistula. (7) The second cleft therefore, is the only one giving rise to fistulae. The outer opening anywhere while the inner opening in the tonsillar fossa or region of the second cleft.

Miller (52) states that it never has been proven that a complete fistula has been formed from either the third or fourth cleft far as Whitman (76) also traced the course of a complete fistula is from the skin often as low as the clavicle to the anterior border of the sternomastoid muscle to the hyoid region where it crosses the digastric muscle then passes between the carotid bifurcation, under the stylo-pharyngeus and stylo-glossus muscles, then crossing nerves IX and X to the tonsillar fossa.

In 1912 Wengowski (73) completed eight years of research using embryos ranging in size from 2.6 mm. to 49 mm. and brought forth theories that were quite startling because they had contradicted the works of all the embryologists and anatomists who had preceded him. These theories advocated by Wengowski have for
most part been disproven and disregarded by most of the foremost men of the present day. Meyers (50), is one of the most prominent proponents of this theory and in his article summarizes Wenglowski's work. Wenglowski contradicted the works of Rabl and His by claiming the branchial clefts and pharyngeal pouches did not parallel each other but crossed each other and for this reason there could be no fistula formed from the second cleft. Kingsbury (38), Keibel and Mall (37), and Bailey (5) on the other hand have since proven Wenglowski to be in error; that these structures do parallel each other.

Another argument advanced by Wenglowski in the cervical sinus does not develop from the second branchial arch but rather from the third. However, Kingsbury (38), Keibel and Mall (51), and numerous more recent investigators have again proven embryologically that the cervical sinus does develop from the second.

Wenglowski stated the arches did not run from superiorly to inferior but from forward back, Kingsbury agreed with this but explained that it was due to the forward flexion of head on the body.

If the second cleft were involved, Wenglowski maintains that the lower limits would be at the level of the hyoid bone, while the internal opening would not be
located posterior to the posterior tonsilar pillar as he claimed it is located. Both Kingsbury (38) and Keibel and Mall (31) that since there is no neck in embryos of the age studied by Wenglowski he failed to notice that the neck structures followed the descent of the heat anlage. As far the internal opening nearly every investigator reports these within the tonsillar fossa.

Finally Wenglowski claims that the thymus duct is the cause of lateral cysts and fistulae, because (1) it corresponds with the course of this duct; (2) the type of epithilium present corresponds to that found in the thymic duct, namely ciliated columnar and squamous epithelium, which would speak against a branchiogenic origin Meyer (58). If these statements were true, claims Kingsbury (38) and others, why shouldn't cysts and fistulae extend entirely to the thymus gland instead of ending at the sternoclavicular junction? As for the epithelial findings, these correspond to the findings of the pharyngeal pouch, ciliated columnar, and to the cervical sinus, stratified squamous.

Wenglowski made no attempt to explain the cysts and fistulae found entirely outside the area of the third pouch, namely the ear region except to say they arrived there via an inflammatory process.
The presence of lymphoid tissue around the tract was, according to Meyer (50), characteristic to the thymus tract, and not to the sinus cervicalis. Other investigators as Bailey (6), Hyndman and Light (31) say this is the result of a chronic inflammation for there is also found red blood cells and polymorphonuclear leukocytes.

Besides Meyers, Klingenstein and Colp (39), Lipschutz (45), Wooden (77) and Kramer (41) are advocators of this theory. Klingenstein and Colp (39) attributes the disappearance of the branchial clefts to two forces, (1) the ingrowth of mesenchymal tissue and (2) the rapid growth of the branchial arches toward each other. They continue "with the disappearnce of the furrows so also the cervical sinus vanishes by the amalgamation of the under surface of the third arch with the projections of the lateral cervical fold." In older embryos the microscopic examination shows stratified squamous epithelial rests embedded in mesenchyme, and they believe these to be from thymic duct or cervical sinus rests. They believe the columnar epithelium is pinched off the branchial furrows.

Lipschutz (45) believes the thymic duct can become secondarily luminated like that of the naso-lacrimal
duct, liver ducts and the mammary gland ducts which were originally solid buds.

Within the past decade there has been a tendency to swing back to the original theory advocated by Bland-Sutton that any one of the branchial complexes is capable of producing a fistulous tract, although the second is the most commonly involved. Hyndman and Light (31) in 1929 reviewed the different theories and were of the opinion that anyone of the following mechanisms may take place.

(1) "Any of the grooves may remain as a fistula or a tract of included ectoderm and endoderm in pure form, having its origin and termination in its own normal embryologic location.

(2) "Any one of the grooves might persist with its normal embryologic origin on the pharyngeal side and by continuation in the cervical sinus have its external opening anywhere from the styloid process to the sternoclavicular joint.

(3) "Any groove might persist in whole or part and connect with another groove via the cervical sinus.

Jasa (24) states he is of the opinion that any one of the branchial grooves is capable of producing a fistula and cites the fistulae of the ear which embryo-
logically comes from the first complex mainly with a few contributions by the second.

About 1 year ago Suermondt (66), states these fistulae may come from the thymopharyngeal duct, second cleft and cervical sinus, or any other cleft that may have ruptured into the cervical sinus early in embryonic life.

The most recent work done on this subject was that of Ladd and Gross (43). These men reason in this manner. "As an integral part of each branchial arch the vascular system acquires an aortic branch coursing in an antero-posterior direction. With degeneration of the arches many of these vessels undergo degeneration.

From Ladd

These authors point out that these anomalies cannot be derived from the thymic duct primarily because
there are certain vestiges that now can be traced to branchial origin. Among the most favorable arguments is the constancy of the location of the cervical fistulae in relation to what would be the course of the upper branchial cleft.

In determining which branchial cleft is involved or at fault, these authors are of the opinion that no one cleft nor any cleft is solely responsible. It is evident they say, that the fourth cannot be so involved as these anomalies have not been found inferior to the aortic arch or subclavian artery. If the third were involved the tract would be postero-inferior to the glossopharyngeal nerve and lateral to the external and internal carotids, a very uncommon condition.

If the second cleft should be involved the fistula would lie between the internal and external carotids. This position is most commonly present. The internal portion is in the tonsillar fossa which again coincides closely with operative findings.

"Regarding anomalies from the first cleft, knowledge is less accurate. Since it is known that the first pouch and cleft lead to the formation of the eustachean tube, external auditory canal, tragus and helix, it is logical to believe that any sinus connecting with these structures is derived from the first cleft."
Shedden (61) an advocate of the Second branchial cleft and cervical sinus theory maintains that with these fistulae of the cervical sinus the external opening may be found anywhere from the external ear to the sterno-clavicular joint while the openings around the ear could not be explained by the thymic duct theory. Shedden in his article recorded Wengowski's conclusions in one column and Kingsbury's comments in the other. Kingsbury is probably regarded as one of the leading embryologists living today. Below is the tabulation.

<table>
<thead>
<tr>
<th>Wengowski</th>
<th>Kingsbury</th>
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<tbody>
<tr>
<td>(1) There develop in man 5-6 branchial arches and as many clefts. They are not open.</td>
<td>(1) In man only 4 clefts normally develop. In 5 mm. embryo there is occasionally a suggestion of a 5th. The second groove probably normally opens only to close again immediately.</td>
</tr>
<tr>
<td>(2) The neck sinus-sinus cervicalis-is built by the approximation of the lateral borders of the neck, breast and under border of the third arch, and not the</td>
<td>(2) At the time the branchial clefts are present there is no neck or breast present. These are formed by ventral growth of the more dor-</td>
</tr>
</tbody>
</table>
second as His contended.

(3) The branchial apparatus lies from front back and not from head downward. The inferior border of the arches and the derived structures are the inferior border of the hyoid bone.

(3) Branchial apparatus lies front to back but this is due to (a) great growth of head which bends it downward; (b) lack of definite neck. Later when due to growth, the neck is established, the head is raised, but the branchial apparatus as such has disappeared. The sites of 4 main arches string from eustachian tube to pyri-form sinus. The interpretation of seeming ventral dorsal sequence in adult is wrong.

(4) The branchial apparatus cannot leave remnants below the hyoid.

(4) Vestiges are not only found above the hyoid and branchial apparatus leaves remnants below hyoid.

(5) The thymus originates from the third pouch in the form of a long canal running

(5) This is correct. The lower end (of the long canal) however, is always
obliquely from the lateral pharyngeal wall to the sternum where the thymus begins to develop.

close to the pericardium and retains that relation in the descent of the heart therefore the thymus develops in the thorax.

(6) The thymic duct usually (6) This is substantially disappears partly or entirely. correct.

Occasionally the entire duct or part of it may remain.

(7) Vestiges of thymic duct (7) I am not sure what is change into a lateral cervical fistula or cysts. If the entire duct persists there is a complete fistula- if part persists--there is an incomplete fistula.

(8) The anatomical situation of the lateral fistulae corresponds very closely
with the course of the thymic duct.

(9) Lateral thyroid lobes have short canals or ducts which normally disappear. Occasionally these may persist and form fistulae and cysts.

(9) Statement essentially correct.
- PATHOLOGY

Not only on the basis of embryological development have explanations to the origin of branchiogenic cysts and fistula been attempted, but also, through pathological studies. Nearly all the authors report the presence of a thick band of lymphoid tissue surrounding the anomaly, and, likewise, each school of thought adopts this finding to his theory. Some as Wenglowski (73), Meyer (50) and Klingenstein and Colp (39) state this finding is normal and is characteristic­ally found with the development of the thymus. At the other extreme are Bailey (6), Baumgartner (8) and Hyndman and Light (32) who believe this dense band of lymphoid tissue is not normally present from early embryological development but is an infiltrative process due to a chronic inflammation.

The type of epithelium present has also been acclaimed by each school of thought as being indicative of the particular theory advocated by each. There are two types of epithelium found stratified squamous and columnar epithelium, ciliated or non-ciliated. All schools of thought say the stratified squamous epithelium is of ectodermal origin and therefore the cyst or fistula must have an ectodermal origin in part, at least.
They all agree also that the columnar epithelium is normal derivative of entodermal tissue, but one school states this finding is pathognomonic of thymus duct origin while the other school says this is the result of entodermal rests from the pharyngeal pouches or arches.

Others have attempted to explain these anomalies on the basis of content but these attempts have not been at all successful in determining the origin but have aided in determining the type of pathology present in cysts or fistula associated with inflammation or not, dermoids, tuberculous glands, malignant growth etc.

In 1884 Senn (60) classified branchial cysts according to the contents and did not explain them in relation to any particular branchial cleft origin. Senn divides them into four groups in this manner.

(1) Mucus branchial cysts. These are usually found in the upper branchial clefts. Their origin is due to the imperfect closure of the upper branchial tracts, consequently the cyst wall may derive its lining from the mucus membrane of the pharynx, and with the retention of the physiological secretions, a mucus cyst will be produced.
(2) **Atheromatous branchial cysts.** These are deep-seated and are found along the sheath of the large vessels of the neck. These are usually located around the second and third branchial tracts near the thyroïd bone. The contents of these cysts are of atheromatous nature and resemble dermoid cysts, except they do not have anything to indicate hair follicles, lanugo hair or sebaceous material.

(3) **Serous branchial cysts.** These are composed of thin cyst walls and contain serous contents and may develop from anyone of the branchial clefts which fails to obliterate completely. They may form anywhere in the neck in relation to the branchial tract. These cysts may be deep seated or superficial and give no trouble, usually except for size.

(4) **Hematocysts of branchial clefts.** These are any of the foregoing group with the contents disclosed by blood.

Since the time of Senn in 1884 nearly all the pathological work has done in reference to histological studies of these fistulous tracts and of the cyst walls. As has already been mentioned the lymphoid tissue that is quite characteristically found surrounding these tracts have been used as an argument by all
According to Wenglowski (73) and more recently Meyer (50), one of the foremost proponents of Wenglowski's thymic duct origin states that lateral cysts and fistulae are rich and abundantly supplied with a zone of lymphoid tissue which indicates thymic duct origin whereas ectodermal cysts and fistulae are devoid of lymphoid tissue. This idea was again advocated by Klingenstein and Colp when they compared the median and lateral fistulae, pointing out that thyroglossal cysts and fistulae which are ectodermal in origin do not possess lymphoid tissue whereas lateral cysts and fistulae do, therefore these structures must be entodermal derivatives and the thymic duct in particular.

On the other hand Hyndman and Light (31) who have studied a large number of cases over a period of ten years, report that upon microscopic studies of the walls the usual thing is an epithelial lined cavity or duct on a thick band of lymphoid tissue, which contains varying amounts of smooth and striate muscle and infiltrated to some extent with the elements of chronic inflammation—round cells, mononuclears and an occasional eosinophilic leukocyte. However, the lymphoid zone may be entirely lacking. Its presence, therefore,
indicates a process of chronic inflammation going on
rather than to the embryonic tissue derivative. These
authors state that most cases seen clinically do have
an inflammatory process of a low grade present. This
theory is supported by such other research men as
Bailey (5), Ladd and Goss (43), Miller (52), and Baum­
gartner (8).

The lining epithelium according to Meyer (50) cor­
responds to the thymic duct in that one finds areas
of stratified squamous epithelium mixed with ciliated
columnar epithelium, and in the walls are encysted
striate muscles, cartilage and mucus glands. Meyers
contends that these squamous and flat epithelial cells
grow over to ciliated columnar epithelium may be several
layers thick. He states this corresponds to the thymus
duct epithelium and the stratified squamous epithelium
appears at the point where the thymic duct touches a
cervical sinus cyst and the latter has broken into the
duct. Wenglowski (73) states that ciliated epithelium
can only be found with entodermal derivatives and not
with ectodermal derivatives.

Brown (11) states that cysts derived from ectoderm
are lined with stratified squamous epithelium while
those of entodermal origin are lined with columnar epi-
thelium. He states further "However, some cysts are lined by both types of epithelium." Brown is one of the ardent advocates of the "cervical sinus" theory and explains the presence of both types of epithelium present in this manner. Normally, the sinus tract is completely obliterated and the epithelium absorbed. "Sometimes, however, the epithelial lining, persists and the embryonic cervical sinus, or part of it forms a cervical cyst. Likewise a pinching off and non-absorption of the entodermal lining and a rupture of the thin membrane between will present a tract containing both ciliated columnar and stratified squamous epithelium."

The walls of these anomalies are composed of more or less embryonic tissue being ectoblast on the inside and epiblast on the outside, according to Miller (52). He based his judgment on the histological examination of the epithelium which is cylindrical at the base and stratified at the top. He further asserts that cysts and fistulae are lined by either stratified squamous or columnar (ciliated or non-ciliated) epithelium. The lining at any given area or within the entire tract depends on the amount of inflammatory process present for where there has been considerable
evidence of inflammation the lining is almost denuded of epithelium or may contain only columnar epithelium. This appears as a quite logical explanation for normally ciliated columnar epithelium is more resistant to trauma and inflammatory processes. Bailey (5) further substantiates this theory.

Lastly, the supporters of Wenglowski's theory, Meyer (50) states external opening of the lateral fistulae may be located from near the pharynx to the sternum along the anterior border of the Sternomastoid muscle, but wherever the external opening is the fistulous tract is always the same. The internal opening is always located behind to the posterior tonsillar pillar or immediately in front of it.

If the above findings were exactly true how can they account for the fistulous openings around the ear, and the occasional tract behind the Sternomastoid muscle. Internal openings according to Bailey (5) are quite uncommon and when they do occur they are located in the region of the tonsillar fossa, or the fossa of Rosenmuller. This relation is important for a number of cases of branchial fistulae have been reported following a tonsillectomy.

Hyndman and Light (31) give further proof that
these histological findings are not conclusive or proof that the thymic duct is not the main or only structure involved in the formation of lateral cysts and fistulae. He points out that there are certain anatomic and histologic features that make their origin solely from the branchial clefts rather than the thymic duct. As has been pointed out Wenglowski argues that most cysts and fistulae of ectodermal origin coming from the cervical sinus with the portions containing entoderm originating from the thymic duct. He felt that the dense lymphoid tissue indicated thymic duct origin.

Hyndman and Light, on the other hand argue that since the cysts and fistulae are lined wholly by prickle cell stratified squamous epithelium they must be of ectodermal origin and are commonly found exhibiting a dense band of lymphoid tissue which contraindicates the thymic duct origin.

Further, cysts located as high as the mastoid process present the same histological structures, and these are located far above the thymic duct origin.

Another argument against this theory is that cysts and fistulae are never found to extend to the thymus gland, and certainly, such would be possible if such an origin were true. Cysts and fistulae have been
reported connected to the greater cornu of the hyoid bone, Hyndman and Light (31), which further bolsters the branchial cleft theory.

Further histological and pathological studies have been made concerning the contents of cysts and fistulae and in making a comparison of the two anomalies. Eggers (23) reports an interesting case of a branchial fistula that became complete following a tonsillectomy which had a patent lumen, throughout. He noted the unusual secretion to be saliva-like, clear fluid with the amount increasing during and following deglutition.

Thomson (70) noted those branchial cysts lying close to the skin are lined with squamous epithelium resemble dermoids, and contained an opaque fluid filled with cholestrin crystals while those deeper are lined with cylindrical epithelium and discharge a glairy mucoid substance.

In comparing and contrasting the cysts and fistulae one finds that fistulae are often present at birth, which can be attributed to imperfect closure of the sinus cervicais whereas cysts are never congenital or present at birth, due to the lack of stimulation of secretion of the epithelial lining. This process occurs with an inflammatory process and especially with an
upper respiratory infection. With inactivity of the lining cells the secretion will be absorbed as rapidly as eliminated whereas with a stimulatory process the balance is disturbed and a cyst results. Fistulae and cysts can further be compared and tabulated to location, type of epithelium that predominates and as to their contents. 

**Fistulae**

1. May be present at birth.
2. Located in lower 1/3 of neck.
3. Lined with ciliated columnar epithelium.
4. Exudes sticky mucus.

**Cysts**

1. Appear in early adult life.
2. Located in upper 1/3 of neck.
3. Lined with stratified squamous epithelium.
4. Filled with opaque fluid rich in cholesterol.
Symptoms and Diagnosis.

Branchial cysts, as a rule appear in early adult life and are never present at birth whereas branchial fistulae may be present at birth or may appear anytime during the patient's life following the mere incising and draining of cysts.

All authors are quite uniformly agreed as to the symptomatology of branchiogenic cysts and fistulae. In discussing this phase the symptoms and diagnosis of each will be discussed separately.

Branchial cysts, clinically, presents a uniform painless, nontranslucent, semi-fixed fluctuant tumor, which is never tender except from pressure or secondary infection, Baumgartner (8). If these fluctuant swellings are found around the anterior border of the sterno-mastoid muscle with the absence of cervical gland enlargement one must think of branchiogenic cysts, Bailey (6). Occasionally additional symptoms and findings occur, these are mainly those of pressure on neighboring structures with the resultant difficulty of breathing and swallowing and presence of hoarseness, the latter due to pressure on the recurrent laryngeal nerve, while the former are due to pressure against the trachea and esophagus, primarily. With
the above symptoms two confirmatory procedures can and should be done. One, as advised by Bailey (5) consists of puncturing the cyst, under sterile conditions and drawing off some fluid, to be examined under the microscope. In cases of a branchial cyst cholesterol crystals will be found. The other method was suggested by Wangenstien (72). He recommends drawing off the fluid within the cyst by means of a needle, under sterile conditions and then while the needle is still in place inject a radio-opaque substance and take an X-ray.

A sinus or fistula, on the other hand, gives a history of periodic drainage of mucoid or thin milky material. Apart from the continual or intermittent discharge of mucus and pus, the leading symptoms are due to recurrent attacks of inflammation of the fistulas tract. In a fistula with an external opening these attacks are fairly constant, (Bailey (5). All fistula patients give a history of an intermittent swelling of the neck, which, at first is small and soft, increasing in size then draining. This drainage is noted especially with fistulae with external openings, Brown (11).

Bailey (5) believes the variety without external openings, is clinically rare, but may be more common
than is supposed and the tracts may be so small as to
unobtrusively discharge pus into the fossa of Rosenmuller. The location or course of the fistulous tract
may be in close proximity to the vagus nerve which
may produce additional symptoms of vagal irritation,
as cough, palpitation and intermittent pulse.

In diagnosing fistulas one must remember the open-
ings may be located along the anterior border of the
Sternomastoid muscle along its entire course from the
external ear to the sternum. Around the opening there
is sometimes an area of pigmented tissue and occasion-
ally one finds a bit of thickened tissue containing
cartilege, cervical auricle, Baumgartner (8) says that
by pulling the skin taut one can feel the tract along
the anterior border of the Sterno-mastoid muscle point-
ing toward the tonsillar fossa.

Bailey (5) suggests the use of lipiodal injection
and X-ray to determine the course of the tract. He
warns, however, against any use during an active in-
flammatory phase. Fourteen days should lapse between
this and the time of lipiodal injection. Bailey uses
this method for investigation. Three to four days
before removal the skin around the orifice is infilt-
rated with 1% novacaine and a purse string suture is
placed very close to the opening of the fistula. Into this opening is placed a catheter or needle, depending on the size of the opening, and through it is injected equal parts of lipiodal and paraffin well stirred. During injection one must constantly be aware of vagal symptoms and stop if they occur. When it is judged the sinus is full and distended the needle or catheter is removed and the purse string is tightened and tied. X-rays are then taken to determine the exact size course and patency of the duct.

An other diagnostic procedure which was used by the earlier investigators, Senn (60), Wenglowski, Whitacre (75) etc., was to insert a probe into the fistula tract in an attempt to determine the distance and course the fistula takes. This practice has fallen into more or less disrepute since the advent of X-ray for diagnostic purposes. Lipshutz (45), adds that the dangers of probing for diagnosis far outweighs the advantages. These four dangers he feels contraindicates probing for diagnosis.

1. Spreading any infection that may be present.
2. Danger of false passage.
3. Practical-impossibility of traversing the upper portion of the tract.
(4) Danger of damage to neck structures with special reference to the great vessels of the neck and the vogue and recurrent laryngeal nerves.

These same contraindications have been expressed by a large number of modern or recent writers.

In the differential diagnosis of these cases one must bear in mind:

(1) **Inflammatory adenitis** which is bilateral with numerous glands involved. These glands are tender and always occur secondarily to some fact of infection in the teeth, tonsils, etc.

(2) **Tuberculous adenitis.** The glands here are tender matted together and are firm. The discharge from these is purulent while a branchial fistula is clear mucoid or milky and has cholestral crystals.

(3) **Cystic hydroma,** is translucent, mainly in the supraclavicular area, is lobulated and has an enormous growth.

(4) **Thyroglossal duct cysts** are usually always mid-line and moves on swallowing.

(5) **Hemiangiomata** decreases in size on pressure and have a typical discoloration.
(6) Lipomata are usually labulated, soft and non-fluctuant.
Treatment

The treatment of lateral cysts and fistulae can be done both conservatively and radically. In the minds of nearly all the present day surgeons radical extirpation is necessary for complete cure whereas conservative treatment should be used in a few carefully selected cases. Prior to the advent of aseptic surgery sclerosing medias and repeated drainage were instituted solely.

The methods used to treat these conditions are (1) incisions: This procedure results in immediate drainage of the fluid and collapses of the cyst wall. With this method there is almost a 100% tendency to recur, thus necessitating repeated drainage. In addition when a cyst is incised there is an almost certain bet that it will be converted into a chronically draining sinus. In the presence of an infection or cellulitis of the neck wide incisions of the cyst or fistula is indicated to drain out the infected material, to be followed later by complete removal.

(2) Electrical Cautery. This procedure is of historical interest now. The dangers and uncertainties far outweigh the advantages. In large cysts or in fistulas with a tortuous tract, actual electrical
cautery of all the tissues is a tedious and hazardous process, for there is danger of destroying not only epithelial tissue, but, also, the surrounding structures. If any of the epithelial tissue remains it can carry on the normal function with reformation of a cyst, Chevers (14), however, reports that he had successfully treated a number of cases by probing the tract with a fine ureteral catheter and silkworm gut to establish free drainage. He then cleaned out the fistula with antiseptic solutions, until no pus was obtained. This was followed by an injection of croton oil to destroy the epithelium and aid in providing obliteration. A Galvanic current via a fine silver wire in the tract was used on repeated occasions to aid in the obliteration.

(3) Injection of sclerosing media. This method of treatment was used almost exclusively prior to surgical extirpation. At the present time however, it is indicated only in the presence of small uncomplicated cysts and in fistula that have no internal opening into the pharynx. The contr-indications for sclerosing solutions are large cysts, infections in the cysts and fistulae, multilocular cysts and fistulae with opening into the pharynx. The dangers of these sclerosing solutions is the production of cervical cellulitis,
cauterization of surrounding normal structures with stricture. This latter is especially dangerous when it involves the great vessels of the neck.

Comer (18) in 1927 reports having treated several cases of complete branchial fistulae with 100% trichloracetic acid. He introduced this solution through the internal opening following an injection of lipiodal to determine the duct course. Such procedure has been quite violently condemned because of the highly caustic substance used and because of the contraindications listed above.

Within the past few years a new sclerosing agent was introduced for use where indicated. This solution was introduced by Cutler and Zollinger (19) and its use recommended by Christopher (16), Bailey and Meyers. Carnay's solution contains:

Absolute Alcohol 6 cc
Chloroform 1 cc
Glacial Acetic Acid 1 cc
Ferric Chloride 1 gram.

This solution is supposed to have the qualities of moderate penetration, rapid local fixation of epithelial tissues and excellent hemostatic. It acts much like tannic acid on the skin for it practically dries the cyst or fistulous lining. These men claim
that while the solution is more efficient it has less local irritation than most caustics used heretofore.

(4) Antiseptic drainage should be used in the presence of infection in the cyst and fistula locally and cellulitis of the neck. Here the tract is opened widely to permit free and adequate drainage until the infectious process has cleared up enough to allow radical surgical removal. Another indication is in infants and young children with large cysts where more radical procedures are not indicated.

(5) Extirpation is the more radical method of treatment. Prior to aseptic this was considered as a long, tedious, and dangerous process and should be used where the cyst is small and superficial. With improvement of the modern surgery radical extirpation of branchial cysts and fistulae has become the procedure of choice.

Von Hocker and Koenig laid down two principles governing the treatment of these cases, Meyer (50). The first principle states that in uncomplicated or uninfected cases the tract should be removed by surgery, either by inversion of the tract into the oral cavity, if the tract is not fixed, or should be dissected to the digastric muscle, then with a finger in the oral cavity
the dissected tract should be inverted and excised.

The other principle deals with infected or otherwise complicated conditions where the treatment should be conservative and surgery not attempted until all infectious processes are cleared.

As was described under Symptoms and diagnosis Bailey closes the external opening with a purse-string suture following the injection of equal parts of lipiodal and paraffin. These are allowed to remain until the paraffin has hardened. By means of transverse oblique incisions around the openings, so as not to destroy the sutures, the skin is opened. Bailey then states that by exerting gentle, steady but firm traction on the fistula the tract is converted into a cyst which can be dissected out much easier. Traction and dissection are then carried up as far as perfect exposure can be obtained.

He then makes a second incision parallel to the first but higher in the neck and threads the dissected tract through it—then proceeds with the dissection higher into the neck. Usually the upper limits can be reached through this incision. The latter part of the incision is rather difficult due to the close relationship of the tract to the great vessels of the neck.
Often the tract is adherent to the jugular vein or passes through the carotid bifurcation, and must be dissected free. The vagus nerve must carefully watched so as not to sever it. As soon as the tract has been dissected out the skin is closed.

Bailey believes this method should be used in removing all cysts and fistulae as adequate exposure is obtained. He believes the inversion of the tract into the mouth as recommended by Meyers (50) and Woodens and Hutchens (77), is less satisfactory and more dangerous.

Later surgeons as Love (40) and Gaston (25) have modified the procedure used by Bailey in that only one incision is made in the neck and the tract dissected out to the pharynx. These authors believe that since most openings and cysts are found in the middle third of the neck adequate removal can be obtained through only one incision. In cases where the lower limits approach the sternum two incisions may be necessary.

Quite frequently large cysts may be found closely adherent to the carotid vessels in the carotid bifurcation. As it is necessary to completely remove all the cystic tissue these sacs should be removed by sharp
dissection. Hicken (30) has worked out a scheme whereby the removal of cysts may be facilitated. He incises the cyst and packs it with sterile gauze until the walls are put on a tension. In doing this whenever a cyst is punctured during dissection the boundaries are not lost. This method is especially valuable in cysts located in the carotid bifurcation as it gives the surgeon something solid to work against and reducing the likliness of damage to the great vessels.

Baumgartner (8) has devised a useful method in aiding surgical removal in that after he has injected the tract with lipiodal solution for X-ray purposes he permits the solution to drain out then reinjects the tract with methylene blue. After the epithelial tissue has been thoroughly stained the excess is washed out with either distilled water or normal saline solution. This has the advantage of not staining the entire field in case the fistula were ruptured.
PART IV

Mid-Line or Thyroglossal Duct Cysts

Embryology

His was the first of the early investigators, to show that the middle lobe of the thyroid gland played an important role in the formation of mid-line cysts and fistulae. The passage from the foramen caecum to the middle thyroid lobe was called the "ductus thyroglossus" by His. These findings were quite generally accepted by the surgeons of the time but there are cases of physicians living at His' time who were not ready to accept this theory.

Kanthack, (36) in 1890-91 made the statement that mid-line cysts and fistulae are not derived from the thyroglossal or lingual ducts but were derivatives from the branchial clefts, and that the mid-line fistula always swung to one side or the other. Kanthack further stated he could not, as yet, prove this. How-on searching the literature for subsequent work by this man none could be found.

Kanthack was not the only surgeon of this time to be a little hesitant about accepting the theory of His for Durham (22) and J. Bland Sutton (68) in 1894 who, although, were convinced with the logic of His'
theory they were not quite willing to accept, for as Durham states "there are undoubtedly many many branchio-genic cysts and fistula that should be regarded as a persistent thyroglossal duct."

With this uncertainty, attempts were begun to explain the histological findings of the fistulous tract which contained both squamous and columnar epithelium. Another finding not fully explained at this time was why the fistula passes through the hyoid bone and why there never is, actually, a complete fistula.

Wenglowski was the first to attempt to explain these findings from actual embryonal studies. He divided his examinations and explanations into three portions; the tongue, the hyoid and the infrahyoid, Meyer (50).

**The Tongue Portion:**

The tongue develops in two entirely separate portions. The two lateral halves of the tip originate from the first branchial arch and meet in the mid-line. The root of the tongue develops from the second and third branchial arches and the mass lying between their medial ends is the so-called "furcula."

Almost simultaneously with the development of the first pharyngeal pouch there also appear the anlage of
the thyroid gland, the ductus thyroglossus. This anlage is recognizable before the first pharyngcal pouch has come into contact with the ectoderm, as a prominence in the ventral wall of the pharynx. This stalk elongates and becomes converted into a epithelial cord which persists for some time. The thyroid anlage is at first anterior to, and not in the region of the second bronchial arch. With growth of the first pharyngeal groove and development of the tuberculum impar the thyroglossal strand is moved back to the region of the second arch, Keibel and Mall (37).

In the 19 mm. embryo, just behind the thyroglossal strand rests, some clear round cells appear. This is the anlage of the hyoid bone body. As this structure grows rapidly forward it is first to come into contact with the thyroglossal strand. If this thyroglossal strand has not disappeared by this time then in a great number of cases it will become incorporated, deeply in the periosteum of the hyoid bone. With continued growth of the hyoid forward and downward it divides the thyroglossal strand into two portions which either disappear or remain for life.

In the two month embryo the foramen caecum appears either as a depression or as a duct, which is lined with squamous epithelium. As this structure progresses it
becomes branched and later becomes lined with epithelium, glands, etc and is called the "lingual duct."

This duct by the fifth month passes almost to the hyoid bone. The structure then totally disappears or if part remains it can be seen in the tongue substance. About this time the thyroglossal tract can be seen to have a definite relation to the tongue structures.

The hyoid portion:

Due to the proximity of the hyoid bone to the thyroglossal strand many complicated changes take place. These changes have been attributed to the growth of the hyoid bone.

At the end of the first and beginning of the second month the thyroglossal strand has a fairly straight course. The hyoid begins posterior to the strand but does not influence its direction in spite of the close proximity. The hyoid grows downward and forward and upward and backward rapidly. As it does so it presses against the thyroglossal tract and bends it. The thyroglossal strand is not a very elastic tissue, Meyer (50), and where the hyoids exerts pressure there is disappearance of thyroid tissue and a replacement by connective tissue, which is more elastic. By this process the thyroglossal strand is divided into two portions separated by connective tissue at the hyoid.
With continued growth of the hyoid the connective tissue usually becomes incorporated within the periosteum of the bone and firmly fixates the tract. About this time the hyoid bone changes shape becoming convex anteriorly and concave posteriorly. With this change in shape the lower portion of the thyroglossal tract is actually pushed up and posteriorly with the hyoid so that the strand runs through the entire boney structure.

**Infro-hyoid region:**

In this area the most important feature is the pyramidal lobe which is connected to the hyoid bone by the thyroglossal strand or by a connective tissue band. The lobe itself lies free, Meyer (50).

Wenglowski (74) is of the opinion that if the thyroglossal duct persists past the eighth embryonic month either in part or in toto it will persist for life, and these rests are potential mid-line cysts and fistulae.

Clute and Cattel (17) in reviewing this subject are quite agreed that thyroglossal duct rests are the cause of mid-line cysts and fistulae. They stress the point that the thyroglossal tract may be located in front of, lateral to, behind, or within the substance of the hyoid bone. One can readily understand these
relationships when one realizes that, normally, the thyroid descends and the duct is obliterated before the development of the hyoid bone. Occasionally the decent has not taken place before the development of the hyoid, in which case the thyroid will be found above the hyoid bone.

According to these authors, thyroglossal cysts and fistulae originate as a retention cyst resulting from desquamation and inflammation of the epithelial cells in a closed portion of the thyroglossal tract. Repeated inflammation results in the increase in size of the cyst. True congenital cases may have an opening demonstrably, in the base of the tongue, whereas others can only rarely be so demonstrated. True congenital cases are rare, however.

Bailey (7) on the other hand, maintains congenital cases rarely if ever occurs. He states these cysts and fistulae occur past the first decade of life. Bailey explains the reason for the latent appearance of the mid-line cysts by the potency of the thyroglossal duct. If such a duct, opening into the mouth, should suddenly become occluded then one might expect a cyst to develop. However, such a theory postulates a patent thyroglossal duct opening into the mouths of a certain
percentage of normal individuals for it would be unreasonable to suppose this duct always become occluded. Evidence at this time does not substantiate this theory.

Bailey does offer this theory to explain the appearance of cysts and fistulae in this area. Normally these epithelial rests are inactive but following an upper respiratory infection the epithelial tissue here is stimulated in the same manner as that along the respiratory tract with the result of secretion into a closed cavity, and a cyst develops. Bailey cites three cases who had no appearance of thyroglossal cysts until after they had an attack of tonsilitis or pharyngitis. Other cases had previous histories of sore throats.

Lipshutz (45) emphasizes these points. The thyroglossal has definitely been established as the etiological factor in mid-line cysts and fistulae. As the gland grows down it disturbs the epithelial tissue along the path and it is these that gives rise to the wide variation in the type of epithelium seen. As further proof for the thyroglossal tract as the etiological factor he offers these five points:

1. The absence of lumen of the thyroglossal duct.
2. The existence of fistulae with more than one tract. The occasional occurrence of lateral
branches communicating with the main tract is well known.

3. The observation of ciliated columnar and stratified squamous epithelium in the same fistula.

4. The presence of epithelial rests in the hyoid bone.

5. The great rarity of these mid-line fistula being complete.

There has been considerable debate whether the thyroglossal fistula extends as from the foramen caecum to the thyroid. Meyer (50) says that suprahyoid fistulae end at the hyoid, as do the infrahyoid. Bailey (5), Baumgartner (8), Clute & Cattel (17) and others say this is true but a definite connection can be traced through the hyoid and therefore the other portion is a potential if not an actual fistula.

Not all mid-line cysts and fistulae are located between the foramen caecum and the thyroid gland for it has been definitely noted that there occasionally occurs a lingual or sublingual cyst that can be traced to the foramen caecum. The origin of these are still quite debateable but due to the relative rarity of these cases a great deal cannot be learned. J. Bland-Sutton (67) reported a case and offered an explanation
that the thyroglossal duct either grew forward itself or as a branch from the main thyroglossal tract. His theory was not well stated. Wenglowksi in 1912 advocated this same theory, but here again the explanation was vague. Montgomery (53) reported a case of a cyst in the anterior portion of the tongue with a fistulous tract leading to the foramen caecum.

This author points out that the tongue has its origin from three portions of the branchial apparatus which fuses to form a "Y" cleavage plane, with the long stem pointing anteriorly from the foramen caecum. He states that it is natural to expect cystic and fistulous tracts along the cleavage planes especially if there is incomplete fusion of the mutual line at the region of the tuberculum impar, and this area should be more prone to fistulous anomalies due to the fusion stress where three planes are concerned in the process.
Pathology

As in lateral cysts and fistulae the pathology of these mid-line anomalies are intimately connected with the embryological descent and development of the thyroid gland, especially the median lobe. It has been shown that the thyroid anlage descends before the development of the hyoid bone. The reason for this is believed by Meyers (50) to be due to the colloid nature of the thyroid tissue. This type of tissue is sensitive to pressure and therefore when any is exerted the colloid will disintegrate and disappear. The thyroid needs ample space for proper development and the region about the hyoid is most suitable.

As the thyroid anlage or the thyroglossal tract descends it leaves behind it epithelial rests of both squamous and ciliated columnar types, which in the cyst and fistulae retain their original characteristics and secretions. Since the thyroglossal duct or tract originates in the tongue region it is conceivable that part of the epithelial tissue of tongue is pulled down into the foramen caecum, with the descent of the thyroglossal duct, and has maintained the original characteristics, Meyer (50).

Microscopically, these cysts have a dense fibrous
layer, sometimes with mucous glands in it. These glands must be distinctly differentiated and separated from thyroid tissue which is not in the cyst wall, but separated from them by muscle and connective tissue layers, Meyers (50).

The histology of the walls is in keeping with the origin of the cyst. The walls contain epithelium of stratified squamous, columnar and ciliated columnar, Clute and Cattel (17). One thing is fairly certain, that most cysts are lined with mixed epithelium, Bailey (5). The accepted theory was the mid-line cysts and fistulae contained only ciliated epithelium but observations showed these also contained stratified squamous. Some of the earlier authors believed this type grew in from the external opening or was pulled down from the foramen caecum, but this did not explain all the stratified squamous present.

Lipshutz (45) states that this finding could be explained by the fact that in the descent of the thyroid epithelial tissue was disturbed and left in the form of epithelial rests. Wenglowski (74) and Meyer (50) reason this finding along the following manner. It has been shown that the thyroid has developed from the base of the tongue and at that time was covered with both stratified squamous epithelium and ciliated
epithelium admixed. In the rapid down growth of the gland the epithelium is shorn off and is deposited along the tract. This theory, they claim, can further be substantiated by the fact that the further away from the tongue one gets the more infrequent will be the epithelial rests. This deposited epithelium maintains its inherent characteristics, becomes surrounded by connective tissue and finally forms a cyst.

It has been noted by numerous authors especially, Bailey (5), Clute and Cattel (1%), Klingenstein and Colp (39) that in the presence of inflammation the surface of the cyst becomes progressively denuded of epithelium with progressively increasing amount of connective tissue overgrowth and markedly thickened.

Two types of mid-line cysts are found pathologically, in adult life, Meyer (50), (1) Epithelial fistulae and cysts with simple or complicated walls and (2) thyroid tissue rests. The first group creates the midline cysts and fistulae, while the latter causes goitre in abnormal locations.

Gilman (27) adds to the group listed above solid tumors. He emphasizes the point that wherever mid-line cysts occur one must examine the thyroid for occasionally the thyroid itself has not developed and these cystic masses are aberrant thyroid tissue that
is attempting to compensate for the normal deficiency.

The contents of mid-line cysts are generally of a mucoid character, but in long standing cases they may contain necrotic material and cholesterin crystals. With infection present the contents may be purulent. Occasionally, in long standing cases osteomyelitis of the hyoid bone has occurred, for as a rule a thyroglossal tract can be traced from a cyst to the hyoid bone, Clute & Cattel (17).

The locations clinical fratures of thyroglossal cysts according to Bailey (5) are:

(1) At the Base of the tongue, beneath the foramen caecum. This is the most frequent site for a thyroglossal cyst to develop, as here the epithelial tissue is in greatest abundance.

(2) In the floor of the mouth.

These are often called "lingual dermoids" and are squamous lined. The material contained has a yellowish hue and like all other thyroglossal cysts are liable to infection.

(3) Suprathyroid--located immediately above the hyoid bone.

(4) Subhyoid. This is also one of the most common sites for thyroglossal cysts to appear. Here they have a tendency to disappear beneath the hyoid bone on swallowing.
(5) At the level of the thyroid. Here the cyst may not always be mid-line for in the anatomical development of the thyroid it takes on the form of a prow which often pushes a cyst to one side, usually the left.

(6) At the cricoid level. The cyst is mid-line. Here one must differentiate between a cyst and an adenoma of the thyroid isthmus.

These cysts usually appear in the first decade of life. According to a series run by Klingenstein and Colp (39) 90% appeared in the first decade of life. They said the reason for this was that these tracts were composed of epithelial tissue with some lymphoid tissue thus with a repeated attacks of upper respiratory infections and tonsilitis there would be activation of epithelial tissue with resultant cystic formations.
Symptoms and Diagnosis.

According to Baumgartner (8), Clute and Clute and Cattel (17), and Klingenstein and Colp (39) the clinical picture of cyst is a painless soft, fluctuant, semi-fixed mass occurring near the mid-line of the neck, giving rise to no subjective symptoms except the undesired cosmetic effect of this mass that moves up and down with swallowing. Symptoms of choking sensations, difficulty in swallowing, obstructive dyspnea are quite rare unless these become actively inflammed, at which time they also give symptoms of swelling, heat, tenderness and sudden enlarging.

In case of a fistulous tract and opening there is a bothersome, continuous or intermittent discharge of mucus or mucopurulent material into the mouth or externally. When these tracts become infected, as they are quite prone to do there may be an occlusion of the opening with a cyst developing, which again drains with subsidence of the inflammation, Clute & Cattel (17).

The diagnosis and physical findings are characteristic. In case of a cyst one finds a round, small, tense cystic mass, varying in size from a pea to larger, over which the skin is moveable, except when inflammation is present and then the skin is tight. Fluctuation is inconstant due to tension within the cyst. Klingen-
Cysts move up and down with the act of swallowing. Bailey (5).

In case of a fistula a small firm mass of tissue may be felt by careful palpation, running subcutaneously from the opening to the hyoid bone, where it is lost. Klingenstein and Colp. (39)

As an aid to diagnosis New (54) recommends the injection of some radio opaque media as Bismuth paste or lipiodal into the cyst or fistula and take an X-ray.

In the differential diagnosis one must bear in mind these points: in diagnosing mid-line cysts, especially above the hyoid bone, one must differentiate between thyroglossal cysts and aberrant thyroid tissue, for if the latter is removed there is danger of putting the patient into hypothyroidism. Gilman (27). The ability to feel the tracheal rings to the sternoclavicular joint should lead to the suspicion of thyroid misplacement along the thyroglossal tract or at the base of the tongue. This tissue hypertrophies especially at puberty, Spencer (65).

"Ranula" is a cystic degeneration of the sub-lingual gland, is usually unilateral located on the anterior floor of the mouth, has a bluish discoloration and does not move with swallowing. Bailey. (5).
Adenitis--These glands are rarely mid-line. They are tender and do not move with swallowing.

Pyramidal-thyroid lobe. This structure is associated with the isthmus, does not enlarge unless associated with goitre. This structure does not fluctuate and contains no fluid. Baumgartner (8).

Tuberculous Adenities: The glands here are tender, matted together and firm, with a purulent discharge whereas the discharge of a cyst is mucoid.

Dermoid Cysts. are attached to the skin and contain epidermal products. Dermoids do not move with deglutition.
Treatment.

In reviewing the early methods of treating cervical cysts and fistulae, Bland Sutton (67) made no distinction between thyroglossal or lateral cysts and fistulae. During this era the treatment consisted mainly of palliative incisions and the use of sclerosing solutions.

At the present time the use of escharotics and other conservative methods have a very limited use. Escharotics are indicated only when the cyst is small, isolated and with no internal opening, but if the cyst is large, infected, lobulated or has a fistulous connection with the foramen caecum then these solutions are contraindicated.

Complete surgical removal of thyroglossal duct cysts is the procedure of choice. Sistrunk (64) and independently, Beer (9), recommended the method now widely accepted as the classical operation.

This operation is done by making a horizontal skin incision over the cyst. The cyst is then excised and the fistulous tract dissected out to the hyoid bone. Should the tract pass through the body of this bone, Sistrunk advises the removal of the central portion, to prevent recurrences at this point. At the level of the hyoid bone the tract turns posteriorly forty-five degrees
and continues to the foramen caecum, which must be remembered when the suprahyoid segment is "cored out."

After the tract has been removed the opening at the foramen caecum is closed, the genioglossus and the mylohyoid muscles are approximated. The hyoid bone is brought together and held by suturing the surrounding tissues. A small rubber drain is inserted and the skin closed.

While this seems a drastic procedure the results justify its use for simple enucleation of the infrahyoid cysts and tract is insufficient and recurrences are prone to occur in the suprahyoid area.

Gessner (26) follows the Sistrunk procedure except he neither divides the hyoid bone nor removes the thyroglossal tract all the way to the foramen caecum, if it is potent. He ties off the tract a short distance below the potent foramen and allows drainage to discharge into the throat. This method has the same disadvantages as the removal of only the infrahyoid segment as recurrences in the suprahyoid are likely to develop.

Baumgartner (8) washes the fistulous tract out with water and normal saline, then reinjects it with methylene blue. This is allowed to stand until the epithelium is thoroughly stained then the excess is washed out. The rest corresponds to Sistrunk's method.

Another modification as recommended by Hicken (30)
is to drain the cyst and pack with gauze until the walls are tense. This allows complete removal of the cyst with no danger of losing the contour as would occur if the cyst were punctured.

Hendrick (29) stresses the importance of complete removal of the entire tract and not the mere lancing. He points out this serves only to convert a cyst into a chronically draining sinus, with nothing gained. Lancing has its place only when the cysts are infected or a cellulitis is present, and then used only until the inflammatory process is cleared up and removal can be done.
Summary

1. Brenchiogenic cysts and fistulae are embryonic anomalies, developing from the second or third branchial clefts via the cervical sinus.

2. Auricular fistulae are probably derivatives of the first branchial.

3. Lateral cysts and fistulae may appear externally, anywhere from the ear to the suprasternal notch, but always along the anterior border of the Sternomastoid muscle.

4. Mid-line cysts and fistulae are embryonic rests of the Thyroglossal tract.

5. Mid-line cysts and fistulae may appear near the mid-line anywhere from the base of the tongue to the suprasternal notch.

6. Lateral cysts and fistulae are best treated by complete excision, using simple drainage as a palliative treatment with the presence of an active infection.

7. Mid-line cysts and fistulae are the best treated by complete removal making a special point of removing the central portion of the hyoid bone.
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