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CHRONIC NONPURULENT SINUSITIS AND ITS CLINICAL SIGNIFICANCE.*

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In writing a paper of this kind we are confronted at the start with difficulties of terminology. In the literature of the subject we find the terms purulent sinusitis, nonpurulent sinusitis, catarrhal sinusitis, hyperplastic sinusitis, and others. Some of these terms are an attempt at a clinical classification and take cognizance of the diagnostic signs, while others are an effort to classify on a histologic basis. None of these terms are significant for the large group of cases with multiform combinations of any or all the qualities signified by the above terms.

Some rhinologists base their diagnosis of infection on the presence or absence of pus, and there seems to be a general impression among the profession at large that when pus disappears the infection is cured. I have several times watched the transition of an acute purulent antrum infection into a chronic catarrhal or hyperplastic type. Pus would be found only during exacerbations, but radiographs taken at intervals over a period of a year or eighteen months would show a progressive increase of pathology as evidenced by increase in thickness of the lining or the development of cysts or polyps. We have also had the experience of making a diagnosis of non-purulent sinusitis, but on histologic examination of the tissues after operation found definite evidence of pus in the form of closed cystic abscesses or purulent infiltration.

We cannot draw sharp lines of demarcation in using the terms purulent and nonpurulent or hyperplastic and catarrhal

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sinusitis. We must recognize that one may merge into another and that there are all kinds of mixtures of type.

Several explanations might be offered to account for the different ways in which the tissues react to infection, as: difference in the biologic constitution, as seen in the allergic individual; differences in the infecting organisms; and difference in the stage of infection—acute, subacute and chronic, but this does not influence the fact that the absence of pus does not mean the absence of sinusitis.

In depending upon pus as an indication for treatment there is danger of overlooking the milder cases of sinusitis and the milder manifestations of coexisting infection in other sinuses. In consequence we may fail to cure the patient and may make it necessary for him to undergo a second operation. From a clinical standpoint it is often the nonsuppurative types that do the most damage. Neglect of this fact is one of the main reasons for the necessity of multiple sinus operations.

As in the clinical side so in the pathologic side there is no sharp transition from one type of inflammation to another.

Except in the extremes of type there is no outstanding difference in the gross appearance of tissues from chronic purulent and nonpurulent sinuses.

Histologic changes in the two stages of inflammation show a great similarity with only a few inconstant differences. Tissues from the suppurating sinuses are usually thinner and more vascular; those from the nonsuppurating sinuses will average a greater thickness; they also show more edema and a greater tendency to thickening of the basement membrane and to perivascular fibrosis with constriction of the blood vessels.

Cellular infiltration also is very similar, exceptions being that it is inclined to be more dense in the purulent cases and that eosinophiles are found more frequently and in greater numbers in the nonpurulent. As to changes in the epithelium, the purulent membranes may show areas where the epithelium is lost, sometimes with actual ulceration, while in the nonpurulent the change is more frequently to a hyperplasia or hyperplasia with mucoid degeneration.

Recurring repeatedly in the literature on sinus infections we find the statement that the epithelial layer is lost. This is not in conformity with our findings. In the majority of specimens we have found the epithelium intact. Even in the cases where the inflammation has been severe enough to cause ulceration or necrosis, we find large areas where the epithelium is still in place. This discrepancy in findings, we think, is due to lack of care in handling the tissues either at operation or in preparation for biopsy. The epithelium over the succulent tissues is very easily destroyed by such manipulations as sponging at operation or smoothing out before fixation.

That the epithelial layer does not offer a barrier to the passage of cells from the subepithelial layers is attested by the numerous sections in which the exudative cells are seen passing to the surface between the cells of the epithelium. We may have pus with an intact epithelial layer.

Anatomists tell us that in the mucous membranes of sinuses the basement membrane is absent or rudimentary. In the sections from sinuses with chronic infection it is nearly always present as a definite fibrous layer, frequently in a state of hyaline degeneration. The change is more pronounced in the nonpurulent than the purulent type. We look upon these changes as an evidence of chronicity, for the greater the chronicity the greater is the thickening of the basement membrane. None of these interstitial changes are constantly associated with either purulent or nonpurulent sinusitis. The only outstanding ones are the edema and the changes in the basement membrane as seen in nonpurulent sinusitis.

A comparison of the bacterial flora from different stages of sinus infection has been interesting. We have routinely taken material for cultures from two, and, when possible, from three sources at the time of operation. When the sinus is opened, swabs are taken from its contents or brushed over the lining. If cysts are present, their contents are aspirated, then the tissues removed are cultured after being washed and ground in sand. The growths from these cultures, from all types of inflammation, were, in the order of their frequency and predominance, streptococcus, staphylococcus, bacillus Friedlander, micrococcus catarrhalis and bacillus influenzae. There was very little difference in the growths from swabs and

tissues except that the swabs showed more mixtures. From the cases without pus streptococcus was the predominating growth in 94 per cent and was present as a definite growth in 96 per cent. Of the cases with pus, staphylococcus was practically always present, but it was found in pure culture only in cases of acute empyema. Cultures from the contents of serous cysts were positive for streptococcus in 46 per cent; a few were mixed with staphylococcus.

Broadly speaking, the streptococcus is not a pus producing organism. The outstanding feature of streptococcic infection is edema, and these infections are prone to carry on in a sub-acute and chronic form. Staphylococci are pus producing organisms; these infections are acute and self-limited or spread as an acute process.

The most uniform interstitial change found in the tissues from chronic nonsuppurative sinuses is edema, and thickening or hyaline degeneration of the basement membrane, and, as stated above, they practically all cultured streptococci.

Admitting that some chronic sinuses are suppurative or purulent, it is my experience that there are more chronic sinus infections without pus than with it. I believe that nonpurulent sinusitis is the usual latent or chronic phase of sinus infection. This view is supported in a measure by the histories of the cases and by the bacteriologic and histologic findings.

Diagnosis is sometimes extremely difficult, particularly in the cases where structural changes are slight, but it is important to recognize these slight changes because I am sure that the seriousness of the sequelæ of sinus infection is not in exact proportion to the amount of pathologic change in the tissues. Radiography has been indispensable to us in the diagnosis of these latent cases.

Cysts and polyps are the result of infection. When they are seen intrasinus in the radiographs the diagnosis is made, but they may be present and not revealed by radiography.

Extreme infiltration or massive edema usually produces a blurring of the outline of the sinus or a thickening of the borders with an irregular outline raised from the bony margins. Dense infiltration or fibrosis produces a uniform increase in density. This is often interpreted as a sinus filled with pus. Lavage, however, may give a negative result.

When the structural changes are slight or the evidence of polyp or cyst is only presumptive, the injection or suffusion of contrast media, lipiodol preferably, has been an invaluable aid. Any increase in thickness of the lining over one-half millimeter we consider suspicious.

The object of this paper would not be advanced by going into the more obvious signs of chronic sinusitis as seen in the nose, but I want to record that of seven cases of choanal polyps and one case of choanal cyst upon which we have done radical sinus surgery, all but one, a polyp, had their origin from the lining of the antrum on the external lateral and posterior wall. None were attached near the osteum.

In the case of the antrum much may be learned from the cytologic examination described by Dr. Sewall of San Francisco. The technic, in brief, is to introduce into the antrum, through the ordinary puncture needle, five to ten cc. of sterile distilled water and reaspirate as much as possible for examination. The antrum should then be washed with warm saline solution to free it from the irritating distilled water and to gain what information you can from lavage. The aspirated fluid is examined macroscopically. It not infrequently shows gross masses of mucus, shreds and flakes, when the lavage will be clear. This fluid is then centrifuged and the sediment examined under the microscope. The sediment may show many leucocytes, lymphoid or plasma cells from a fluid that appeared perfectly clear. Gross particles may contain pus cells but are frequently made up of epithelial cells and cell débris held together by mucus. The entire mass of a very dense sediment is often made up entirely of débris and epithelial cells in various stages of disintegration. The liberated nuclei of epithelial cells may be, and I think frequently are, mistaken for round cells; however, massive sediments of this type are as significant in the diagnosis of chronic infection as the finding of many exudative cells. If one insists upon the presence of a certain number of true exudative cells in his cytologic examination he will miss many cases of chronic sinusitis.

Histologic examination of the lining of these antrums explains why there is so much of this débris and exfoliated epithelium. The subepithelial tissue will be edematous, with a moderate degree of cell infiltration. The epithelium will be

in a state of hyperplasia and metaplasia. There will be several layers of columnar cells with the surface layer in a state of mucoid degeneration, with exfoliated epithelial cells in the surface exudate. In some sections it will be hard to find a cell that has not become a goblet cell.

I think that in this condition these cells are cast off very rapidly because I have frequently found the field full of columnar epithelial cells with actively motile cilia. Ciliary activity will not be seen, however, unless normal saline solution is used in doing the cytologic examination.

When the attention of the profession was first attracted to foci of infection as a cause of systemic disease, infected tonsils and dental sepsis were considered the most important sources. Nasal sinus infection was relegated to a secondary place and attention paid most particularly to the more florid forms. The reason for this was that these infections were more obvious, and were more easily eradicated than that of obscure sinus infection.

From the clinical standpoint, practically any disease which can be produced by focal infection anywhere can be produced by sinusitis. We will consider a few that demonstrate the importance of latent infection and show its influence in some of the more obscure systemic disturbances.

The relation of sinus infection to bronchitis and asthma has been discussed so much that we mention it only to cite a few clinical coincidences in our experience. Bronchitis with copious purulent expectoration has usually been associated with purulent sinusitis. Bronchitis with an intractable cough that is productive of only a small amount of serous or mucus expectoration is associated most frequently with nonpurulent sinusitis. This cough is much like that from pressure, as with a substernal goiter, but the cough from pressure is usually nonproductive. Results following the cure of sinus infection in chronic sinus bronchitis have been the most satisfactory of any in our experience.

Most of our asthmatics have had sinusitis, usually of the nonsuppurative type. It is rarely confined to one sinus, and the majority of our asthmatics have had pansinusitis. Results from operation have been variable.

The diseases of the rheumatic group are essentially self-limited, but among those that have a tendency to persist, in a subacute or chronic form, we have found many with a latent or nonpurulent sinusitis that had been overlooked or considered of no consequence in the search for foci of infection, as in the following case:

Man, age 43, suffering from a subacute polyarthritis for nine months. No dental sepsis. Tonsils had been removed without benefit. Evidence of other sources of infection lacking. Sinus diagnosis was inconclusive, but there was evidence casting suspicion on the antrums. It was explained to the patient that we were unable to make a positive diagnosis of sinus infection, but that we advised exploration of his antrum. To this the patient readily agreed. At operation the lining of the right antrum showed a slight increase in thickness with two small glandular cysts in the alveolar recess. The lining of the left antrum showed a moderate uniform thickening throughout. Both membranes cultured streptococci that had a specificity for the joints of rabbits. Before operation this patient required assistance in dressing, and when walking went with two canes. Three days after operation he could get from bed and into his dressing gown with ease and comfort. He made steady progress and now, with orthopedic correction of secondary structural changes in his feet and ankles, he goes as a normal man.

Chorea minor has long been accepted as a disease due to focal infection. Like rheumatic fever it runs a definite course. But some cases go on to chorea intermittens, or even chorea permanens. We have had five cases of this type. The duration was eighteen months to three years; ages, 9 to 13. All had had tonsils and adenoids removed with temporary or no improvement. All had multiple chronic sinus infection. Two had purulent antrums. Two had latent infection in both antrums without purulence. One had purulent antrums with a nonpurulent ethmoid and sphenoid on one side. All showed immediate and definite improvement following exenteration of the antrums. The case with ethmoid and sphenoid infection, however, relapsed and did not show a permanent improvement until the ethmoids and sphenoids were operated upon.

Sinus infection has been a factor in a number of troublesome disease condition not so well defined, as in the following cases:

1. Secondary anemia with chronic cholecystitis and chronic nonpurulent sinusitis. The anemia persisted in spite of the usual methods of treatment. A double radical antrum operation was done. Following this, with no other change in treatment the blood picture rapidly returned to normal.

2. Tachycardia with dyspnea and fatigue, of unknown origin. Patient entered the hospital complaining of fatigue, dyspnea and rapid heart action. Examination showed mild diabetes, chronic cholecystitis and tachycardia up to 110. Detailed cardiovascular examination gave essentially normal findings. Accurate control of the diabetes did not relieve the fatigue and dyspnea. Following operation for chronic non-purulent sinusitis all of the subjective symptoms were entirely relieved. Acute infections do disturb the tolerance of the diabetic, but in our experience the cure of chronic infection in a large number of diabetics has not shown that it had any beneficial influence on the diabetes itself.

3. Infectious atheromatous type of cardiovascular disease with cardiac failure. The overcoming of the cardiac failure was not possible under control. Septic tonsils were removed without result. On the radical removal of the antrum disease recompensation of the heart took place promptly. The patient gained a greater degree of health, strength and absence of dyspnea on exertion than he had had for two years previously. He resumed his business and indulged in moderate outdoor sports.

Recently we have been very much interested in a group of tic cases in which we found chronic sinus infection; the possibility of foci of infection being an etiologic or contributory factor in these disturbances having been brought to our attention by Dr. Laurence Selling. So far we have found definite foci of chronic infection in every tic case we have examined. Following is a brief synopsis of the outstanding facts from the histories of the three cases that have been longest under observation:

Boy, age 14, had his first appearance of tic following a prolonged sinus infection at the age of 6. From that time until

his sinus operation there were recurrent sinus infections, always accompanied by exacerbations of the tic. Gradual lessening in the frequency and intensity of the infections was accompanied by an improvement in the general physical condition and a lessening of the tics. Some months before his operation he had a subacute flare-up of his sinus infection, accompanied by a violent recrudescence of his tics. His early sinus infections were purulent. During the last flare-up no pus was seen (radiographs indefinite, showing only a suspicion of thickening). Three antrum punctures at weekly intervals showed no macroscopic pus, but always several polymorphonuclear cells to the field in the cytologic examination. At bilateral radical antrum operation we found in both antrums a moderate soft uniform thickening without surface discharge. It is nearly a year since his operation. He still has an occasional blink or twitch. To the casual observer he is a normal but slightly nervous boy.

Boy, age 11. Tics began insidiously between age of 6 and 8. Became intermittently more pronounced until age 10, when it was difficult for him to remain in school on account of his explosive speech and jerking and twisting. In his eleventh year he had violent attacks, during which he became uncontrollable. His sinus history was negative. Tonsils were out. Antrum lavage and cytologic examination were negative, but there was sufficient radiographic evidence to justify exploration of the antrums. At operation the right antrum showed a moderate thickening and edema throughout and the lining contained three glandular cysts. The left antrum showed a definite hyperplasia in the alveolar recess. The rest of the lining showed very little change. Following the operation there was a striking improvement, but when he returned to school there were several other severe recurrences over a period of three months. During the last quarter he has remained a quiet, contained and almost normal boy.

E. R., boy, age 14. Tics began with an acute onset, without apparent cause six months before our examination. Nose and throat diagnosis was infected tonsils, purulent antrums and a suspicion of infection in the ethmoids. Tonsils and adenoids were removed with no improvement following. Bilateral radical antrum operation showed a definite thickening with poly-

poid edema and some fibrosis. Following the antrum operation there was a definite reduction in the frequency and intensity of the movements, but at the end of two months the improvement not having come up to our expectations we exenterated the ethmoids and sphenoids. The lining of these cells was definitely hyperplastic throughout. Since this operation there has been a slow but steady improvement. He has slight residual tic movements, but is almost back to normal.

The first of these cases was under my observation for eight years, during which time there was a transition from a suppurating sinusitis into a latent chronic sinus infection without purulency and with only moderate changes in the sinus lining. The second had nothing in his history to suggest sinus infection, which was found only after careful examination of his sinuses. The third had multiple infections but did not recover until treatment had been carried to the limit of his least obvious infection.

I am firmly convinced that the infection in chronic sinuses is as great if not a greater source of trouble than the chronic tonsils, and that our failure to recognize it is responsible for our failure to relieve many of our patients suffering from focal infection. Another cause of failure is conservatism where only radical measures can eradicate all of the infected tissues. We have seen a number of instances where intranasal drainage of suppurating antrums put an end to purulency, but where relief from the secondary disease was accomplished only after radical exenteration. I believe it is just as important to remove the entire mucoperiosteal lining of an infected sinus as it is to remove the whole tonsil.

I think that purulency depends upon the type of infecting organism and the stage of its activity and that pathogenic organisms capable of doing serious damage may be harbored in a sinus without producing surface discharge but always causing structural changes in the tissues of the sinuses.

Diagnosis should be based upon the evidence for infection, whether surface discharge be present or not.