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CHRONIC SINUSITIS OF THE PARANASAL
SINUSES, DIAGNOSIS AND TREATMENT

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Senior Thesis Presented to the

College of Medicine

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Omaha

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Introduction

Disease of the accessory sinuses of the nose occurs in all ages and in all classes of people. However, it is more prevalent in those areas where the more radical changes in climate occur. In the younger individuals sinusitis usually occurs in the acute form, while in the adult the disease has usually become chronic in nature.

If we accept Doctor Parkinson's definition of chronic sinusitis, which is, "When after a period of time the membranes show hyperplasia, infiltration and connective tissue replacement, a diagnosis of chronicity should be made," then most of us who have attained maturity probably could be proven by biopsy to be afflicted with the disease. (17, Parkinson)

Few of those in whom the disease is present in their youth have symptoms severe enough to warrant even a casual examination of their sinuses, and only those with severe symptoms or complications are referred to the rhinologist for examination and treatment. Hence, chronic sinusitis becomes a disease found most frequently in the adult and in many cases remains undiagnosed and untreated throughout its course, unless there occurs an acute exacerbation of the disease or the disease process becomes manifest through one or more of its many complications.

Thus the primary object of this paper becomes one of diagnosis and treatment of chronic sinusitis of the paranasal sinuses.

As it is useless to attempt a diagnosis or treatment of a disease without familiarity with the anatomy and histology of the parts affected, these will be included in this paper. In the diagnosis of chronic sinusitis it is also necessary to know the pathological changes in the membrane lining the sinus cavities, and since treatment differs in the acute and chronic forms pathology will be included to help differentiate between these.

- - -

Anatomy

In the eighth week of embryonic life the lateral wall of the nose and the nasal septum are in the precartilage stage, and by the end of the third month the nasal capsule is well advanced as a cartilaginous structure, the cartilage having formed not only in the lateral walls of the nasal cavities and meatus, but in the primary and secondary nasal concha as well. Thus the rudiments of the paranasal sinuses have first to do with membranous and cartilaginous relationships. It is only later in fetal life and always afterward, when the cartilage becomes replaced with bone and the latter grows to large dimensions, does the problem of bone invasion and pneumatization become a factor in the secondary phase of development of the sinuses. (20, Schaeffer)

In this invasion and pneumatization of the bones bounding the nasal fossae, it is always necessary to remember that normally growth hormones have to do with the paranasal sinuses just as they have to do with the development of other parts. Conditions which affect the growth, histological structure and health of the cranial and facial bones, can and probably do greatly influence the growth and general morphological development of these chambers. The concept that growth hormones have to do with growth and repair processes, and are involved in some of the morphologic and histologic problems of the paranasal sinuses in health and disease, merits attention and further study. (7, Dean)

The morphological and clinical problems of the paranasal sinuses are better understood, or at least less obscure, if one bears in mind that all of these cavities have their origin in the ethmoid field, that the primary points of outgrowth of the mucous membrane of the nose remain as the permanent ostia in the adult, or apertures of communication between the sinuses and the nasal fossae. All of these ostia of the paranasal sinuses are located within the confines of the ethmoid portion of the lateral nasal wall. Ultimately the outlying portions of the sinuses pneumatize large portions of the ethmoid, frontal, maxillary and sphenoidal bones. Their drainage, however, regardless of size or complexity, must needs be in the ethmoid field of the nasal fossae. (11, Jackson and Coates)

The rudiments of the paranasal sinuses are demonstrable as slight areas and evaginations in more or less specific regions of the nasal mucous membrane during the later part of the third month of fetal life. The maxillary sinuses and the ethmoid cells appear to be sufficiently advanced in their development at birth to be of clinical importance. (24, Shea)

The sphenoid sinuses may have acquired the size of small peas by the end of gestation period; however, in the majority of cases they are probably not sufficiently advanced at birth to be of clinical importance. Indeed, the sphenoid sinuses may remain extremely small and limited permanently to the fields of the sphenoid concha, and really never invade the sphenoid bone

proper. The frontal sinuses are not as a rule clearly differentiated as such at birth, but are near to or in reality a part of the frontal group of the anterior ethmoidal cells from which the frontal sinuses arise in the majority of instances. Usually it is not until one or two years after birth that the frontal sinuses invade the frontal bone. (20 B, Schaeffer)

Doctor Manges states that the maxillary antra and ethmoids are subject to diagnosis and can be visualized by Roentgen ray during the first year; that the sphenoids usually become evident in the second or third year, although at this time they can scarcely be distinguished; that the frontal sinuses become apparent during the third year as projections upward into the frontal bones; that variations in development of the several groups of sinuses occur in the same and different individuals. (15, Manges)

The frontal sinuses show the largest variation, from entire absence to those of large size on one or both sides of the median line, or there may be single or multiple cells on one or both sides. They may vary in depth as well as in width and in thickness of their bony walls.

The ethmoid cells also vary in size and number, as well as in their extent of distribution.

The maxillary antra are the most nearly constant and uniform in the individual, but differ materially in size in different persons.

Variations in the sphenoids are seen in the same and in different persons. The distribution of the bony septum dividing the right from the left varies, so that one cannot always be distinguished from the other.

The maxillary antra develop first of all the paranasal sinuses and reach adult proportions at a relatively early age. The anterior posterior diameter is always the greatest, then comes the height and width. In operative procedures on the maxillary sinus of youths, it is essential that one have knowledge of the shape and size of the chamber. For some time after birth the width of the sinus does not extend below the orbit. By one year of age the sinus has grown laterally to be in relation to the infra-orbital canal; by age two it has grown longer and extends above the unerupted first permanent molar tooth, and from ages two to four it grows laterally with rapidity. (20, Schaeffer - 11, Jackson and Coates)

The average size of the maxillary antra at different ages is given in the chart that follows--

<u>Age</u>	<u>Length in mm.</u>	<u>Height in mm.</u>	<u>Width in mm.</u>
Newborn	7. to 8.	4. to 6.	3. to 4.
9 Months	11. " 14.	5. " 6.	5. " 5.5
1 Year	14. " 16.	6. " 6.5	5. " 6.
2 Years	21. " 22.	10. " 11.	8. " 9.
3 Years	22. " 23.	11. " 12.	9. " 10.
6 Years	27. " 28.	16. " 17.	16. " 17.

<u>Age</u>	<u>Length in mm.</u>	<u>Height in mm.</u>	<u>Width in mm.</u>
10 Years	30. to 31.	17.5 to 18.	19. to 20.
15 Years	31. " 32.	18. " 20.	19. " 20.
18 Years	31. " 33.	20. " 21.	19. " 21.
Adult	34.	23.	23.

The maxillary sinus may be considered as having three walls, a roof and a floor. The medial wall forms part of the lateral wall of the nasal cavity, and the apex extends variously into the zygomatic process of the maxilla and into the maxillary border of the zygomatic bone. (11, Jackson and Coates)

The anterior or ventral wall of the sinus corresponds to the facial surface of the maxilla; the posterior or dorsal wall to the infratemporal surface; the roof to the orbital surface, and the floor to the alveolar process.

Variations occur in the size, shape and number of the sinuses. They may be incompletely or completely divided into sub-compartments or recesses by variously placed septum. Each compartment may have separate ostia by which they communicate with the infundibulum ethmoidal, or one compartment may have two ostia. The ostian is a round, oval or narrow elongated aperture called the ostium maxillare, and occasionally may replace the entire floor of the ethmoid infundibulum. In approximately one third of the cases there is an accessory ostium which connects the sinus directly with the middle meatus. It is variously located: just outside of the dorsal extremity of the infundibulum

ethmoid, within the dorsal extremity of the same, or farther forward immediately below the miduncinate region.

The number of permanent teeth in relation to the floor of the maxillary sinus of course varies with the degree of excavation of the alveolar process. The teeth most constantly in intimate relationship to the floor are the three molars. Very frequently the roots of these teeth crowd the mucous membrane of the floor of the sinus into mound-like relief. These relations are the same in male and female, young or old. Some authors maintain that perhaps sixty or even seventy per cent of paranasal sinus cases show some form of dental caries in the antral floor. (20, Schaeffer - 6, Davis) X

The frontal sinus has various potential rudiments in the ethmoid field. First--The three or four anterior ethmoid cells. Second--The frontal recess as a whole. Third--The ventral extremity of the ethmoid infundibulum. Fourth--The suprabullar process of the ethmoid. However, as has been previously stated, it most frequently arises from the frontal anterior ethmoid group of cells. (31, Turner)

From their beginning the frontal sinuses vary considerably in size and shape, and are usually asymmetrical in their invasion of the frontal bone. Not being demonstrable at birth and considering the various potential rudiments from which they can develop, any statement as to their size at a given age or in the adult would be misleading. In the majority of cases they are asymmetrical often

to a marked degree, and are often divided into subcompartments and recesses by incomplete bony partitions. Supernumerary frontal sinuses are commonplace, as many as six have been found in the same individual, each with an independent connection with some portion of the middle nasal meatus. They may be tier-like, side by side, or one behind the other. The nasofrontal sinus connections vary considerably. The frontal sinus may communicate with the pouch-like frontal recess of the middle meatus, either by means of a constricted canal (the nasofrontal duct), or by a direct frontal ostium; with a frontal extension of the ethmoid infundibulum, and rarely with the suprabullar process. (20, Schaeffer)

The sphenoid sinuses do not invade the sphenoid bone until about four years of age has been attained. Previously to this they are located in the sphenoid concha and ossicles of Bertin, and it is not until these fuse with the bone proper that they begin to pneumatize the same. In fact, they may never grow into the sphenoid bone, or in the adult they may extend into the great wings of the sphenoid, the pterygoid process and the rostrum. Occasionally they extend forward and replace the posterior ethmoid cells. Less frequently they are in intimate relationship with the maxillary sinus, only thin lamella of bone and tissue interposed, and rarely they may communicate with the maxillary sinus directly. (20, Schaeffer)

In the average adult the sphenoid sinus on each side communicates with the corresponding ethmoid-sphenoid recess

located above the highest and most dorsal of the ethmoid concha by means of a small aperture, the sphenoid ostium. This aperture is located in the anterior wall of the sphenoid sinus and in the dorsal wall of the sphenoid-ethmoid recess from three to twenty millimeters above the sinus floor. Occasionally the ostium of the sinus is located in the angle formed by the posterior-lateral walls of the sphenoid-ethmoid recess. (6, Davis)

The relations of the sphenoid sinus to other structures in the region are extremely important when considering operative procedures. These relations are often complicated by the marked asymmetry of the sinus development. The hypophysis-cerebri is located above the highest and most dorsal part of the sinuses, and the optic chiasma rests upon the hypophysis, the diaphragma-cella alone intervening. Above and lateral are the optic nerves, often separated by a thin paper like bone, or just the meninges may separate the nerve from the sinus mucous membrane. Laterally are the dural cavernous sinuses with the related oculomotor, trochlear, ophthalmic, maxillary and abducens nerves, and the internal carotid artery. In the floor is the pterygoid canal with its vidian nerve and vessels. Owing to the many variations in the sinuses, relational anatomy cannot be constant. The sinuses may be partially divided and recesses formed by osseous septa. (18, Phillips)

The ethmoid cells develop from the ethmoid infundibulum, the suprabullar recess, the bullar furrow, the infrabullar furrow, the frontal recess and the frontal furrows. These cells are

divided from their beginning in the fetus into two primary groups, anterior and posterior. The anterior group varies in number from two to ten, and communicates with various parts of the middle meatus. This group is further divisible into three secondary groups. Those that have their outlet in the frontal recess are called the frontal anterior ethmoid cells; those that communicate with the infundibulum, the infundibular anterior ethmoid; those related to the ethmoid bulla, the bullar ethmoid cells.

(20, Schaeffer)

The posterior group of ethmoid cells in accordance with their origin communicate with the superior and supreme nasal meatuses and vary in number from one to eleven cells.

The ethmoid field is constant in size and usually occupied by the cells regardless of number. When the cells are few, they are larger, and when many, smaller in size. They may expand into the maxilla at the expense of the maxillary sinuses: the frontal bone with encroachment on the frontal sinuses; the sphenoid bone where partial or complete replacement of the sphenoid sinuses may occur. (10, Hourn)

The blood supply to the anterior ethmoid cells comes from an arterial plexus in the bullar furrow and infundibulum, and through their nasal walls. The plexus in the bulla and infundibulum is formed by a branch from the middle or inferior turbinate arteries. This plexus also receives an important supply from the terminal branches of the anterior ethmoid artery.

The posterior ethmoid cells obtain a nasal blood supply from two sources: through the ostia from the superior turbinate branch of the nasopalatine in the periosteal layer, and through their nasal walls. (4, Burnham)

The vascular supply to the maxillary antrum passes from the nasal side through the maxillary ostium from the uncinate aperture and through the posterior half of the common meatus. This supply is from the antral branch of the inferior turbinate artery. They also receive small branches through their bony walls.

The sphenoid sinuses are supplied with blood from the ostial arteries and also through the anterior wall by small vessels from the nasal cavity and posterior ethmoid vessels.

The frontal sinus is dependent almost entirely on its ostial plexus for its blood supply. There are three sources to the ostial plexus, two from the anterior ethmoid arteries and one from a small branch of the ophthalmic.

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Histology

The mucous membrane of the paranasal sinuses is composed of three layers of cells, each layer being more or less distinct in its characteristics and the cells of which it is composed. The consensus of opinion indicates that the superficial layer or covering in the normal membrane is composed of simple, ciliated, columnar epithelial cells, relatively tall, and between the bases of which are found numerous irregular shaped basal cells not extending to the surface. A few mucous secreting goblet cells are scattered among the ciliated columnar cells, these goblet cells being more abundant in the membrane of the maxillary sinus than that of the other sinuses. (20 B, Schaeffer)

The tall ciliated cells vary in size, but always extend from the free surface to the basement membrane. Their basal ends are tapered because of the interposed basal cells. The cilia are long, being six to ten microns in length, and attached in the peripheral ends of the columnar cells to densely staining basal granules. The cytoplasm of these cells is granular, while that of the basal cells is less granular and more homogeneous in character. These basal cells are thought by some to develop into goblet cells, while others are of the opinion that from them can develop either goblet cells or the ciliated columnar epithelial cells. (13, Latta and Schall)

The goblet cells vary in size and number in the same

and different sinuses. Their size and form depend on the stage of development attained. The fully formed are greatly rounded and distended peripherally with contained secretions. Their basal process is narrow and contains a compact nucleus. (13, Latta and Schall)

These cells rest upon a basement membrane of sub-epithelial connective tissue stroma, which contains blood and lymph capillaries.

The second layer of the mucous membrane is composed of loose connective tissue stroma containing a sparse number of mucus glands. These are found more frequently around the ostia of the sinuses and are more prevalent in the maxillary sinus than any of the others. The tissue contains a large proportion of collagenous fibers with numerous scattered fibroblasts; no elastic fibers are present except those in the walls of the blood vessels. (20 B,

The deep stroma contains the larger blood and lymph vessels and is intimately associated with the periosteum, from which it cannot be separated.

The thickness of the normal mucous membrane of the various sinuses as given by Schaeffer is as follows: maxillary sinus-- medial wall 0.2 to 1.2 millimeters in thickness; the lateral wall as 0.1 to 0.5 millimeters; the frontal as 0.06 to 0.5 millimeters; the ethmoid as 0.08 to 0.45 millimeters; and the sphenoid as 0.07 to 0.6 millimeters thick. (20 A, Schaeffer)

Pathology

In Doctor Parkinson's definition of chronic sinusitis we find the first condition mentioned was hyperplasia. This occurs in the epithelium in two forms, hyperplasia of the ciliated cells and hyperplasia of the goblet cells.

When the mucous membrane of any of the sinuses becomes irritated the first change that appears is hypertrophy of the cells reaching to the surface. The ciliated cells become taller and the cilia more pronounced. If irritation is continued for some time further increase in thickness is not accompanied by further hypertrophy, but by an increase in compactness, with crowding and further hyperplasia finally producing a truly stratified epithelium. In some cases the epithelial thickness may become twice that described as normal when the epithelium is stratified, the cells lining the surface are highly ciliated, with goblet cells crowded between the tall columnar cells. (13, Latta and Schall)

In the chronic suppurative sinusitis a goblet cell hyperplasia is more apt to occur. Divergence of opinion exists as to the exact process of this condition: whether the suppurative process is the cause of the goblet cell hyperplasia, or the goblet cell hyperplasia the cause of the suppuration. It is the opinion of some men that the hyperplasia and hypertrophy of the goblet cells cause a crowding and eventually a necrosis of the ciliated

columnar cells with the resulting sloughing of these cells. Others maintain that chronic infection leads to this necrosis and sloughing with the result that the goblet cells proliferate and become more numerous in the membrane. These goblet cells appear quite cylindrical in shape with slight narrowing at their free border. Their cytoplasm is extremely scanty, and the nucleus is compressed in the basal portion of the cell. Where the goblet cells become numerous, the ciliated cells tend to spread out, and their cilia become longer as if in an effort to maintain cover of the free surface with cilia. (21, Schall - 13, Latta and Schall)

Infiltration, the next condition mentioned in the definition of chronic sinusitis, probably occurs concurrently with hyperplasia of the ciliated and goblet cells in a vast majority of cases. Edema of intra and extracellular character is most marked in the superficial portion of the stroma. This precedes any or all cellular infiltration and is accompanied by dilated glands and thickened blood vessel walls. Cellular infiltration occurs throughout the stroma, particularly beneath the basement membrane, but is most marked around the glands. A cellular predominance of lymphocytes, with polymorphonuclear leucocytes, macrophages and eosinophiles in the minority is found. At times the lymphocyte infiltration around the glands may be so great that it resembles lymph nodules. Perivascular infiltration does occur but the most of the infiltration is of periglandular type. In this condition

the glands appear to be exceedingly numerous. This may be an actual increase in number or an increase in activity with distention of the pre-existing glands, so that they become easier to recognize. (20 B, Schaeffer, 1933)

Connective tissue replacement occurs primarily as a connective tissue hyperplasia. An increase in the connective tissue cellular elements occurs with the infiltration of other cellular forms. These cellular elements become organized into definite connective tissue stroma which is more dense in character and thicker than that in the normal sinuses. As these cellular elements become organized the cells decrease in number and the structure becomes one almost hyalin in character. Due to this fibrotic change with the accompanying restriction of blood supply, lymph drainage and constriction of the lumen of the ducts to the glands, formation of cysts, polypi and minute abscesses occur. (20 B, Schaeffer, 1933 - 8, Eggston)

- - -

Diagnosis

From the definition of chronic sinusitis as given by Doctor Parkinson, it would seem that the only positive diagnosis of the disease which could be made would be one made by biopsy or at the autopsy table. However, such is not the case, as various authors have given us definite clinical manifestations which are almost pathogomonic of the disease. Through the curiosity and ingenuity of mankind there has also been developed various mechanical instruments by which the various recesses of the nasal fossa and the interior of some of the sinuses can be viewed, thus supplementing our clinical manifestations with visual inspection of the field. In addition to these we have the Roentgen ray, and although there is doubt as to its infallibility in some cases, it remains one of the surest means of establishing or confirming a diagnosis. (25, Skillern - 1, Amano - 7, Dean - 26, Smith - 5, Chase)

The clinical symptoms most frequently associated with the disease, and some of which are present in the majority of cases, are--

1. Post-nasal discharge
2. Pain which is not severe, but nearly always present
3. Headache
4. Nasal obstruction
5. Sore throat and anterior nasal discharge

6. Recurrent colds
7. Earache and disorders of sight
8. Earache and increasing deafness
9. Chronic cough and hoarseness
10. Feeling of lassitude, difficulty in concentration, giddiness and rheumatic pains.

(29, Syme - 18, Phillips - 31, Turner)

When any group of these symptoms are present a thorough examination of the nasal accessory sinuses should be made. As these symptoms do not definitely locate the sinus involved, but are more or less general, further examination by the mechanical instruments is indicated. Perhaps the various forms of nasal speculums are the most useful. With these and by a good light the lateral nasal walls can be inspected. Change in their mucosal lining can be observed as well as any polyposus which may be present. Polypi in the nasal cavity are usually definite indication of sinus infection, as any rhinitis of sufficient long standing to produce polypi is or was sure to involve one or more of the sinus cavity membranes. Often the polypi originate in the sinus and have grown or been forced out through the ostium of the sinus. Another observation to be made by the nasal speculum and light is the point or points from which the nasal discharge is coming. If this discharge is profuse, necessary cleansing is done by nasal irrigation with warm normal saline solution.

The antrascop, one of man's ingenious inventions, requires an intranasal puncture before its use of inspecting the maxillary sinus can be accomplished; thus it becomes an instrument of the specialist, unless the general practitioner wishes to do minor surgery in the nose. The antral puncture is a simple operation which the general practitioner should be able to do, as it is indicated in many of the acute conditions. However, the anatomy of the antrum should be thoroughly familiar, especially where a puncture is to be attempted in a young person. In the adult the operation is one of simply forcing a trocar through the nasal wall, beneath the inferior turbinate, after which the antrum can be irrigated or inspected by the use of the antrascop.

Transillumination of the sinuses is easily accomplished and the necessary equipment is not very extensive. A simple electric light with glass covers can be used for the maxillary sinuses and is placed in the mouth of the patient, and with the lips closed the light illuminates the antrums, the degree of illumination depending on the clearness of the antrum. The greater the amount of discharge and the thicker the membrane of the antrum, the less the illumination shows through. A hooded light is used in transilluminating the frontal sinuses. The light is placed against the upper lid with the open end of the hood directed medialward and upward. An uninfected sinus will usually show the transparency of the structures anterior to the sinus. However, this method is not infallible, as normally heavy skeletal and

tissue structure over the sinuses may make the sinus appear clouded.

In the final diagnosis and before any radical operations are attempted, X-ray examination of the sinuses should be made. These should be made by a Roentgenologist, who is familiar with the technique necessary to obtain radiographs of sufficient clearness and in position to give the best possible delineation of the sinus cavities. (15, Manges)

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Treatment

The treatment of chronic sinusitis, as advocated by different Rhinologists, varies from that consisting of practically no treatment to the most radical operations which attempt to obliterate the various sinus cavities.

The Proetz displacement method of treatment is perhaps as simple as any method, and as this requires only a minimal amount of equipment, and no surgery, it can be successfully carried out by any practitioner. The equipment necessary consists of a water suction unit where running water is available, or a motor driven suction unit where running water is not available. Other parts are about five feet of tubing and glass nasal tips. The treatment consists of having the patient lie on his back with the head extended so that the external meatus of the ear is vertical with the point of the chin. One or two ccs of normal saline or preferably Locke's solution are installed in the nose by a dropper. The suction is regulated to about one half pound of negative pressure and the glass tip applied to the nares of one side while the other side is closed by the operator's thumb or finger. This produces a vacuum in the sinuses and the fluid flows into them when the suction is removed. Suction is applied and released about every twenty seconds. This will generally partially fill the antra and ethmoid cells. The frontal sinus is better filled by the use of a prone position with the head

flexed. Usually before starting a Proetz displacement treatment the nasal mucosa is shrunken with an ephedrine sulphate solution applied ten to fifteen minutes before starting. (19 A and B, Proetz)

The maxillary antra may be successfully irrigated through their normal or accessory ostia, but in some cases will require an intranasal antral puncture before satisfactory irrigation can be accomplished. The intranasal puncture was described in diagnosis. To further drainage, a window operation may be performed. This consists of the removal of part of the bone separating the nasal and antrum cavities. In this operation the mucosa and periosteum are opened in the inferior meatus and elevated from the bone. By a punch an opening is made into the sinus, and this opening enlarged, as is considered necessary, by the use of rongeurs or bone rasps. The membranes are swung in around the edges to prevent closure of the opening. This provides permanent drainage at a much lower site than the original ostium. Some men attempt the removal of polypi or the entire exenteration of the antral cavity through such a window. (16, Mithoefer - 22 A and B, Sewell).

Probing of other sinuses through their ostium and ducts can be done in some cases, but requires considerable practice and the results are not satisfactory. Due to trauma of the ostium there may result permanent closure of this orifice. (2, Black)

In the so-called radical operative procedures on the paranasal sinuses, two operations appear to be outstanding in their successful results. These are the Caldwell-Luc, or a modification of it, on the maxillary antra, and the external fronto-ethmo-sphenoidal operation on the frontal, ethmoid or sphenoid cells, or the involvement of more than one of these.

The Caldwell-Luc operation is the one of choice where exenteration of the maxillary antrum is necessary. This operation can be done under local anaesthesia, but probably is less disturbing to the patient when done under a general anaesthetic. The operation itself consists of an incision along the gum line of the upper teeth on the side involved. This incision is started over the root of the canine tooth and extended backward and lateralward for about two and one half centimeters. The mucous membrane and periosteum are elevated over the portion of the maxilla above these teeth. A small opening is made into the antrum with a chisel and enlarged to necessary proportions by rongeurs. Through this opening the entire cavity is visible and the contents can be entirely removed. After complete removal of the membrane and contents, a window is made through the nasal wall and the cavity packed with iodoform gauze, the end of which is drawn through this nasal window. This allows the removal of the pack through the nose, and the opening into the buccal cavity can be closed. (26, Smith)

The pack is left in place from two to five days. After its removal the antrum is irrigated until all discharge stops.

A report of one hundred cases on which the Caldwell-Luc operation was performed follows--

Operative Findings

In 19 cases the mucous membrane was edematous

In 13 cases the mucous membrane was thickened

In 25 cases pus was present

In 52 cases polypi were present

2 cases had alveolar abscesses

Pus was generally present in cases with polypi

Table showing general and local results

<u>General</u>	<u>Local</u>
Good in two to three years - 3	Good in two to three years - 4
Good in one to two years - -19	Good in one to two years - -17
Good under one year- - - - -43	Good under one year- - - - -40
Bad in two to three years - 1	Bad in two to three years - 0
Bad in one to two years - - 1	Bad in one to two years - - 4
Bad under one year- - - - - 3	Bad under one year- - - - - 5

23 cases did not report

1 case hospitalized with erysipelas

1 case resulted in death

(29, Syme)

The radical operation of choice for the other sinuses is the external fronto-ethmo-sphenoidal operation. Doctor F. L. Bryant gives this choice of operations and further states, "It is most certainly not one through the intranasal route where the field is obscured by blood, and the punch and curet are guided not by sight, but by imaginary lines projected on the patient's face". (3, Bryant)

This operation consists of an incision about two and one half centimeters long extending along the side of the nose from its base distally. By dissection from the line of incision the lamina papyracea is brought into view, and the posterior ethmoid artery exposed and ligated. This is the main factor in having a bloodless operative field. Then by breaking through the lamina papyracea the entire ethmoid field is exposed, and these cells and the middle turbinate can be removed if necessary. The floor of the frontal sinus and agger-nasi cells can be removed, allowing a splendid view of the anterior wall of the sphenoid sinus. If necessary this can be broken away by punch forceps, a complete exenteration being accomplished by careful use of these forceps.

Results of this operation on twenty-eight cases follows--

No deaths

No post-operative hemorrhage

Diplopia in three cases for from one to three months

End results were complete cure of those with nasal obstruction and purulent discharge. One with recurring polyps and

complete nasal obstruction was cured of these but still had periodic headaches.

Two cases with asthma had no further attacks, and one case had attacks only during head colds. One case was much improved.

What is meant by cure? A definition of cure as given by Doctor Ferris Smith is as follows: "The ideal cure obviously demands the restoration of normal condition of function, but this is too much to expect in any long standing infectious process . . . Clinical cure demands the complete removal of underlying pathological condition, and the preservation of the normal appearance of the patient. It presupposes the complete eradication and the absence of local manifestations." (26, Smith)

From these reports it would appear that the results to be expected by these radical operations would be good in about sixty per cent of those operated on by the Caldwell-Luc operation, and higher in the external fronto-ethmo-sphenoidal operation. However, a statement by Doctor Eugene R. Lewis implies some doubt as to the value of these or any other radical operations. "A clinical diagnosis of chronic sinusitis implies that the patient has a localized disease of the sinuses, that operation is indicated and will provide a cure. That this is not the case is apparent to the most casual observer. It is my private opinion that patients as a whole would be better off by complete abandonment of radical sinus surgery." (14, Lewis)

Summary

1. From the anatomy of the paranasal sinuses one finds the maxillary antra and the ethmoid cells present at birth. The sphenoid sinuses are present but of no clinical significance until the second or third year of life. The frontal sinuses cannot be differentiated as such until after the first or second year of life.
2. The mucous membrane lining the sinus cavities is composed of--
 - (1) A lining epithelium of simple ciliated columnar cells between the bases of which are found numerous basal cells, and scattered among the ciliated columnar cells are a few mucus secreting goblet cells. These lining epithelium cells rest on a basement membrane of subepithelial connective tissue.
 - (2) The underlying connective tissue stroma contains blood and lymph vessels and a few mucus secreting glands.
 - (3) A deep stroma of connective tissue containing the larger blood and lymph vessels, this layer being intimately associated with the periosteum. The thickness of the membrane varies in the different sinuses.
3. In the pathology of the mucous membrane lining the sinuses in chronic sinusitis there is a change from simple to stratified ciliated columnar epithelium. There is hyperplasia of both ciliated and goblet cells. Infiltration of cells occurs and connective tissue proliferation and replacement of normal

tissue are the final manifestations of chronic disease.

4. Diagnosis is made by correlation of clinical findings, physical examination transillumination and X-ray findings.
5. Treatment of two types can be carried out, operative and nonoperative. Nonoperative treatment consists of packs, displacement lavage, intranasal irrigations and postural drainage. Operative treatment of choice for the maxillary antra is the external nasal Caldwell-Luc operation through the buccal cavity, and the external fronto-ethmo-sphenoidal operation for one or more of the frontal, ethmoid or sphenoid cells.
6. The results to be expected from these operations are good in about sixty per cent of the cases operated by the Caldwell-Luc operation and higher in those reported from the fronto-ethmo-sphenoidal operation.

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