Etiology Of Erysipelas. Its Relation To The Nasal Cavities And Its Destructive Effects Upon The Eye ..

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The exciting cause of erysipelas is a streptococcus—indeed we may now say the streptococcus. "Streptococci are most frequently encountered in their parasitic abode." Though capable of existing for a short time outside of the animal body, their slow growth on culture media and their short lives, point to direct transference from body to body. Although these characteristics are not absolutely uniform, I beg you to observe that they militate strongly against the idea that erysipelas is an air borne disease, and on this important point I will submit to you further evidence presently.

Streptococci are subject to many variations in form. They appear as diplocci, in chains of from four to six smaller cocci, and in longer chains with both large and small segments. There is no apparent specific difference between streptococcus longus, streptococcus brevis, streptococcus conglomeratus, streptococcus gracilis and streptococcus involutus, since comparatively slight changes in culture media or a sojourn in an animal organism (and this is a very important point in our study of this subject) can change the morphologic characters of the organism. The rate of growth on artificial media differs in streptococci from different sources, but all are of comparatively slow growth. The virulence of streptococci from different sources also differs most markedly, not only in transferring the cocci from animals of one race to those of another, but in transferring from animal to animal of the same race. In other words, environment, the culture medium employed, may increase or decrease the virulence of the germ and its toxins. Streptococci are pus producers. They may be associated with all stages of pyogenic infection from local inflammation to general septicemia. They are encountered in inflammations of all mucous and serous membranes, in bones and in such organs as the liver and the brain. Among other infections they are found either alone or combined with other organisms in spreading phlegmon and cellulitis, anginas, lobular pneumonia, synovitis and osteomyelitis, lymphangitis, pleuritis, peritonitis and puerperal septicaemia. It was formerly thought that the streptococcus of Fehleisen (streptococcus erysipelatis) was specifically different from those concerned in other inflammations. For instance, John Collins Warren (171), writing on erysipelas in 1894, said "Fehleisen concludes, from his observations, that the erysipelas coccus is a specific microbe which will always reproduce the disease when inoculated even in
the smallest quantities. . . . The question of the identity of the erysipelas coccus with the streptococcus pyogenes has frequently been raised and authorities are not yet entirely agreed upon this point. The coccus of erysipelas is larger than the streptococcus. . . . Many modern observers concede that the erysipelas coccus causes not only erysipelas, but also abscess, but many others believe that when suppuration occurs, it is due to pyogenic cocci which have become inoculated secondarily, and that suppuration is therefore merely a complication of the disease. Experimental inoculation with erysipelas cocci has, in the hands of one observer, always produced erysipelas, while inoculations with the streptococcus produced phlegmonous inflammation."

Since this was written, however, it has been satisfactorily demonstrated that the streptococcus of erysipelas may become pyogenic and the streptococcus pyogenes may produce a characteristic erysipelatous inflammation of the skin, and we find one of the standard textbooks of the day on pathology (58) declaring that "the conditions which they induce depend upon the route by which they gain access to the body, and especially upon their virulence which may be exalted to an extraordinary degree by certain conditions of cultivation and passage through animals. In short, it has been shown that the activity of a streptococcus, which only causes abscess, may be exalted to a virulence by which erysipelas, purulent infiltration or fatal septicemia results. These experiments serve to sustain the views as to the common ancestry and close relationship of the various streptococci as indicated by morphologic and physiologic considerations, and to emphasize the desirability of considering them as a single group. Besides their more active manifestations streptococci may lie latent."

One of the most important studies that led to the setting forth of this modern dictum was that of Fraenkel (72) who reported to the Hamburg Society of Physicians that from the pus contained in abscesses that had developed in the course of an attack of erysipelas, he had been able to cultivate an organism that corresponded to the streptococcus erysipelatis. He had also observed a case in which the development of facial erysipelas was ascribed to infection from a felon in the pus of which streptococci were found. In a case of extensive facial erysipelas, there was also suppuration of the subcutaneous tissues of the greatly swollen eyelids and of the inter-
muscular and intramuscular tissues of the neck. In the pus and in the edematous fluid streptococci were found microscopically and by culture. In experimental results it appeared that the streptococcus produced at one time lymphangitis or a phlegmon, at another erysipelas or peritonitis. He had succeeded in inducing erysipelas by injections of streptococcus pyogenes into the ears of rabbits, and he had also occasioned suppuration and peritonitis by inoculation of erysipelas cultures. Nor were the results confined to one species of animal.

Prof. William H. Welch, Johns Hopkins University, Baltimore, in his reply to a recent communication from me requesting his opinion, says: "Streptococcus erysipelatis (Fehleisen) cannot be distinguished by any properties morphologic, cultural, pathogenic, from streptococcus pyogenes, and practically all authorities in bacteriology consider the two identical. Attempts to subdivide into different species or varieties the various streptococci found in human beings in health and in disease, have met with little success. There is a wide range of variation, of course, in all properties, but none seem sufficiently constant to serve as a basis of classification. We must, I think, recognize that a given streptococcus, at least for the time being, is endowed with certain biologic qualities which render it capable of producing effects which another streptococcus may not be able to produce, but such biologic differences are either too inconstant or beyond our control or methods of study to enable us to base species characters upon them."

Having determined the status of the infectious organism, let us inquire as to its normal habitat and the probable circumstances under which it invades and produces disease in the tissues of the body of man.

We know the normal habitat of the typhoid bacillus and the means by which it gains access to the body; we know the normal habitat of the bacillus of tetanus and how it gains entrance to its unwilling human host, and we are now in a position to declare that we know the normal habitat of the streptococcus and how, under certain circumstances, it can virulently attack and produce disease in man.

The nose, the antra of Highmore, the ethmoid cells, the sphenoid cell or cells, the frontal sinus or sinuses, the Eustachian tube, the middle ear and the mastoid antrum, present a continuous surface of mucous membrane of fairly identical
structure in all its parts, moistened physiologically by a more or less abundant mucous secretion and directly continuous by way of the nasopharynx with the pharynx, the tonsillar region and the mouth.

Lewis and Turner (50), of Edinburgh, published in 1905 a bacteriologic study of the nose and its accessory cavities and I have availed myself freely of their work for the reason that they have reviewed all of the previous literature and have, by their own labors, practically brought the subject down to date.

Thompson and Hewlett (36) in 1895 had examined ninety-one cover glass smears from nasal mucus and nasal mucous membrane and had found eighty per cent of those from the interior of the nose sterile. The vestibule was never sterile.

The work of subsequent observers, however, cast doubt upon these results. Klemperer, and Park and Wright (37) determined that the interior of the healthy nose is not free from germs and that the nasal secretion has no bactericidal action. They found only six cases sterile out of thirty-six specimens taken. Hasslauer (38) in an examination of 186 specimens from 111 nasal cavities found the Staphylococcus pyogenes albus in twenty-five per cent, the pneumococcus in 20 per cent, the streptococcus pyogenes in seventeen per cent, and the pseudo-diphtheria bacillus in thirteen per cent. Viollet (39) also found staphylococci, streptococci and pneumococci in normal nasal secretion. Finally Lewis and Turner endeavored to eliminate the sources of error encountered by their predecessors and undertook and published this most valuable and conclusive series of observations on the healthy and the inflamed nose, mouth and accessory nasal cavities.

They took twenty-six specimens from sixteen healthy noses, and of these only three were found sterile. Thirteen specimens from seven persons were mono-organismal. Nine from seven persons showed two varieties of bacteria. One specimen showed three varieties. The pneumococcus was found in four cases, staphylococci in thirteen, streptococci in six, Hoffman’s bacillus in two, bacillus aureus in two, bacillus mesentericus in two, spirillum in two, bacillus of Friedlander, the proteus vulgaris and unknown bacillus in one each. Organisms from nine healthy noses were non-pathogenic on inoculation in animals. From two healthy noses pathogenic organisms were obtained.
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From one of these the staphylococcus aureus and albus, produced local abscess in but were not fatal to guinea pigs. In the other case streptococcus pyogenes was present, the broth culture proving fatal to a rabbit in fourteen days after intra-peritoneal injection of 2 c. c. Slow growth on culture media makes it appear "that the interior of the normal nose may appear sterile, owing to the fact that organisms, though present, occur in such few numbers as to escape recognition by rapid methods. Further it appears that the staphylococci found in the healthy nose are often of low vitality and do not grow so readily in ordinary media as the same varieties derived from pus. . . . . It happened more than once that broth in which a swab had been immersed and incubated for forty-eight hours showed no cloudiness or other sign of growth in the first twenty-four hours; on the second day, however, the broth either became cloudy throughout or remained clear, but with distinct sedimentary growth. . . . . The inference is that the nose contained numerically few organisms or that the organisms present in the nose were of diminished vigor and were revived after a period in a suitable medium, such as broth."

It appears that the organisms of the healthy nose belong to the same varieties as those found in abnormal conditions, but that they differ from the flora of pathologic nasal membrane in actual numbers, in purity of culture, in vigor of growth and in pathogenicity.

In inflammatory conditions of the nasal cavities, the organisms present belong to very much the same varieties as those which may be found in the healthy cavities. . . . . All the varieties present may not be pathogenic on injection into animals, but usually one variety is virulent in the early stages of the disease. . . . . The pathogenicity is high at first and diminishes rapidly so that an organism isolated in the first few days of a nasal catarrh and then very fatal to guinea pigs, becomes later incapable of producing any pathogenic effect. . . . . To produce nasal inflammation not only is the presence of pathogenic varieties necessary, but these varieties must be virulent, or if avirulent, must recover their virulence by the influence of other factors.

Thirteen specimens were examined from eight acute cases and one chronic case of purulent nasal catarrh.

The streptococcus pyogenes was present in six of the acute
and in the chronic case—various staphylococci were present in six cases and the pneumococcus in one case. Of the eight acute cases, pure cultures of staphylococci were obtained in two and in the remaining six the streptococcus was the probable exciting cause.

In the chronic case, both were found, but the streptococcus was probably the etiologic factor. From three of the cases virulent pathogenic organisms were obtained—twice the streptococcus and once the staphylococcus pyogenes citreus. The streptococci in these cases were so virulent as to prove fatal to guinea pigs in twenty-four hours. Ten days later the streptococcus isolated afresh from the discharge in one of these cases proved nonpathogenic.

The pathogenic bacteria of the mouth include many varieties which are found in suppuration of the antrum and other sinuses. The streptococcus pyogenes, the staphylococci, the pneumococcus, the B. diphtheriae and the B. pyocyanus are all found at times in the mouth. In addition to the organisms specially associated with carious teeth—streptococcus brevis, B. necrodentalis and staphylococcus albus—any of the denizens of the mouth may, of course, be found on the outer surfaces, if not in the deeper layers of the carious matter.

Törne (44) has published the only observations on the bacteria of the healthy accessory sinuses. He examined thirty-six cadavera in which the maxillary and frontal sinuses were healthy. Twenty-two were examined within two and one-half hours after death and in all these the sinuses were found sterile. Of the remaining fourteen examined, from three to twenty-five hours post mortem, seven were sterile and seven contained bacteria. This suggests that the entrance of organisms occurs some hours after death.

The maxillary and frontal sinuses were sterile in twenty-nine of the thirty-six cadavera examined within twenty-five hours post mortem. Törne also examined twenty-six pathologic cavities in sixteen cadavera. Eleven cavities examined three hours post mortem showed catarrhal changes, but nine of these were sterile. Twelve cavities showed chronic purulent inflammation. There were present streptococci, micrococcus pyogenes aureus, pseudo-catarrhalis, tardiliquans, etc. Three cavities in acute cases examined one and one-fourth hours after death, all showed bacillus pneumoniae.

Pearce (45) found inflammatory changes in the maxillary
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antrum of many cases of diphtheria, with Klebs-Loeffler bacilli present in nearly all.

In four cases of diphtheria, complicated with scarlet fever, pus was found in the antra in three and the organisms present were streptococci and staphylococci. In 102 post mortem examinations in which the accessory sinuses were examined, Kirkland and Stacey (46) found thirty-four cases of infection by microorganisms in which streptococci, staphylococci and pneumococci were found.

Herzfeld and Herman (47) in ten cases of antral suppuration found the streptococcus in eight cases and staphylococcus in seven.

Howard and Ingersoll (48), in an investigation as to the causes of inflammations of the accessory sinuses, concluded that these inflammations are due to the bacteria which are commonly present in the buccal and nasal cavities—in the former in health and in the latter occasionally in health and usually in disease. These organisms are the diplococcus lanceolatus, streptococcus, staphylococcus pyogenes, B. diphtheriae and B. influenzae.

Stanculeanu and Baup (49) determined that, clinically and bacteriologically, there are two varieties of empyema of the facial sinuses, one with fetid pus following on dental affections (14) and the other of nasal origin with non-fetid pus—the latter being due to such organisms as the streptococcus and the pneumococcus. The greater frequency of anaerobic organisms in the mouth lends some support to these views. As to pathogenicity, they state that in cases of nasal origin the aerobes, and in cases of dental origin the anaerobes, are always found virulent on injection into animals.

Finally, Lewis and Turner themselves report on their extensive series of observations. They examined eighty specimens of pus from fifty-seven antral cavities. They found streptococci in 43 or 75.4 per cent, pneumococci in 42 or 74.1 per cent, and staphylococci in 40 or 70.1 per cent. Swabs were taken from the nasal chambers of forty-two of these cases. Pneumococci were found in twenty-nine, or 70 per cent, staphylococci in twenty-eight, or 66.6 per cent and streptococci in twenty-seven, or 64.3 per cent. Swabs were taken directly from the antral cavities in twenty-seven of the cases. Pneumococci were found in twenty-one, or 77 per cent, staphylococci in twenty-one, or 77 per cent, and streptococci in twenty-one, or 77 per cent. Of the forty-seven cavities, there were
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only four in which the swab yielded an absolutely pure culture. In two, the streptococcus, in one the staphylococcus, and in one the pneumococcus.

Thirteen acute cases showed staphylococci in eleven, or 84.6 per cent; pneumococci in eleven or 84.6 per cent, and streptococci in eight, or 61.6 per cent. Forty-four chronic cases showed streptococci in thirty-five, or 80 per cent; pneumococci in thirty-one, or 70 per cent, and staphylococci in twenty-nine, or 60 per cent. The B. influenza, which was only obtained in one instance, occurred in a recent case of only three weeks’ duration.

The authors state: “Though in the wealth of organisms associated in these cases, and possibly pathogenic, it could not be certainly stated which was the fons et origo mali, yet in some of the cases we were enabled to conjecture which organism was most probably responsible. This we did on consideration (1) of the pathogenicity of the organism (as ascertained by experiments on animals) and (2) of the organisms in direct swab as compared with nasal swab from the same case, and (3) of the persistence in chronic cases of particular varieties, and (4) of the occurrence in pure culture of one organism. In this way we are able, though with some diffidence, to assign the principal role to the pneumococcus in fourteen, to the streptococcus pyogenes in nineteen and to the staphylococcus in six of the fifty-seven cavities.”

Among the recent cases, the pneumococcus was probably responsible for the inflammation in four, the staphylococcus in three, and the streptococcus in two—four cases being undeterminable. Among the long-standing cases, the pneumococcus was probably responsible in ten, the staphylococcus in three and the streptococcus in seventeen—fourteen being undeterminable.

In twelve cases, the antral disease was complicated by inflammation of the ethmoid in four cases, by disease of the frontal sinuses in six cases, and by disease of both ethmoid and frontal in two cases. Ten cavities showed staphylococci, seven showed streptococci and seven pneumococci. Pus from a chronic inflammation of the ethmoid sinus alone showed both streptococci and staphylococci. Pus from the frontal sinus alone showed in one case pneumococcus and staphylococcus, and in another case streptococcus and staphylococcus, and in a third case all three organisms.
In order to ascertain whether the combinations of organisms present might be pathogenic, even though the individual organisms in pure culture were not so, several injections of impure cultures were made. The results yielded no evidence that organisms, which in pure culture were non-pathogenic, would in combination give rise to disease. The reverse was, however, not the case, for in three instances a pneumococcus, which in pure culture was pathogenic, produced no illness when injected along with the other organisms present in the same case. Pneumococci, tested in ten acute cases, were pathogenic to rabbits in five, or 50 per cent. Staphylococci, tested in ten acute cases, were pathogenic to guinea pigs in five, or 50 per cent, and streptococci, tested in eight acute cases, were pathogenic in six, or 75 per cent.

Pneumococci, tested in seventeen chronic cases, were pathogenic to rabbits in five, or 29 per cent. Staphylococci, tested in twenty-eight chronic cases, were pathogenic in nine, or 32 per cent. In four cases in which the condition had lasted more than eight years, streptococci were found pathogenic to animals, but not fatal.

“In recent cases the organisms are pathogenic twice as often as in chronic cases.” “In both recent and chronic cases, the streptococci are more pathogenic to animals than all other varieties.” “The streptococci are almost always pathogenic when recovered from recent cases, but in chronic cases seem to have largely lost their virulent characters. There is no guarantee, however, that these organisms would remain so little virulent if by chance implanted on more suitable soil.”

Iglauer (73) of Cincinnati, working in the Pathological Institute of Vienna, and taking nasal mucus directly from the posterior nares by means of a head section as soon post mortem as practicable, found, in twenty selected cases, the staphylococcus pyogenes aureus in eleven cases, the staphylococcus pyogenes albus in six cases, the diplococcus pneumoniae in eight cases and the streptococcus pyogenes in six cases. In fourteen additional cases in which there was a marked pulmonic lesion, he found the staphylococcus pyogenes aureus in seven cases, the staphylococcus pyogenes albus in eight cases, the diplococcus pneumoniae in eight cases and the streptococcus in six cases. Finally, as a negative contribution to the etiology of diseases of the maxillary antrum, the only one of the accessory cavities suspected of having any other than a nasal source for
the inflammations that attack it, I would quote Fletcher (70), who examined the 200 antra of 100 skulls for (1) abscessed teeth, (2) septa, (3) for conical protrusions of the roots of the teeth into the antrum, (4) for perforation by the roots of the teeth without protrusion and (5) for perforation of the antrum from ulcerated teeth. He says: "As to the molars, ulceration was found in more than 25 per cent of the skulls, there being in these 200 examinations fifty-seven ulcerated teeth, and out of these fifty-seven possible cases of perforation by inflammation and its results, we found such to be the case only four times, all other cases having perforated the alveolar border and discharged the pus into the mouth, two of them discharging both in the mouth and in the antrum." Lewis and Turner cite a number of observers to the same effect.

It is quite possible for bacteria to enter the middle ear and they probably do so, through the Eustachian tube, remaining dormant under normal conditions and eventually losing their vitality. In scarlet fever and other severe anginas, the micro-organisms effect an indirect invasion by way of the lymphatics—and in other diseases, such as endocarditis and diphtheria, by way of the blood vessels. Politzer (74) says that entrance may be effected from the external auditory canal through either the perforated or intact membrana tympani. Zaunfal and Nadoleczny, quoted by Politzer, state that the streptococcus pyogenes and diplococcus pneumoniae are the exciting causes of acute otitis media. If the middle ear secretion is examined immediately after a paracentesis diplococci and streptococci occur just as often alone as in combination with other pathogenic micro-organisms. Except in the case of such specific diseases as diphtheria, typhoid, influenza and epidemic cerebrospinal meningitis, where the specific micro-organisms of these diseases are found, the finding of micro-organisms in the discharge other than the pneumococcus or the streptococcus indicated a secondary infection.

Lermoyez and Helme (82) came to the conclusion from innumerable investigations that otitis media acuta is always of mono-bacillar origin and that the pneumococcus or streptococcus is seldom found in combination with other organisms. Secondary infection by the staphylococcus takes place only in the later course of the disease, per tubam or through the external auditory canal.

Before quitting the subject of the bacteriology of the